Appendix C Chemical Risk Assessment – AECOM

Prepared for
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AECOM

Beetaloo Exploration and Appraisal Program - Hydraulic Fracturing Chemical Risk Assessment

Beetaloo Sub-basin, NT

15-Jun-2023

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Beetaloo Exploration and Appraisal Program - Hydraulic Fracturing Chemical Risk Assessment

Beetaloo Sub-basin, NT

Client: Tamboran B2 Pty Ltd

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			Name/Position	Signature
A	6 August 2019	Draft	Hayden Seear Project Manager	
0	16-Dec-2019	Final	Hayden Seear Project Manager	
1	18-Mar-2020	Addition of Perfomatrol chemical to drilling fluid	Hayden Seear Project Manager	
2	05-Feb-2022	Addition of chemicals to drilling fluid	Alana Court Project Manager	
3	07-Jul-2022	Minor update to CRA	Alana Court Project Manager	
4	05-Dec-2022	Addition of Newpark chemicals	Alana Court Project Manager	
5	05-June-2023	Addition of packer fluid and lubricant chemicals	Alana Court Project Manager	

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1.0 Background

Chemical risk assessments for the hydraulic fracturing fluid systems were undertaken to assess the potential human health and environmental effects of the chemicals proposed to be used in Tamboran's exploration and appraisal program.

The following fluid systems were assessed:

- Hydraulic fracture stimulation fluids
- Hydraulic fracture chemical tracers
- Drilling fluids
- Packer fluids and lubricants.

The risk assessment aligns with the *Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021* (herein referred to as DEPWS 2021) and is in accordance with requirements of the *Petroleum (Environment) Regulations 2021* (herein referred to as the Regulations).

The methods used for this updated chemical risk assessment also follow the guidance provided by the *Department of the Environment and Energy, Exposure Draft - Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction, 2017* (DoEE, 2017) and the methodology adopted for the chemical risk assessment is in general accordance with the following:

- National Industrial Chemicals Notification and Assessment Scheme (NICNAS), National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, 2017 (herein referred to as NICNAS 2017)
- enHealth. Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards, 2012
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM); Schedule B4, Site-specific health risk assessment methodology, 2013

The chemical risk assessment comprised the following tasks:

- Hazard assessment. An evaluation of the environmental hazard of the chemical additives in the hydraulic fracturing fluid systems, based on their environmental persistence, bioaccumulation and aquatic toxicity properties. Also included was an evaluation of human health effects (i.e. genotoxicity, carcinogenicity, reproductive toxicity, oral toxicity, inhalation toxicity, dermal toxicity, chronic repeated dose toxicity).
- Exposure assessment. The exposure assessment comprised of an evaluation of surface and sub-surface exposure pathways assessment and mass balance calculation to identify the amount of each chemical additive of the hydraulic fracturing fluid system.
- Screening and validation processes via Tier 1 and Tier 2 assessments. Determination of chemicals known to be of low concern, and identification of chemicals for further risk assessment.
    - Tier 1: using published information about each chemical proposed to be used in the hydraulic fracturing fluid systems.
    - Tier 2: A quantitative evaluation of the risks using toxicity values and quantitative estimates of chemical intake to provide an estimate of potential human health risk associated with the hydraulic fracturing activities, based on the identification of complete exposure pathways and hazard identification.

This document has been updated to include chemical risk assessments for two packer fluid recipes sodium bromide (NaBR) and calcium chloride (CaCL2) and lubricants.

2.0 Hydraulic Fracture Chemical Risk Assessment Tier 1 Screen

2.1.1 Outcome of Tier 1 Screen – Stimulation Fluid Recipes

Three Haliburton stimulation fluid recipes (SW, Hybrid and HVFR) and one Schlumberger fluid recipe (SLB HVFR) will be used for the Beetaloo Exploration and Appraisal Program.

Comparison of the chemicals with the assessment criteria as presented in DoEE (2017) and in Appendix C of DEPWS (2021) indicated that 10 chemicals from the Haliburton recipes and 21 chemicals from the Schlumberger recipe were not considered to require a Tier 2 assessment. Some of the chemicals have been assessed under the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia using the adapted IMAP screening process (NICNAS 2017) and were identified to be of low concern because of low hazard. Table 1and Table 2 presents a summary of the chemicals identified to be of low concern to human health for the hydraulic fracture stimulation fluid recipes.

Table 1 Chemicals identified to be of low human health concern (Tier 1) – Haliburton (HAL)Stimulation Fluid Recipes

CAS	Chemical	Reasoning
9003-04-7	Sodium polyacrylate	NICNAS (2017) low concern chemical
25987-30-8	Acrylamide acrylate copolymer	NICNAS (2017) low concern chemical
25987-30-8	Acrylamide, sodium acrylate polymer	NICNAS (2017) low concern chemical
107-21-1	Ethylene glycol	NICNAS (2017) low concern chemical
67-48-1	Choline chloride	NICNAS (2017) low concern chemical
77-92-9	Citric acid	NICNAS (2017) low concern chemical
7681-82-5	Sodium iodide	NICNAS (2017) low concern chemical
9000-30-0	Guar gum	NICNAS (2017) low concern chemical
7757-82-6	Sodium sulfate	NICNAS (2017) low concern chemical
126-96-5	Sodium diacetate	NICNAS (2017) low concern chemical

Based on the Tier 1 screening, most chemicals (24 from SW, 30 from Hybrid and 25 from HVFR) were identified to require a Tier 2 assessment. It is to be noted that none of these chemicals were identified to be persistent and bioaccumulative.

Table 2 Chemicals identified to be of low human health concern (Tier 1) – Schlumberger (SLB) Stimulation Fluid Recipes

CAS	Chemical	Reasoning
7647-01-0	Hydrochloric acid	The risk was classified as low based on chronic data. The substance is not classified as PBT. Management of this chemical is addressed in the EMP to prevent accidental release. OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.
67-48-1	2-hydroxy-N, N,N-trimethylethanaminium chloride	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
9000-30-0	Guar gum	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.

CAS	Chemical	Reasoning
107-21-1	Ethylene glycol	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
129898-01-7	2-Propenoic acid, polymer with sodium phosphinate	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
25085-02-3	Acrylamide sodium acrylate copolymer	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
1310-73-2	Sodium hydroxide	The risk was classified as low based on chronic data. The substance is not classified as PBT. Management of this chemical is addressed in the EMP to prevent accidental release. OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.
31726-34-8	Poly(oxy-1,2-ethanediyl), alphahexyl-omega-hydroxy-	The risk was classified as low based on chronic and acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
7647-14-5	Sodium Chloride	The risk was classified as low based on chronic data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
10043-52-4	Calcium Chloride	The risk was classified as low based on chronic data and acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
25038-72-6	Vinylidene chloride/methylacrylate copolymer	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
110-17-8	but-2-enedioic acid	The risk was classified as low based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
111-46-6	Diethylene glycol	The risk was classified as low based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
7447-40-7	Potassium Chloride	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
7631-86-9	Non-crystalline silica (impurity)	The risk was classified as low based on acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.

CAS	Chemical	Reasoning
14807-96-6	Talc	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.
67-63-0	Propan-2-ol	The risk was classified as low based on chronic and acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
67-56-1	Methanol	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
595585-15-2	Diutan	The risk was classified as low based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
125005-87-0	Diutan gum	The risk was classified as low based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
9002-84-0	poly(tetrafluoroethylene)	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.

The Tier 1 screening is provided in **Appendix A** to **Appendix D**, and the chemical toxicological profiles are provided in **Appendix G** to **Appendix I**.

2.1.2 Outcome of Tier 1 Screen – Drilling Fluids

Two drilling fluid recipes (Original and Newpark) will be used for the Beetaloo Exploration and Appraisal Program.

2.1.2.1 Outcome of Tier 1 Screen – Original Drilling Fluid Recipe

Comparison of the chemicals with the assessment criteria indicated that 30 chemicals were not considered to require a Tier 2 assessment. 22 chemicals have been assessed by NICNAS (2017) and were identified to be of low concern. In following the IMAP screening process, a further 8 chemicals (which were not assessed by NICNAS 2017) were identified to be of low concern to human health.

Table 3 presents a summary of the chemicals identified to be of low concern to human health for the Original drilling fluid recipe.

Table 3 Chemicals identified to be of low human health concern (Tier 1) – Original Drilling Fluids

CAS	Chemical	Reasoning
Not Applicable	Proprietary Chemical	NICNAS (2017) low concern chemical
77-92-9	Citric acid	NICNAS (2017) low concern chemical
9004-32-4	Poly Anionic Cellulose	NICNAS (2017) low concern chemical
7447-40-7	Potassium Chloride	NICNAS (2017) low concern chemical
144-55-8	Sodium Bicarbonate	NICNAS (2017) low concern chemical
7647-14-5	Sodium Chloride	NICNAS (2017) low concern chemical
6381-77-7	Sodium erythorbate	NICNAS (2017) low concern chemical

CAS	Chemical	Reasoning
11138-66-2	Xanthan Gum	NICNAS (2017) low concern chemical
1317-65-3	Calcium Carbonate	NICNAS (2017) low concern chemical
1310-73-2	Sodium hydroxide	Acute toxicity only. No evidence of systemic toxicity. Due to the unavailability of a NOAEL, quantification of risks from repeated exposure is not possible. However, due to dissociation into ions which are subject to homeostatic controls in the human body, systemic effects from repeated exposures to sodium hydroxide are not expected (NICNAS 2017).
1310-58-3	Potassium Hydroxide	Acute toxicity only. No evidence of systemic toxicity. Similar results were reported for sodium hydroxide (NICNAS 2017).
9005-25-8	Starch	NICNAS polymer of low concern (PLC)
12199-37-0	Smectite	No chronic data available. Read across to bentonite which is listed as a NICNAS (2017) low concern chemical.
38193-60-1	Polyacrylamide	NICNAS PLC
1332-58-7	Plagioclase Feldspar/Kaolinite	Listed in US Food and Drug Administration (FDA) Generally Recognized as Safe (GRAS) list and Inert Ingredients Eligible for US Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 25(b) pesticide products.
Proprietary	Performatrol*	A low weight and stable polymer that is highly biodegradable with low environmental toxicity.
13462-86-7	Barite	NICNAS (2017) low concern chemical
9003-05-8	Partially hydrolysed polyacrylamide	NICNAS (2017) low concern chemical
9004-32-4	Polyanionic cellulose, low viscosity	NICNAS (2017) low concern chemical
7727-43-7	Barium sulphate	NICNAS (2017) low concern chemical
7439-92-1	Lead	Maximum concentration below Australian Drinking Water Guidelines (NHMRC, 2018) and Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018).
7782-42-5	Graphite	NICNAS (2017) low concern chemical
14807-96-6	Talc	NICNAS (2017) low concern chemical
8042-47-5	Mineral oil	NICNAS (2017) low concern chemical
7440-50-8	Copper	NICNAS (2017) low concern chemical
7440-66-6	Zinc	NICNAS (2017) low concern chemical
1305-78-8	Calcium oxide	NICNAS (2017) low concern chemical
7429-90-5	Aluminium not powder, dust or fume	NICNAS (2017) low concern chemical
1317-38-0	Copper (II) Oxide	NICNAS (2017) low concern chemical
64-02-8	Tetrasodium ethylenediaminetetraacetate	NICNAS (2017) low concern chemical

*CAS number not provided to AECOM, information obtained via chemical manufacturer's SDS

Based on the Tier 1 screening 26 drilling fluid chemicals were identified to require a Tier 2 assessment. It is to be noted that none of these chemicals were identified to be persistent and bioaccumulative.

2.1.3 Outcome of Tier 1 Screen – Newpark Drilling Fluid Recipe

Comparison of the chemicals with the assessment criteria indicated that 42 chemicals were not considered to require a Tier 2 assessment. Eight chemicals have been assessed by NICNAS (2017) and were identified to be of low concern. In following the IMAP screening process, a further 34 chemicals (which were not assessed by NICNAS 2017) were identified to be of low concern to human health.

Table 4 presents a summary of the chemicals identified to be of low concern to human health for the Newpark drilling fluid recipe.

Table 4 Chemicals identified to be of low human health concern (Tier 1) – Newpark Drilling Fluids

CAS	Chemical	Reasoning
Proprietary	Barium Sulphate	NICNAS (2017) low concern chemical
Proprietary	Sodium Chloride	NICNAS (2017) low concern chemical
Proprietary	Citric acid	NICNAS (2017) low concern chemical
Proprietary	Calcium Carbonate (Limestone)	NICNAS (2017) low concern chemical
Proprietary	Disodium Pyrophosphate	NICNAS (2017) low concern chemical
Proprietary	Sodium sulphate	NICNAS (2017) low concern chemical
Proprietary	Sodium erythorbate	NICNAS (2017) low concern chemical
Proprietary	Potassium Chloride	NICNAS (2017) low concern chemical
Proprietary	Oxirane, 2-methyl-, polymer with oxirane, di-(9Z)-9-octadecenoate	NICNAS polymer of low concern (PLC)
Proprietary	Fatty acids, tall-oil	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	Poly Anionic Cellulose	The risk was classified as low based on acute data. It is not expected to be readily biodegradable however it is not expected to be bioaccumulative. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Acetic acid, ethenyl ester, polymer with ethenol	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Crystalline silica, quartz	The risk was classified as low based on acute data. The substance is not classified as PBT. It is noted that the substance is hazardous to human health via the inhalation pathways and as such OH&S procedures implemented by Tamboran will minimise human health exposure. Management of this chemical is addressed in the EMP to prevent accidental release. A Tier 2 assessment is not required.

CAS	Chemical	Reasoning
Proprietary	Calcium Chloride	The risk was classified as low based on chronic data and acute data. The substance is inorganic and ubiquitous in the environment. A Tier 2 assessment is not required.
Proprietary	Sodium hydroxide	The risk was classified as low based on chronic data. The substance is not classified as PBT. Management of this chemical is addressed in the EMP to prevent accidental release. OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.
Proprietary	Calcium carbonate	The risk was classified as low based on acute data. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Starch	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Xanthan Gum	The risk was classified as low based on acute data, and it is expected to be readily biodegradable and not bioaccumulative. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Polyethylene Glycol	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Octan-2-ol	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Organic fibres / Cellulose	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Poly(oxy-1,2-ethanediyl), alpha-octyl-omega-hydroxy-	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Starch, carboxymethyl ether, sodium salt	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Methanol	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not

CAS	Chemical	Reasoning
		bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	Poly(oxy-1,2-ethanediyl), alpha-hydro-omega-hydroxy-, mono(2-(4,5-dihydro-2-nortall-oil alkyl-1H-imidazol-1-yl)ethyl) ethers	The risk was classified as low based on acute data. A Tier 2 assessment is not required.
Proprietary	Acetic acid	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Magnesium oxide	The risk was classified as low based on acute data. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Calcium oxide	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	Non-crystalline silica (impurity)	The risk was classified as low based on acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	2,2`,2"- Nitrilotriethanol (Triethanolamine)	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.
Proprietary	Ethanamine, N-ethyl-N-hydroxy-	The risk was classified as low based on acute data. A Tier 2 assessment is not required.
Proprietary	Ethanolamine	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Sodium Glycolate (impurity)	The risk was classified as moderate based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	Hexanedinitrile, hydrogenated, high-boiling fraction	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Sodium Carbonate	Inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.

CAS	Chemical	Reasoning
Proprietary	Sodium sulphite	A Tier 1 Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to the environment and thus required no further assessment.
Proprietary	Diethanolamine	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.
Proprietary	Methyl alpha-D-glucopyranoside	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	1,2,3-Propanetriol, homopolymer	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	1,2,3-Propanetriol, homopolymer, (Z)-9-octadecenoate	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
Proprietary	1-Dodecene, dimer	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.
Proprietary	Glycol	Based on information provided in the SDS, this substance is classified as not hazardous. A Tier 2 assessment is not required.

Based on the Tier 1 screening three Newpark recipe drilling fluid chemicals were identified to require a Tier 2 assessment. It is to be noted that none of these chemicals were identified to be toxic *and* persistent *and* bioaccumulative.

Two of the chemicals from the Original drilling fluid recipe and all chemicals from the Newpark Recipe are proprietary. For the proprietary chemicals, the CAS number and name have been redacted from the public submission to protect the intellectual property of chemical manufacturer. Although the proprietary details of the chemical have been redacted in this report, AECOM had access to the chemical name and CAS number and the assessment of risk from the redacted chemical is presented in this report. For the one proprietary chemical (Performatrol), the CAS number was not provided by the chemical manufacturer, however the information in its SDS was utilised to inform this assessment.

The Tier 1 screening is provided in **Appendix E**, the chemical toxicological profiles are provided in **Appendix H** and the Newpark Drilling Fluid SDS are provided in **Appendix J.**

2.1.4 Outcome of Tier 1 Screen – Chemical Tracers

The following chemical tracers may be used for the Beetaloo Exploration and Appraisal Program – CFT, GFT and WFT. The proprietary chemical CAS numbers and names have been redacted from the public submission to protect the intellectual property of chemical manufacturers. Although the proprietary details of the chemicals have been redacted in this report, AECOM had access to the chemical names and CAS numbers (with the exception of Performatrol) and the assessment of risk from the redacted chemicals is presented in this report.

Comparison of the chemicals with the assessment criteria indicated that all chemicals were considered to require a Tier 2 assessment. However, none of these chemicals were identified to be persistent and bioaccumulative.

The Tier 1 screening is provided in **Appendix F**, and the chemical toxicological profiles are provided in **Appendix I**.

2.1.5 Outcome of Tier 1 Screen – Packer Fluid Recipes

Comparison of the chemicals with the assessment criteria indicated that all 8 chemicals were not considered to require a Tier 2 assessment. One chemical has been assessed by NICNAS (IMAP) and was identified to be of low concern. In following the IMAP and DEPWS (2021) screening process, a further 9 chemicals (which were not assessed by NICNAS 2017) were identified to be of low concern to human health.

Table 5 presents a summary of the chemicals identified to be of low concern to human health for the two packer fluid recipes (NaBr and CaCL2).

Table 5 Chemicals identified to be of low human health concern (Tier 1) – Packer Fluid Recipes (NaBR and CaCL2)

CAS	Chemical	Reasoning
7647-15-6	Sodium Bromide	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to human health and the environment and thus required no further assessment.
111-30-8	Glutaraldehyde	The risk was classified as moderate based on chronic data; however the substance is readily biodegradable and not bioaccumulative. The exposure concentration is several orders of magnitude below the respective ecotoxicity values. A Tier 2 assessment is not required.
67-56-1	Methanol	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	BARACOR W-991 (chemical formulation unknown)	Due to proprietary controls, the chemical name or CAS numbers were not provided to AECOM, and a quantitative assessment could not be completed. However, based on the information provided in the SDS, this product is not classified as hazardous, and a Tier 2 assessment is assumed to be not required.
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethanol	The risk was classified as high based on acute data; however the substance is readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
Proprietary	OXYGON (chemical formulation unknown)	Due to proprietary controls, the chemical name or CAS numbers were not provided to AECOM, and a quantitative assessment could not be completed. However, based on the information provided in the SDS, this product is not classified as hazardous, and a Tier 2 assessment is assumed to be not required

CAS	Chemical	Reasoning
10043-52-4	Calcium Chloride	The risk was classified as low based on chronic data and acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
141-43-5	Ethanolamine	The risk was classified as low based on chronic data, and it is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.

Based on the Tier 1 screening none of the packer fluid chemicals were identified to require a Tier 2 assessment. It is to be noted that none of these chemicals were identified to be toxic *and* persistent *and* bioaccumulative.

Two of the products from the Packer fluid recipes are proprietary to protect the intellectual property of chemical manufacturer. Although the proprietary details of the products such as chemical formulation and CAS numbers have not been provided to AECOM, the information in their SDS' was utilised to inform this assessment.

The Tier 1 screening is provided in **Appendix E**, the chemical toxicological profiles are provided in **Appendix I** and the Packer Fluid SDS are provided in **Appendix J.**

2.1.6 Outcome of Tier 1 Screen – Lubricant Recipes

Comparison of the chemicals with the assessment criteria indicated that all 7 chemicals were not considered to require a Tier 2 assessment. One chemical has been assessed by NICNAS (IMAP) and was identified to be of low concern. In following the IMAP and DEPWS (2021) screening process, a further 6 chemicals (which were not assessed by NICNAS 2017) were identified to be of low concern to human health.

Table 6 presents a summary of the chemicals identified to be of low concern to human health for the lubricant recipes.

Table 6 Chemicals identified to be of low human health concern (Tier 1) – Lubricant recipes

CAS	Chemical	Reasoning
143-22-6	Triethylene glycol, monobutyl ether,	A Tier 1 Environmental Assessment for this chemical has been conducted by NICNAS under the IMAP framework which concluded that it was low concern to the environment and thus required no further assessment.
111-76-2	2-Butoxyethanol	The risk was classified as low based on chronic and acute data. The substance is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.
111-42-2	Diethanolamine	The risk was classified as high based on chronic data. However, the substance is expected to be readily biodegradable and not bioaccumulative and the exposure concentration is several orders of magnitude below the respective ecotoxicity values. A Tier 2 assessment is not required.

CAS	Chemical	Reasoning
Unknown	Fatty Esters (Radiagreen EME)	Due to proprietary controls, the chemical name or CAS numbers were not provided to AECOM, and a quantitative assessment could not be completed. However, based on the information provided in the SDS, this product is not classified as hazardous, and a Tier 2 assessment is assumed to be not required
Unknown	Fatty Esters (Radiagreen EBL)	Due to proprietary controls, the chemical name or CAS numbers were not provided to AECOM, and a quantitative assessment could not be completed. However, based on the information provided in the SDS, this product is not classified as hazardous, and a Tier 2 assessment is assumed to be not required
100-42-5	Styrene	The risk was classified as high based on acute and chronic data. However, the substance is expected to be readily biodegradable and not bioaccumulative. Due to proprietary controls the chemical concentration was not provided to AECOM, and a quantitative assessment could not be conducted. Based on the information provided in the SDS, this product is classified as hazardous. Management of this chemical is addressed in the EMP to prevent accidental release. OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required
Unknown	Sulphonated organic polymer (Polydrill)	Due to proprietary controls, limited chemical information was obtained from the supplier. However, based on the information provided in the SDS, this product is not classified as hazardous, and a Tier 2 assessment is assumed to be not required.

Based on the Tier 1 screening none of the lubricant chemicals were identified to require a Tier 2 assessment. It is to be noted that none of these chemicals were identified to be toxic *and* persistent *and* bioaccumulative.

Four of the products from the lubricant recipes are proprietary to protect the intellectual property of chemical manufacturer. Although the proprietary details of the products such as chemical formulation, CAS numbers and concentrations have not been provided to AECOM, the information in their SDS' was utilised to inform this assessment.

The Tier 1 screening is provided in **Appendix K**, the chemical toxicological profiles are provided in **Appendix I** and the Lubricant SDS are provided in **Appendix J.**

3.0 Hydraulic Fracture Chemical Risk Assessment Tier 2 Screen

3.1.1 Tier 2 Screen Methodology

The Tier 2 assessment evaluated the toxicity of the individual chemicals and characterised the cumulative risks of the total fluid mixtures to Workers. The methodology incorporated an assessment of potential exposures to the Workers, with the following identified as the only potentially complete exposure pathways:

- Incidental ingestion and dermal contact of flowback fluid by Workers during the hydraulic stimulation period for a maximum duration of 1 month; and
- Inhalation of mist from the evaporation units at the flowback tank by Workers for a maximum duration of 1 year.

These scenarios are also deemed protective of the following due to the less frequent and short duration of these exposures occurring:

- Worker exposure during a spill (i.e., a coupling breaks on a tank and releases product onto the worker) or leak scenarios.

Based on the risk mitigation measures identified in the NT Government *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory*, the *Code of Practice for Onshore Petroleum Activities* in the Northern Territory and mitigation measures outlined by Tamboran in its EMPs, no potentially complete exposure pathways were identified for hydraulic fracturing chemicals to impact groundwater that is used for beneficial use in the project area. The specific controls implemented by Tamboran focussed on the protection of aquifers follow industry standard practice and include:

- the physical vertical separation distances of 1,400 m between the aquifer and target formation to prevent any migration of stimulation fluid to aquifer units
- the horizontal separation distance between the exploration well and the closest groundwater extraction bores of at least 1 km, as per the Code
- use of double lined wastewater tanks with leak detection
- implementation of spill management plan
- use of enclosed tanks and freeboard requirements
- mandatory secondary containment requirements.

Potential exposures to hydraulic fracturing chemicals at the project area were therefore assessed to be limited to the above ground storage and handling of flowback water. Management of flowback water involves temporary storage in above ground fluid holding tanks for evaporation.

3.1.2 Chemicals of Potential Concern

Exposure point concentrations (EPC) were developed for each of the hydraulic fracturing fluid systems using theoretical calculations, where it was conservatively assumed that 100% of the mass of the chemicals injected into the well will be present in the flowback water.

A summary of the chemicals that require further assessment are presented in Table 7 to Table 13.

Table 7 Chemicals requiring further assessment (Tier 2) – Stimulation Fluid HALSW Recipe (24 chemicals)

CAS	Chemical Name
7647-01-0	Hydrochloric acid
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated
7647-14-5	Sodium Chloride
64-19-7	Acetic acid
81741-28-8	Tributyl tetradecyl phosphonium chloride
25322-68-3	Polyethylene glycol
7631-90-5	Sodium bisulfite
104-55-2	Cinnamaldehyde
111-46-6	Diethylene glycol
67-56-1	Methanol
61788-90-7	Amine oxides, cocoalkyldimethyl
1310-73-2	Sodium hydroxide
100-52-7	Benzaldehyde
64-17-5	Ethanol
64742-47-8	Hydrotreated light petroleum distillate
61791-00-2	Fatty acids, tall-oil, ethoxylated
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)
71-36-3	Butyl alcohol
68131-39-5	Alcohols, C12-15, ethoxylated
68551-12-2	Alcohols, C12-16, ethoxylated
107-13-1	Acrylonitrile
111-42-2	Diethanolamine
111-30-8	Glutaraldehyde

Table 8 Chemicals requiring further assessment (Tier 2) – Stimulation Fluid HAL Hybrid Recipe (30 chemicals)

CAS	Chemical Name
7647-01-0	Hydrochloric acid
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated
1319-33-1	Ulexite
102-71-6	Triethanol amine
7647-14-5	Sodium Chloride
1310-73-2	Sodium hydroxide
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated
64-19-7	Acetic acid
111-42-2	Diethanolamine

CAS	Chemical Name
81741-28-8	Tributyl tetradecyl phosphonium chloride
7631-90-5	Sodium bisulfite
7758-19-2	Chlorous acid, sodium salt
12008-41-2	Disodium octaborate tetrahydrate
104-55-2	Cinnamaldehyde
25322-68-3	Polyethylene glycol
111-46-6	Diethylene glycol
14808-60-7	Crystalline silica, quartz
67-56-1	Methanol
7775-27-1	Sodium persulfate
61788-90-7	Amine oxides, cocoalkyldimethyl
100-52-7	Benzaldehyde
64-17-5	Ethanol
64742-47-8	Hydrotreated light petroleum distillate
61791-00-2	Fatty acids, tall-oil, ethoxylated
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)
71-36-3	Butyl alcohol
68131-39-5	Alcohols, C12-15, ethoxylated
68551-12-2	Alcohols, C12-16, ethoxylated
107-13-1	Acrylonitrile
111-30-8	Glutaraldehyde

Table 9 Chemicals requiring further assessment (Tier 2) – Stimulation Fluid HAL HVFR Recipe (25 chemicals)

CAS	Chemical Name
64-19-7	Acetic acid
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated
68131-39-5	Alcohols, C12-15, ethoxylated
68551-12-2	Alcohols, C12-16, ethoxylated
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)
61788-90-7	Amine oxides, cocoalkyldimethyl
100-52-7	Benzaldehyde
71-36-3	Butyl alcohol
104-55-2	Cinnamaldehyde
111-42-2	Diethanolamine
111-46-6	Diethylene glycol
64-17-5	Ethanol

CAS	Chemical Name
68439-54-3	Ethoxylated branched C13 alcohol
61791-00-2	Fatty acids, tall-oil, ethoxylated
7647-01-0	Hydrochloric acid
64742-47-8	Hydrotreated light petroleum distillate
67-56-1	Methanol
25322-68-3	Polyethylene glycol
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)
7631-90-5	Sodium bisulfite
1310-73-2	Sodium hydroxide
9005-65-6	Sorbitan monooleate polyoxyethylene derivative
81741-28-8	Tributyl tetradecyl phosphonium chloride
10486-00-7	Sodium perborate tetrahydrate

Table 10 Chemicals requiring further assessment (Tier 2) – Stimulation Fluid SLB HVFR Recipe (11 chemicals)

CAS	Chemical Name
1319-33-1	Ulexite
7789-38-0	Sodium bromate
7727-54-0	Diammonium peroxidisulphate
111-30-8	Glutaraldehyde
1303-96-4	Sodium Tetraborate Decahydrate
61789-77-3	Dicoco dimethyl quaternary ammonium chloride
61791-00-2	Fatty acids, tall-oil (CAS propreitary)
68527-49-1	Thiourea, polymer with formaldehyde and 1-phenylethanone
68951-67-7	Aliphatic alcohols, ethoxylated #2 (proprietary CAS)
107-19-7	Prop-2-yn-1-ol
629-73-2	Hexadec-1-ene

Table 11 Chemicals requiring further assessment (Tier 2) – Drilling Fluids- Original Recipe (26 chemicals)

CAS	Chemical Name
78330-21-9	Alcohol, C11-14, ethoxylated
64742-47-8	Distillates, hydrotreated light
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues
111-30-8	Glutaraldehyde
107-22-2	Glyoxal <1%
67-56-1	Methanol
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate
14808-60-7	Quartz/Cristobite

CAS	Chemical Name
497-19-8	Sodium Carbonate
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione
50-01-1	Guanidine, hydrochloride (1:1)
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano
10192-30-0	Ammonium hydrogensulfite
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine
34590-94-8	(2-methoxymethylethoxy)propanol
1120-36-1	1-tetradecene
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol
629-73-2	Hexadec-1-ene
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO
64741-44-2	Distillates (petroleum), straight-run middle
8052-42-4	Bitumen
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano
10192-30-0	Ammonium hydrogensulfite
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine
34590-94-8	(2-methoxymethylethoxy)propanol
1120-36-1	1-tetradecene
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol
629-73-2	Hexadec-1-ene
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO
64741-44-2	Distillates (petroleum), straight-run middle
8052-42-4	Bitumen
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts

Table 12 Chemicals requiring further assessment (Tier 2) – Newpark Drilling Fluids (3 chemicals)

CAS	Chemical Name
Proprietary	Distillates, hydrotreated light
Proprietary	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues
Proprietary	Glutaraldehyde

Table 13 Chemicals requiring further assessment (Tier 2) – Chemical Tracers (4 chemicals)

CAS	Chemical Name
Proprietary	CFT (one chemical selected to represent a group of 20 similar chemicals)
Proprietary	GFT (one chemical selected to represent a group of 15 similar chemicals)
Proprietary	WFT
Proprietary	WFT

3.1.3 Outcome of Tier 2 Screen

For the assessment of the overall potential for adverse human health effects posed by simultaneous exposure to multiple chemicals, the estimated daily intake of the chemicals by inhalation and direct (ingestion and dermal) contact were compared to acceptable risk-based intakes to calculate an individual hazard quotient (HQ) and then summed for all constituents into a hazard index (HI).

Consistent with Australian risk assessment methodologies, if the HI is less than or equal to 1, then no adverse health effects are likely associated with exposures. However, if the total HI is greater than 1, adverse health effects may be possible and therefore the assumptions inherent in the risk characterisation process warrant further evaluation.

3.1.3.1 Stimulation Fluids

A summary of the calculated risks for the workers that are relevant to the assessment of potential exposure to COPCs in stimulation fluids on-site, based on the available data is presented in Table 14 and Table 15.

Table 14 Risk associated with potential exposure to Workers – Haliburton Stimulation Fluids

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker - Exposure to Stimulation Fluid SW Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.01
Dermal exposure to chemicals via incidental contact with flowback water	0.20
Inhalation of mist from the evaporation units containing flowback water	0.05
Total Risk	**0.3**
Worker - Exposure to Stimulation Fluid Hybrid Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.03
Dermal exposure to chemicals via incidental contact with flowback water	0.08
Inhalation of mist from the evaporation units containing flowback water	0.74
Total Risk	**0.9**
Worker - Exposure to Stimulation Fluid HVFR Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.01

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Dermal exposure to chemicals via incidental contact with flowback water	0.22
Inhalation of mist from the evaporation units containing flowback water	0.05
Total Risk	**0.3**

The following can be noted from the table above:

- The calculated risks associated with potential exposure to COPC identified in flowback water, where either SW, Hybrid or HVFR stimulation fluid recipes are used and assuming 100% mass recovery, are below the target 1, hence, risks are considered to be low and acceptable.

Table 15 Risk associated with potential exposure to Workers – Schlumberger Stimulation Fluid

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker - Exposure to Stimulation Fluid SW Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.12
Dermal exposure to chemicals via incidental contact with flowback water	0.06
Inhalation of mist from the evaporation units containing flowback water	0.67
Total Risk	**0.8**

The following can be noted from the table above:

- The calculated risks associated with potential exposure to COPC identified in flowback water, where the SLB HVFR stimulation fluid recipe is used and assuming 100% mass recovery, is below the target 1, hence, risks are considered to be low and acceptable.

3.1.3.2 Drilling Fluid

A summary of the calculated risks for the workers that are relevant to the assessment of potential exposure to COPCs in the drilling fluid on-site, based on the available data is presented in Table 16 for the Original drilling fluid recipe and Table 17 for the Newpark drilling fluid recipe.

Table 16 Risk associated with potential exposure to Workers – Original Drilling Fluid Recipe

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker	
Ingestion of chemicals via incidental contact with flowback water	0.004
Dermal exposure to chemicals via incidental contact with flowback water	0.007
Inhalation of mist from the evaporation units containing flowback water	0.2
Total Risk	**0.3**

The following can be noted from the table above:

- The calculated risks associated with potential exposure to COPC identified in flowback water, where Original drilling fluid recipe is used and assuming 100% mass recovery are below the target 1, hence, risks are considered to be low and acceptable.

Table 17 Risk associated with potential exposure to Workers – Newpark Drilling Fluid Recipe

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker	
Ingestion of chemicals via incidental contact with flowback water	0.03
Dermal exposure to chemicals via incidental contact with flowback water	0.02
Inhalation of mist from the evaporation units containing flowback water	0.18
Total Risk	**0.24**

The following can be noted from the table above:

- The calculated risks associated with potential exposure to COPC identified in flowback water, where Newpark drilling fluid recipe is used and assuming 100% mass recovery are below the target 1, hence, risks are considered to be low and acceptable.

3.1.3.3 Chemical Tracers

A summary of the calculated risks for the workers that are relevant to the assessment of potential exposure to COPCs in the Chemical Tracers on-site, based on the available data is presented in Table 18.

Table 18 Risk associated with potential exposure to Workers – Chemical Tracers

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker – Exposure to Chemical Tracer CFT Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.0000032
Dermal exposure to chemicals via incidental contact with flowback water	0.000010
Inhalation of mist from the evaporation units containing flowback water	0.000018
Total Risk	**0.00003**
Worker – Exposure to Chemical Tracer GFT Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.0000047
Dermal exposure to chemicals via incidental contact with flowback water	0.0010
Inhalation of mist from the evaporation units containing flowback water	0.000026
Total Risk	**0.001**
Worker – Exposure to Chemical Tracer WFT Recipe	
Ingestion of chemicals via incidental contact with flowback water	0.30
Dermal exposure to chemicals via incidental contact with flowback water	0.012
Inhalation of mist from the evaporation units containing flowback water	-
Total Risk	**0.3**

The following can be noted from the table above:

- The calculated risks associated with potential exposure to COPC identified in flowback water, where either CFT, GFT or WFT chemical tracer recipes are used and assuming 100% mass recovery, are below the target 1, hence, risks are considered to be low and acceptable.

3.1.3.4 Combination of Hydraulic Fracturing Fluid Systems

A summary of the calculated risks for the workers that are relevant to the assessment of potential exposure to COPCs from combinations of hydraulic fracturing fluid systems on-site, based on the available data is presented in Table 19 and Table 20.

Table 19 Risk associated with potential exposure to Workers – Combination of Haliburton Hydraulic Fracturing Fluid Systems

Receptor	Threshold Hazard Index
	100% Mass Return
Worker	
Exposure to SW + Original Drilling Fluid + Chemical Tracer CFT Recipes	0.5
Exposure to Hybrid + Original Drilling Fluid + Chemical Tracer CFT Recipes	1
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer CFT Recipes	0.5
Exposure to SW + Original Drilling Fluid + Chemical Tracer GFT Recipes	0.5
Exposure to Hybrid + Original Drilling Fluid + Chemical Tracer GFT Recipes	1
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer GFT Recipes	0.5
Exposure to SW + Original Drilling Fluid + Chemical Tracer WFT Recipes	0.8
Exposure to Hybrid + Original Drilling Fluid + Chemical Tracer WFT Recipes	1
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer WFT Recipes	0.8
Exposure to SW + Newpark Drilling Fluid + Chemical Tracer CFT Recipes	0.5
Exposure to Hybrid + Newpark Drilling Fluid + Chemical Tracer CFT Recipes	1
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer CFT Recipes	0.5
Exposure to SW + Newpark Drilling Fluid + Chemical Tracer GFT Recipes	0.5
Exposure to Hybrid + Newpark Drilling Fluid + Chemical Tracer GFT Recipes	1
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer GFT Recipes	0.5
Exposure to SW + Newpark Drilling Fluid + Chemical Tracer WFT Recipes	0.8
Exposure to Hybrid + Newpark Drilling Fluid + Chemical Tracer WFT Recipes	1
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer WFT Recipes	0.8

The following can be noted from the table above:

- On the basis of the risk evaluation, no unacceptable risk to Workers was identified in all of the possible recipe combinations of Haliburton stimulation fluids, drilling fluids and chemical tracers. It is noted that conservative risk scenarios assessed included regular exposure to the flowback water during the hydraulic stimulation and evaporation phases, with exposures to high theoretical concentrations of COPC in the flowback water. This may result in overestimation of the risk.

Table 20 Risk associated with potential exposure to Workers – Combination of Schlumberger Hydraulic Fracturing Fluid Systems

Receptor	Threshold Hazard Index
	100% Mass Return
Worker	
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer CFT Recipes	1
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer GFT Recipes	1
Exposure to HVFR+ Original Drilling Fluid + Chemical Tracer WFT Recipes	1

Receptor	Threshold Hazard Index
	100% Mass Return
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer CFT Recipes	1
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer GFT Recipes	1
Exposure to HVFR+ Newpark Drilling Fluid + Chemical Tracer WFT Recipes	1

The following can be noted from the table above:

- On the basis of the risk evaluation, no unacceptable risk to Workers was identified in all of the possible recipe combinations of Schlumberger stimulation fluids, drilling fluids and chemical tracers. It is noted that conservative risk scenarios assessed included regular exposure to the flowback water during the hydraulic stimulation and evaporation phases, with exposures to high theoretical concentrations of COPC in the flowback water. This may result in overestimation of the risk.

It is to be noted that this assessment does not replace the requirement for appropriate occupational health and safety procedures and management plans. Crystalline silica is scheduled by Safe Work Australia as a chemical for which health monitoring may be required.

The Tier 2 assessment is provided in **Appendix A to Appendix F**, the chemical toxicological profiles are provided in **Appendix G** to **Appendix I.**

4.0 Chemical Transport, Storage and Handling

Tamboran aligns its transport, storage, and handling of hazardous chemicals with WHS Regulations, and the prescribed chemical legislation including all obligations and duties for storage and handling of hazardous chemicals and eliminating risks to workers from potential exposure and the potential requirements for health monitoring.

The following prescribed chemical legislation, as defined by the Petroleum (Environment) Regulations 2016, will be followed as it relates to the transport, storage, and handling of HFS chemicals:

- *Medicines, Poisons and Therapeutic Goods Act 2012 and Medicines, Poisons and Therapeutic Goods Regulations 2014*
- *Dangerous Goods Act 1998*
- *Water Act 1992*
- *Waste Management and Pollution Control Act 1998*
- *Work Health and Safety (National Uniform Legislation) Act 2011*
- *Radiation Protection Act 2004.*

5.0 References

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Appendix A

Chemical Risk Assessment Hydraulic Fracture Stimulation Fluid – HAL Hybrid

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Hydrochloric acid	7647-01-0	1.152	10,206	0.0392%	11,757	0.0421%	474	Acid	Algae = 0.492 mg/L Daphnia = 0.492 mg/L Fish = 4.92 mg/L Daphnia (chronic) = 62 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only
Alcohols, C6-12, ethoxylated propoxylated	68937-66-6	0.94	5,253	0.0202%	4,938	0.0177%	199	Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) EC50 (48h) 0.14 mg/L (Daphnia magna) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) NOEC 4.4 mg/L (Pimephales promelas, juvenile)	Based on Chronic: Moderate	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	1.40E-03	7.78E-05	7.79E-03	9.26E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ulexite	1319-33-1	1.49	3,476	0.0134%	5,175	0.0185%	209	Crosslinker	Chronic endpoints for Boric acid were available for Daphnia (6 mg/L) and Fish (2.1 mg/L).	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	7.63E-03	3.21E-03	4.25E-02	5.33E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Triethanol amine	102-71-6	1.1245	3,309	0.0127%	3,721	0.0133%	150	Crosslinker	Fish: 96h-LC50 of 11,800 mg/ Daphnia: 24h-EC50 of 1,390 mg/l Daphnia: 21 d NOEC of 16 mg/l Algae:96 h EC50 of 910 mg/l	Based on Chronic: Low	Inherently biodegradable	Not Bio accumulative (Based on an estimated log Kow value of -1.0, and BCF value of <3.9)	Tier 2	4.21E-04	9.55E-06	2.35E-03	2.78E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium Chloride	7647-14-5	2.165	2,859	0.0110%	6,189	0.0221%	249	Stabiliser	EC50 = 400 to 30000 mg/L EC50 Fish = 1290 mg/L NOEC = 314 mg/L (Daphnia)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value
Sodium hydroxide	1310-73-2	1.515	2,059	0.0079%	3,119	0.0112%	126	pH buffer	Measured acute endpoints were available for fish (196 mg/L). Measured chronic endpoint were available for Daphnia (240 mg/L)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body
Alcohols, C10-16, ethoxylated propoxylated	69227-22-1	0.94	1,876	0.0072%	1,763	0.0063%	71	Friction Reducer, Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa EC50 (48h) 0.14 mg/L (Daphnia magna) ErC50 (48h) 0.7 mg/L (Skeletonema costatum) ErC50 (16.9h) > 10 g/L (Pseudomonas putida)	Based on Acute: Very high	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	4.99E-04	6.59E-02	2.78E-03	6.92E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Acetic acid	64-19-7	1.05	1,558	0.0060%	1,636	0.0059%	66	Acid	Acute endpoints: Fish = 75 mg/L, Daphnia EC50 = 32 mg/L Chronic endpoints: Daphnia = 150 mg/L	Based on Chronic: Low	Readily biodegradable	Not Bio accumulative (Based on log Kow = -0.136)	Tier 2	1.93E-05	4.93E-06	1.07E-04	1.32E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Diethanolamine	111-42-2	1.1	1,459	0.0056%	1,605	0.0057%	65	Breaker Activiator	Fish 96-h LC50 = 1370 mg/l Invertebrates 48-h EC50 = 55 mg/l Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l Microorganisms 16-h TTC = 16 mg/l Daphnia magna, the NOEC (21 days) was 0.78 mg/l	Based on Chronic: High	Readily biodegradable	Not Bioaccumulative. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16	Tier 2	1.62E-02	3.37E-04	9.04E-02	1.07E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Tributyl tetradecyl phosphonium chloride	81741-28-8	0.95	736	0.0028%	700	0.0025%	28	Biocide	LC50: (96 hour) 0.46 mg/L (Oncorhynchus mykiss) LC50: (96 hour) 0.06 mg/l (Lepomis macrochirus) LC50: (96 hour) 0.58 mg/l (fish) TLM96: 1.6 mg/l (Crangon crangon) TLM48: 0.025 mg/l (Daphnia magna Modelled acute endpoint: Daphnia is 16.788 mg/L Fish is 1059.2530 mg/L	Based on Acute: Very high	Not available, however it has been observed to biodegrade in sediment.	Not bioaccumulative (Based on an estimated log Kow value of 6.26)	Tier 2	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only
Sodium bisulfite	7631-90-5	2.44	483	0.0019%	1,179	0.0042%	47	Scale Inhibitor	72h-EC50 = 36.8 mg sodium sulfite/L (alga) NOEC of >8.41 mg sodium sulfite/L (Daphnia)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.59E-05	3.04E-11	8.85E-05	1.04E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Chlorous acid, sodium salt	7758-19-2	2.47	458	0.0018%	1,131	0.0040%	46	Breaker	LC50 values above 100 mg/l (fish) LC50 48-hour = 0.063 mg/l (daphnia) ECr50 value at 72 h as 1.2 mg/l (algae)	Based on Acute: Very High	No. Not expected to be persistent due to its instability.	No. Based on an estimated log Kow value of 3	Tier 2	4.10E-03	1.56E-08	2.29E-02	2.70E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Disodium octaborate tetrahydrate	12008-41-2	1.874	336	0.0013%	630	0.0023%	25	Crosslinker	Algae: EC10 (3 d) 96.5 mg/L (Pseudokirchneriella subcapitata) Fish: LC50 (96 h) 314.6 mg/L (Pimephales promelas), NOEC (34 d) 25.2 mg/L (Danio rerio) Invertebrates: NOEC (21 d) 42.5 mg/L (Daphnia magna) Microorganism: EC50 (3 h) > 39371 mg/L (activated sludge)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	9.29E-04	3.90E-04	5.17E-03	6.49E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Cinnamaldehyde	104-55-2	1.048	332	0.0013%	348	0.0012%	14	Corrosion Inhibitor	Danio rerio (Zebrafish) 96 h LC50 = 3.1 mg/L; Daphnia magna (Water flea) 48 h EC50 = 3.86 mg/L; Pseudokirchneriella subcapitata (Green algae) 72 h EC50 = 4.07 mg/L. 72 h NOEC value = 2.0 mg/L Pseudokirchneriella subcapitata (Green algae)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	2.46E-05	5.89E-05	1.37E-04	2.21E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Polyethylene glycol	25322-68-3	1.21	328	0.0013%	397	0.0014%	16	Scale Inhibitor	LC50 = 100 mg/L (fish) LC50 = 1000 mg/L (invertebrates) EC 50 = 15.91 mg/L (algae)	Based on Acute: Moderate	Expected to be readily biodegradable	No based on BCF of 3.2	Tier 2	7.03E-06	6.92E-09	3.92E-05	4.62E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Diethylene glycol	111-46-6	1.12	303	0.0012%	339	0.0012%	14	Corrosion Inhibitor	LC 50 = >100 mg/L (fish, invertebrates, algae)	Based on Acute: Low	Readily biodegradable	No based on the estimated BCF of 3	Tier 2	1.60E-04	3.07E-06	8.91E-04	1.05E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Crystalline silica, quartz	14808-60-7	2.6	235	0.0009%	611	0.0022%	25	Crosslinker	no acute toxicity to fish, Daphnia, or algae, though some physical effects were observed with loading rates of greater than or equal to 10 g/L (OECD 2004). Any harmful effects to aquatic ecosystems are therefore not ecotoxicological in nature. No chronic toxicity data were identified.	Based on Acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	NA. Not toxic via oral exposure as not absorbed via GI tract	NA. Not toxic via dermal exposure.	5.62E-01	5.62E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Methanol	67-56-1	0.791	125	0.0005%	99	0.0004%	4	Corrosion Inhibitor, Surfactant	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	No based on the Log Kow of -0.74	Tier 2	3.76E-04	5.52E-05	2.10E-03	2.53E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium persulfate	7775-27-1	1.68	116	0.0004%	194	0.0007%	8	Breaker	LC50 fish = 163 to 771 mg/L. EC50 invertebrates = 133 and 519 mg/L EC50 algae = 116 mg/L	Based on Acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	4.10E-05	1.33E-08	2.29E-04	2.70E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amine oxides, cocoalkyldimethyl	61788-90-7	0.716	103	0.0004%	74	0.0003%	3	Corrosion Inhibitor	LC50/EC50/ErC50 values: 0.60-32 mg/L for fish 0.50-10.8 mg/L for Daphnia magna 0.010-5.30 mg/L for algae NOEC/ EC20: 0.010-1.72 mg/L for algae 0.28 mg/L for Daphnia 0.31 mg/L for fish	Based on Chronic: Very High	Readily biodegradable	No based on the calculated Log Kow of <2.7 and BCF <87	Tier 2	1.30E-04	6.18E-03	7.27E-04	7.04E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Benzaldehyde	100-52-7	1.0415	47	0.0002%	48	0.0002%	2	Corrosion Inhibitor	Acute LC50 for freshwater fish is 1.07 mg/L, freshwater invertebrates is 16.2 mg/L and EC10 for freshwater algae is 20 mg/L. Chronic NOEC for freshwater fish is 0.12 mg/L.	Based on Chronic: High	Expected to be readily biodegradable	No based on Log Pow of 1.4	Tier 2	2.29E-05	4.03E-05	1.27E-04	1.91E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethanol	64-17-5	0.7864	45	0.0002%	35	0.0001%	1	Surfactant	LC50/EC50 > 1000 mg/L (fish, daphnia, algae) NOEC for invertebrates is 9.6 mg/L (10 day reproduction), plants it is 280 mg/L (7 day study)	Based on Chronic: High	Readily biodegradable	No based on calculated logBCF=0.5	Tier 2	2.07E-07	5.11E-08	1.15E-06	1.41E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hydrotreated light petroleum distillate	64742-47-8	0.8	43	0.0002%	35	0.0001%	1	Friction Reducer, Surfactant	96 hr LL50 was 2 to 5 mg/L (fish) 48 hr EL50 was 1.4 mg/L (daphnia) 21 d NOEL = 0.48 mg/L (daphnia)	Based on Chronic: High	Readily biodegradable	Yes based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight	Tier 2	4.90E-07	4.41E-04	2.73E-06	4.45E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Fatty acids, tall-oil, ethoxylated	61791-00-2	1.054	23	0.0001%	24	0.0001%	1	Surfactant	96h-LL50 > 100 mg/L (fish) 48h-EL50 = 12.41 mg/L (invertebrates) 72h-EL50 = 39.7 mg/L (algae) 72h-EL10 = 7.08 mg/L (algae)	Based on Acute: High	Readily biodegradable (read across)	No based on low BCF values of < 100 L/kg ww	Tier 2	3.37E-07	3.27E-06	1.88E-06	5.48E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	0.9	22	0.0001%	20	0.0001%	1	Surfactant	LC50 (96h) 6.7 mg/L (Danio rerio) (similar substance) LC50 (21d) = 0.1 mg/L (Daphnia magna) LC50 (48h) = 2.15 mg/L EC50 (72h) 2.2 mg/L (Scendesmus subspicatus) (similar substance)	Based on Chronic: High	Readily biodegradable (read across)	No Log Kow 3	Tier 2	5.67E-06	1.86E-04	3.16E-05	2.23E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Butyl alcohol	71-36-3	0.81	22	0.0001%	18	0.0001%	1	Surfactant	Fish, LC50 (96h) 1376 mg/l Invertebrates, EC50 (48h) 1328 mg/L) Algae, EC50 (96h) 225 mg/L EC10 (17h) Pseudomonas putida = 2476 mg/L Chronic NOECrepro (21d) = 4.1 mg/L for Daphnia magna	Based on Chronic: Moderate	Readily biodegradable	No based on low log Kow values of 1	Tier 2	1.98E-06	2.11E-06	1.10E-05	1.51E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-15, ethoxylated	68131-39-5	0.867	20	0.0001%	18	0.0001%	1	Friction Reducer, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	4.97E-06	3.39E-06	2.77E-05	3.61E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-16, ethoxylated	68551-12-2	0.97	20	0.00008%	19	0.00007%	1	Corrosion Inhibitor, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	5.42E-06	2.24E-03	3.02E-05	2.27E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Acrylonitrile	107-13-1	0.806	2	0.00001%	2	0.00001%	0.1	Surfactant	96h LC50 for freshwater fish = 10 - 20 mg/l 96h LC50 for saltwater fish 8.6 mg/l 48h EC50 for Daphnia = 7.6 mg/l 30d NOEC for fish of 0.17 mg/l	Based on Chronic: High	Biodegradable	No based on the low log Pow (0.00-0.30)	Tier 2	1.11E-04	5.95E-05	6.21E-04	7.92E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Glutaraldehyde	111-30-8	1.05	0	0.0000001%	0	0.00000%	0.001	Biocide	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduct'n Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 2	7.47E-05	1.12E-05	4.16E-04	5.02E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
																Total Risk	**0.9**	The calculated risks associated with potential exposure to COPC identified in flowback water, where the HYBRID Recipe is used and assuming 100% mass recovery is below the target of 1, respectively. Hence, chronic health risks are considered to be low and acceptable.

Notes
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using Commonwealth of Australia 2013 Ecotoxicity Assessment Guidelines (presented as Table 4 in the Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019))
3- Biodegradation assessed as per Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019) and Australian Government Department of Health National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
BCF - Bioconcentration Factor
NA - Not Applicable
MOE - Margin of Exposure
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DOE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures									
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well														
1319-33-1	Boronatrocalcite/Ulexite[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated[B]	0.5	D	1.21E-04	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated[B]	0.5	D	2.87E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
64-19-7	Acetic acid	12	D	5.56E-04	EPI				42	converted from RFD		1200	NICNAS (2017)	100	NICNAS (2017)
25322-68-3	Polyethylene glycol	8	D	2.14E-06	EPI				28	converted from RFD		8000	REACH	1000	D
7631-90-5	Sodium bisulfite[C]	10.5	D	4.16E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
104-55-2	Cinnamaldehyde	2	D	5.20E-03	EPI				7	converted from RFD		200	NTP (2004); REACH	100	D
67-56-1	Methanol	0.037	D	3.19E-04	EPI				0.13	converted from RFD		3.7	NICNAS (2017)	100	NICNAS (2017)
61788-90-7	Amine oxides, cocoalkyldimethyl	0.08	D	1.03E-01	EPI				0.28	converted from RFD		80	OECD (2001)	1000	D
100-52-7	Benzaldehyde	0.3	D	3.83E-03	EPI				1.05	converted from RFD		300	OECD (2002); REACH; NICNAS	1000	D
64-17-5	Ethanol	24	D	5.38E-04	EPI				84	converted from RFD		2400	NICNAS (2017)	100	NICNAS (2017)
64742-47-8	Hydrotreated light petroleum distillate	10	D	1.96E+00	EPI				35	converted from RFD		1000	NICNAS (2017)	100	NICNAS (2017)
61791-00-2	Fatty acids, tall-oil, ethoxylated	10	D	2.11E-02	EPI				35	converted from RFD		1000	REACH	100	D
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	0.5	D	7.14E-02	EPI				1.75	converted from RFD		50	USEPA (2010)	100	D
71-36-3	Butyl alcohol	1.25	D	2.31E-03	EPI				4.375	converted from RFD		125	OECD (2001)/NICNAS	100	D
68131-39-5	Alcohols, C12-15, ethoxylated[B]	0.5	D	1.48E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
68551-12-2	Alcohols, C12-16, ethoxylated[B]	0.5	D	8.97E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
107-13-1	Acrylonitrile	0.0025	D	1.16E-03	EPI				0.00875	converted from RFD		0.25	OECD (2005); NICNAS	100	D
111-42-2	Diethanolamine	0.014	D	4.51E-05	EPI				0.049	converted from RFD		14	REACH; OECD (2002); NICNAS	1000	D
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI				0.14	converted from RFD		4	NICNAS (2017)	100	NICNAS (2017)
102-71-6	Triethanol amine	1.25	D	4.93E-05	EPI				4.375	converted from RFD		125	NICNAS (2017)	100	NICNAS (2017)
7758-19-2	Chlorous acid, sodium salt	0.039	D	8.27E-09	EPI				0.1365	converted from RFD		3.9	NICNAS (2017)	100	NICNAS (2017)
12008-41-2	Disodium octaborate tetrahydrate[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
7775-27-1	Sodium persulfate	0.67	D	7.05E-07	EPI				2.345	converted from RFD		67	NICNAS (2017)	100	NICNAS (2017)
68439-54-3	Ethoxylated branched C13 alcohol	0.5	D	1.06E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)	25	JECFA	5.02E-02	EPI				87.5	converted from RFD		-	JECFA(1973); US FDA; FSANZ (2018)	-	-
9005-65-6	Sorbitan monooleate polyoxyethylene derivative	10	EFSA	3.54E-09	EPI				35	converted from RFD		-	EFSA (2017)	-	-
111-46-6	2,2''-oxydiethanol (diethylene glycol)	0.3	D	4.17E-05	EPI				1.05	converted from RFD		300	Health Council of the Netherlands (2007); NICNAS	1000	D
7631-90-5	Sodium bisulfate[C]	10.5	D	9.29E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
14808-60-7	Crystalline silica, quartz	Not toxic via oral/dermal exposure							0.003	USEPA (2019)		-	-	-	-
10486-00-7	Sodium perborate tetrahydrate	0.05	D	1.81E-06	EPI				0.175	converted from RFD		50	REACH	1000	D

Notes:

A - Read across data from Boric Acid

B - Read across data from Alcohol ethoxylates C6-C12

C - Read across data from Sodium Sulfite

References:

D - Derived (refer to individual Toxicity Profiles)

EFSA - European Food Safety Authority

EPI - USEPA Estimation Programs Interface (EPI) Suite

FSANZ - Food Standards Australia New Zealand

J- JECFA - Joint FAO/WHO Expert Committee on Food Additives

NICNAS - National Industrial Chemicals Notification and Assessment Scheme. Assessed at https://www.nicnas.gov.au/

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

NTP - US Department of Health and Serices National Toxicology Program

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - Hybrid Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

	Chemical	Toxicity Data				Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% Chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	198.94	8.3E-07	7.0E-04	--	1.4E-03
1319-33-1	Boronatrocalcite/UlexiteA		9.6E-02		9.6E-02	208.50	8.7E-07	7.3E-04	--	7.6E-03
102-71-6	Triethanol amine		1.3E+00		1.3E+00	149.92	6.3E-07	5.3E-04	--	4.2E-04
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	71.05	3.0E-07	2.5E-04	--	5.0E-04
64-19-7	Acetic acid		1.2E+01		1.2E+01	65.91	2.8E-07	2.3E-04	--	1.9E-05
111-42-2	Diethanolamine		1.4E-02		1.4E-02	64.65	2.7E-07	2.3E-04	--	1.6E-02
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	47.49	2.0E-07	1.7E-04	--	1.6E-05
7758-19-2	Chlorous acid, sodium salt		3.9E-02		3.9E-02	45.57	1.9E-07	1.6E-04	--	4.1E-03
12008-41-2	Disodium octaborate tetrahydrateA		9.6E-02		9.6E-02	25.38	1.1E-07	8.9E-05	--	9.3E-04
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	14.02	5.9E-08	4.9E-05	--	2.5E-05
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	16.01	6.7E-08	5.6E-05	--	7.0E-06
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	13.65	5.7E-08	4.8E-05	--	1.6E-04
67-56-1	Methanol		3.7E-02		3.7E-02	3.98	1.7E-08	1.4E-05	--	3.8E-04
7775-27-1	Sodium persulfate		6.7E-01		6.7E-01	7.82	3.3E-08	2.7E-05	--	4.1E-05
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	2.97	1.2E-08	1.0E-05	--	1.3E-04
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	1.95	8.2E-09	6.9E-06	--	2.3E-05
64-17-5	Ethanol		2.4E+01		2.4E+01	1.41	5.9E-09	5.0E-06	--	2.1E-07
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	1.39	5.8E-09	4.9E-06	--	4.9E-07
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	0.96	4.0E-09	3.4E-06	--	3.4E-07
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	0.81	3.4E-09	2.8E-06	--	5.7E-06
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	0.71	3.0E-09	2.5E-06	--	2.0E-06
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	0.71	3.0E-09	2.5E-06	--	5.0E-06
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	0.77	3.2E-09	2.7E-06	--	5.4E-06
107-13-1	Acrylonitrile		2.5E-03		2.5E-03	0.08	3.3E-10	2.8E-07	--	1.1E-04
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	0.85	3.6E-09	3.0E-06	--	7.5E-05
								Total Risk (mixture)		**3.21E-02**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - Hybrid Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = SAw*ET*CF*EF*ED / BW*AT	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

	Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	1.2E-4	198.94	4.6E-08	3.9E-05	--	7.8E-05
1319-33-1	Boronatrocalcite/UlexiteA		9.6E-02		9.6E-02	9.1E-4	208.50	3.7E-07	3.1E-04	--	3.2E-03
102-71-6	Triethanol amine		1.3E+00		1.3E+00	4.9E-5	149.92	1.4E-08	1.2E-05	--	9.6E-06
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	2.9E-1	71.05	3.9E-05	3.3E-02	--	6.6E-02
64-19-7	Acetic acid		1.2E+01		1.2E+01	5.6E-4	65.91	7.0E-08	5.9E-05	--	4.9E-06
111-42-2	Diethanolamine		1.4E-02		1.4E-02	4.5E-5	64.65	5.6E-09	4.7E-06	--	3.4E-04
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	4.2E-9	47.49	3.8E-13	3.2E-10	--	3.0E-11
7758-19-2	Chlorous acid, sodium salt		3.9E-02		3.9E-02	8.3E-9	45.57	7.2E-13	6.1E-10	--	1.6E-08
12008-41-2	Disodium octaborate tetrahydrateA		9.6E-02		9.6E-02	9.1E-4	25.38	4.5E-08	3.7E-05	--	3.9E-04
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	5.2E-3	14.02	1.4E-07	1.2E-04	--	5.9E-05
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	2.1E-6	16.01	6.6E-11	5.5E-08	--	6.9E-09
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	4.2E-5	13.65	1.1E-09	9.2E-07	--	3.1E-06
67-56-1	Methanol		3.7E-02		3.7E-02	3.2E-4	3.98	2.4E-09	2.0E-06	--	5.5E-05
7775-27-1	Sodium persulfate		6.7E-01		6.7E-01	7.1E-7	7.82	1.1E-11	8.9E-09	--	1.3E-08
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	1.0E-1	2.97	5.9E-07	4.9E-04	--	6.2E-03
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	3.8E-3	1.95	1.4E-08	1.2E-05	--	4.0E-05
64-17-5	Ethanol		2.4E+01		2.4E+01	5.4E-4	1.41	1.5E-09	1.2E-06	--	5.1E-08
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	2.0E+0	1.39	5.3E-06	4.4E-03	--	4.4E-04
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	2.1E-2	0.96	3.9E-08	3.3E-05	--	3.3E-06
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	7.1E-2	0.81	1.1E-07	9.3E-05	--	1.9E-04
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	2.3E-3	0.71	3.1E-09	2.6E-06	--	2.1E-06
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	1.5E-3	0.71	2.0E-09	1.7E-06	--	3.4E-06
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	9.0E-1	0.77	1.3E-06	1.1E-03	--	2.2E-03
107-13-1	Acrylonitrile		2.5E-03		2.5E-03	1.2E-3	0.08	1.8E-10	1.5E-07	--	5.9E-05
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	3.3E-4	0.85	5.3E-10	4.5E-07	--	1.1E-05
									Total Risk (mixture)		**7.92E-02**

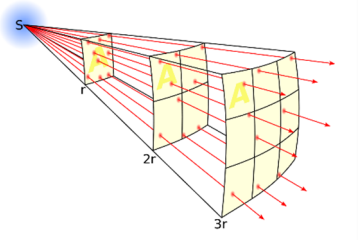
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - Hybrid Recipe

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
68937-66-6	Alcohols, C6-12, ethoxylated propoxyla	198.94	71619.76796	2.500000E-03
1319-33-1	Boronatrocalcite/UlexiteA	208.50	75061.62126	2.500000E-03
102-71-6	Triethanol amine	149.92	53969.54143	2.500000E-03
69227-22-1	Alcohols, C10-16, ethoxylated propoxy	71.05	25578.48856	2.500000E-03
64-19-7	Acetic acid	65.91	23729.05222	2.500000E-03
111-42-2	Diethanolamine	64.65	23274.23026	2.500000E-03
7631-90-5	Sodium bisulfateC	47.49	17096.46645	2.500000E-03
7758-19-2	Chlorous acid, sodium salt	45.57	16404.17744	2.500000E-03
12008-41-2	Disodium octaborate tetrahydrateA	25.38	9138.176627	2.500000E-03
104-55-2	Cinnamaldehyde	14.02	5046.11094	2.500000E-03
25322-68-3	Polyethylene glycol	16.01	5761.962715	2.500000E-03
111-46-6	2,2"-oxydiethanol (diethylene glycol)	13.65	4915.303675	2.500000E-03
67-56-1	Methanol	3.98	1431.585551	2.500000E-03
7775-27-1	Sodium persulfate	7.82	2816.350509	2.500000E-03
61788-90-7	Amine oxides, cocoalkyldimethyl	2.97	1069.713505	2.500000E-03
100-52-7	Benzaldehyde	1.95	703.1990079	2.500000E-03
64-17-5	Ethanol	1.41	508.3231621	2.500000E-03
64742-47-8	Hydrotreated light petroleum distillate	1.39	501.7922025	2.500000E-03
61791-00-2	Fatty acids, tall-oil, ethoxylated	0.96	345.0387202	2.500000E-03
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxye	0.81	290.4332727	2.500000E-03
71-36-3	Butyl alcohol	0.71	254.0323025	2.500000E-03
68131-39-5	Alcohols, C12-15, ethoxylatedB	0.71	254.9143591	2.500000E-03
68551-12-2	Alcohols, C12-16, ethoxylatedB	0.77	278.0084294	2.500000E-03
107-13-1	Acrylonitrile	0.08	28.55172359	2.500000E-03
111-30-8	Glutaraldehyde	0.85	306.4351619	2.500000E-03
14808-60-7	Crystalline silica, quartz	24.60	8857.767115	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - Hybrid Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB	1.99E+02	1.00	2.50E-03	1.75E+00	6.85E-05	1.36E-02	7.79E-03
1319-33-1	BoronatrocalciteUlexiteA	2.09E+02	1.00	2.50E-03	3.36E-01	6.85E-05	1.43E-02	4.25E-02
102-71-6	Triethanol amine	1.50E+02	1.00	2.50E-03	4.38E+00	6.85E-05	1.03E-02	2.35E-03
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB	7.11E+01	1.00	2.50E-03	1.75E+00	6.85E-05	4.87E-03	2.78E-03
64-19-7	Acetic acid	6.59E+01	1.00	2.50E-03	4.20E+01	6.85E-05	4.51E-03	1.07E-04
111-42-2	Diethanolamine	6.47E+01	1.00	2.50E-03	4.90E-02	6.85E-05	4.43E-03	9.04E-02
7631-90-5	Sodium bisulfateC	4.75E+01	1.00	2.50E-03	3.68E+01	6.85E-05	3.25E-03	8.85E-05
7758-19-2	Chlorous acid, sodium salt	4.56E+01	1.00	2.50E-03	1.37E-01	6.85E-05	3.12E-03	2.29E-02
12008-41-2	Disodium octaborate tetrahydrateA	2.54E+01	1.00	2.50E-03	3.36E-01	6.85E-05	1.74E-03	5.17E-03
104-55-2	Cinnamaldehyde	1.40E+01	1.00	2.50E-03	7.00E+00	6.85E-05	9.60E-04	1.37E-04
25322-68-3	Polyethylene glycol	1.60E+01	1.00	2.50E-03	2.80E+01	6.85E-05	1.10E-03	3.92E-05
111-46-6	2,2''-oxydiethanol (diethylene glycol)	1.37E+01	1.00	2.50E-03	1.05E+00	6.85E-05	9.35E-04	8.91E-04
67-56-1	Methanol	3.98E+00	1.00	2.50E-03	1.30E-01	6.85E-05	2.72E-04	2.10E-03
7775-27-1	Sodium persulfate	7.82E+00	1.00	2.50E-03	2.35E+00	6.85E-05	5.36E-04	2.29E-04
61788-90-7	Amine oxides, cocoalkyldimethyl	2.97E+00	1.00	2.50E-03	2.80E-01	6.85E-05	2.04E-04	7.27E-04
100-52-7	Benzaldehyde	1.95E+00	1.00	2.50E-03	1.05E+00	6.85E-05	1.34E-04	1.27E-04
64-17-5	Ethanol	1.41E+00	1.00	2.50E-03	8.40E+01	6.85E-05	9.67E-05	1.15E-06
64742-47-8	Hydrotreated light petroleum distillate	1.39E+00	1.00	2.50E-03	3.50E+01	6.85E-05	9.55E-05	2.73E-06
61791-00-2	Fatty acids, tall-oil, ethoxylated	9.58E-01	1.00	2.50E-03	3.50E+01	6.85E-05	6.56E-05	1.88E-06
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	8.07E-01	1.00	2.50E-03	1.75E+00	6.85E-05	5.53E-05	3.16E-05
71-36-3	Butyl alcohol	7.06E-01	1.00	2.50E-03	4.38E+00	6.85E-05	4.83E-05	1.10E-05
68131-39-5	Alcohols, C12-15, ethoxylatedB	7.08E-01	1.00	2.50E-03	1.75E+00	6.85E-05	4.85E-05	2.77E-05
68551-12-2	Alcohols, C12-16, ethoxylatedB	7.72E-01	1.00	2.50E-03	1.75E+00	6.85E-05	5.29E-05	3.02E-05
107-13-1	Acrylonitrile	7.93E-02	1.00	2.50E-03	8.75E-03	6.85E-05	5.43E-06	6.21E-04
111-30-8	Glutaraldehyde	8.51E-01	1.00	2.50E-03	1.40E-01	6.85E-05	5.83E-05	4.16E-04
14808-60-7	Crystalline silica, quartz	2.46E+01	1.00	2.50E-03	3.00E-03	6.85E-05	1.69E-03	5.62E-01
							Total Threshold Risk (mixture)	**0.7**

Summary of Risk to Workers - Hybrid Recipe
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Stimulation Fluid in Hydraulic Fracturing	
HYBRID Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.03
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.08
Inhalation of mist from the evaporation units	0.74
Total Risk	**0.85**

Appendix B

Chemical Risk Assessment Hydraulic Fracture Stimulation Fluid – HAL HVFR

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment
Acetic acid	64-19-7	1.05	1050.64	0.0032%	1,103	0.0032%	35	Acid	Acute endpoints: Fish = 75 mg/L, Daphnia EC50 = 32 mg/L Chronic endpoints: Daphnia = 150 mg/L	Based on Chronic: Low	Readily biodegradable	Not Bio accumulative (Based on log Kow = -0.136)	Tier 2	1.03E-05	2.63E-06	5.72E-05	7.01E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Acrylamide acrylate copolymer	9003-06-9	0.75	1991.54	0.0061%	1,494	0.0043%	47	Scale Inhibitor	96 hour LC50 for fish = 1 400 mg/L 48 hour EC50 for Daphnia magna = 1 200 mg/L 21 day EC50 for Daphnia magna = 680 mg/L 21 day NOEC for algae = 380 mg/L	Based on Chronic: Low	Polymers are not readily biodegradable, hence they meet the screening criteria for persistence.	Polymers are expected to have very high molecular weights and poor water solubility. They are not expected to be bioavailable.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Acrylamide, sodium acrylate polymer	25987-30-8	0.75	19778.02	0.0603%	14,834	0.0424%	472	Corrosion Inhibitor	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) EC50 (48h) 0.14 mg/L (Daphnia magna) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) NOEC 4.4 mg/L (Pimephales promelas, juvenile)	96 hour LC50 for fish = 1 400 mg/L 48 hour EC50 for Daphnia magna = 1 200 mg/L 21 day EC50 for Daphnia magna = 680 mg/L 21 day NOEC for algae = 380 mg/L	Based on Chronic: Low	Polymers are not readily biodegradable, hence they meet the screening criteria for persistence.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Alcohols, C10-16, ethoxylated propoxylated	69227-22-1	0.94	1950.67	0.0059%	1,834	0.0052%	58	Friction Reducer, Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa EC50 (48h) 0.14 mg/L (Daphnia magna) ErC50 (48h) 0.7 mg/L (Skeletonema costatum) ErC50 (16.9h) > 10 g/L (Pseudomonas putida)	Based on Acute: Very high	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	4.10E-04	5.41E-02	2.28E-03	5.68E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-15, ethoxylated	68131-39-5	0.867	1679.39	0.0051%	1,456	0.0042%	46	Friction Reducer, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	3.25E-04	2.21E-04	1.81E-03	2.36E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-16, ethoxylated	68551-12-2	0.97	1.25	0.0000%	1	0.0000%	0	Corrosion Inhibitor, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	2.70E-07	1.11E-04	1.51E-06	1.13E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C6-12, ethoxylated propoxylated	68937-66-6	0.94	5461.88	0.0166%	5,134	0.0147%	163	Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) EC50 (48h) 0.14 mg/L (Daphnia magna) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) NOEC 4.4 mg/L (Pimephales promelas, juvenile)	Based on Chronic: Moderate	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	1.15E-03	6.38E-05	6.39E-03	7.60E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	0.9	1843.23	0.0056%	1,659	0.0047%	53	Surfactant	LC50 (96h) 6.7 mg/L (Danio rerio) (similar substance) LC50 (21d) = 0.1 mg/L (Daphnia magna) LC50 (48h) = 2.15 mg/L EC50 (72h) 2.2 mg/L (Scendesmus subspicatus) (similar substance)	Based on Chronic: High	Readily biodegradable (read across)	No based on Log Kow of 3	Tier 2	3.71E-04	1.22E-02	2.06E-03	1.46E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amine oxides, cocoalkyldimethyl	61788-90-7	0.716	6.50	0.0000%	5	0.0000%	0	Corrosion Inhibitor	LC50/EC50/ErC50 values: 0.60-32 mg/L for fish 0.50-10.8 mg/L for Daphnia magna 0.010-5.30 mg/L for algae NOEC/ EC20: 0.010-1.72 mg/L for algae 0.28 mg/L for Daphnia 0.31 mg/L for fish	Based on Chronic: Very High	Readily biodegradable	No based on the calculated Log Kow of <2.7 and BCF <87	Tier 2	6.50E-06	3.08E-04	3.62E-05	3.51E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Benzaldehyde	100-52-7	1.0415	2.94	0.0000%	3	0.0000%	0	Corrosion Inhibitor	Acute LC50 for freshwater fish is 1.07 mg/L, freshwater invertebrates is 16.2 mg/L and EC10 for freshwater algae is 20 mg/L. Chronic NOEC for freshwater fish is 0.12 mg/L.	Based on Chronic: High	Expected to be readily biodegradable	No based on Log Pow of 1.4	Tier 2	1.14E-06	2.01E-06	6.35E-06	9.49E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Butyl alcohol	71-36-3	0.81	1791.35	0.0055%	1,451	0.0041%	46	Surfactant	Fish, LC50 (96h) 1376 mg/l Invertebrates, EC50 (48h) 1328 mg/L) Algae, EC50 (96h) 225 mg/L EC10 (17h) Pseudomonas putida = 2476 mg/L Chronic NOECrepro (21d) = 4.1 mg/L for Daphnia magna	Based on Chronic: Moderate	Readily biodegradable	No based on low log Kow values of 1	Tier 2	1.30E-04	1.38E-04	7.22E-04	9.90E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Choline Chloride	67-48-1	1.1	31430.04	0.0958%	34,573	0.0988%	1099	Clay Stabiliser	96-hour fish LC50 value is >100 mg/L 48-hour in vertebrate EC50 is 349 mg/L 72-hour EC50 to Pseudokirchneriella subcapitata is >1,000 mg/L 21-day Daphnia NOEC value is 30.2 mg/L	Based on Chronic: Low	Choline chloride is readily biodegradable and thus it does not meet the screening criteria for persistence.	Not Bioaccumulative (based on a measured log Kow of -3.77 and a calculated BCF of 0.59)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Cinnamaldehyde	104-55-2	1.048	20.95	0.0001%	22	0.0001%	1	Corrosion Inhibitor	Danio rerio (Zebrafish) 96 h LC50 = 3.1 mg/L; Daphnia magna (Water flea) 48 h EC50 = 3.86 mg/L; Pseudokirchneriella subcapitata (Green algae) 72 h EC50 = 4.07 mg/L. 72 h NOEC value = 2.0 mg/L Pseudokirchneriella subcapitata (Green algae)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.23E-06	2.93E-06	6.83E-06	1.10E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Citric acid	77-92-9	1.542	144.39	0.0004%	223	0.0006%	7	Corrosion Inhibitor	LC50/EC50 > 100 mg/L (fish, daphnia, algae) 8 day NOEC = 425 mg/L (algae)	Based on Chronic: Low	Readily biodegradable	No based on low log Kow	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Diethanolamine	111-42-2	1.1	133.12	0.0004%	146	0.0004%	5	Breaker Activiator	Fish 96-h LC50 = 1370 mg/l Invertebrates 48-h EC50 = 55 mg/l Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l Microorganisms 16-h TTC = 16 mg/l Daphnia magna, the NOEC (21 days) was 0.78 mg/l	Based on Chronic: High	Readily biodegradable	No. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16	Tier 2	1.17E-03	2.42E-05	6.51E-03	7.70E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment
Diethylene glycol	111-46-6	1.12	19.09	0.0001%	21	0.0001%	1	Corrosion Inhibitor	LC 50 = >100 mg/L (fish, invertebrates, algae)	Based on Acute: Low	Readily biodegradable	No based on the estimated BCF of 3	Tier 2	7.96E-06	1.53E-07	4.44E-05	5.25E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethanol	64-17-5	0.7864	3692.09	0.0113%	2,903	0.0083%	92	Surfactant	LC50/EC50 > 1000 mg/L (fish, daphnia, algae) NOEC for invertebrates is 9.6 mg/L (10 day reproduction), plants it is 280 mg/L (7 day study)	Based on Chronic: High	Readily biodegradable	No based on calculated logBCF=0.5	Tier 2	1.35E-05	3.34E-06	7.53E-05	9.21E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethoxylated branched C13 alcohol	68439-54-3	0.8	1019.49	0.0031%	816	0.0023%	26		96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No.	Tier 2	1.82E-04	8.88E-05	1.02E-03	1.29E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethylene glycol	107-21-1	1.11	2040.97	0.0062%	2,265	0.0065%	72	Crosslinker	LC50 for fish = 22800 mg/L LC50 for Daphnia =7800 mg/L NOEC for Algae =100 mg/L	Based on Acute: Low	Readily biodegradable	No based on the measured log Kow of -1.36 and a measured BCF of 10	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Fatty acids, tall-oil, ethoxylated	61791-00-2	1.054	1869.83	0.0057%	1,971	0.0056%	63	Surfactant	96h-LL50 > 100 mg/L (fish) 48h-EL50 = 12.41 mg/L (invertebrates) 72h-EL50 = 39.7 mg/L (algae) 72h-EL10 = 7.08 mg/L (algae)	Based on Acute: High	Readily biodegradable (read across)	No based on low BCF values of < 100 L/kg ww	Tier 2	2.20E-05	2.14E-04	1.23E-04	3.58E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hydrochloric acid	7647-01-0	1.152	4292.88	0.0131%	4,945	0.0141%	157	Acid	Algae = 0.492 mg/L Daphnia = 0.492 mg/L Fish = 4.92 mg/L Daphnia (chronic) = 62 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	Acute Toxicity Only	Acute Toxicity Only	Acute Toxicity Only	Acute Toxicity Only	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hydrotreated light petroleum distillate	64742-47-8	0.8	18843.51	0.0574%	15,075	0.0431%	479	Friction Reducer, Surfactant	96 hr LL50 was 2 to 5 mg/L (fish) 48 hr EL50 was 1.4 mg/L (daphnia) 21 d NOEL = 0.48 mg/L (daphnia)	Based on Chronic: High	Readily biodegradable	Yes based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight	Tier 2	1.68E-04	1.52E-01	9.38E-04	1.53E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Methanol	67-56-1	0.791	191.40	0.0006%	151	0.0004%	5	Corrosion Inhibitor, Surfactant	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	No based on the Log Kow of -0.74	Tier 2	4.55E-04	6.68E-05	2.54E-03	3.06E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Polyethylene glycol	25322-68-3	1.21	341.37	0.0010%	413	0.0012%	13	Scale Inhibitor	LC50 = 100 mg/L (fish) LC50 = 1000 mg/L (invertebrates) EC 50 = 15.91 mg/L (algae)	Based on Acute: Moderate	Expected to be readily biodegradable	No based on BCF of 3.2	Tier 2	5.77E-06	5.68E-09	3.21E-05	3.79E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sobitan, mono-9-octadecenoate, (Z)	1338-43-8	1.06	1002.94	0.0031%	1,063	0.0030%	34	Surfactant	96 h LC50 for fish = 75 mg/L	Based on Acute: Low	Readily biodegradable	No. Based on a calculated BCF of 2.832 and a BAF of 36.4	Tier 2	4.75E-06	1.10E-04	2.65E-05	1.41E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium bisulfite	7631-90-5	2.44	614.20	0.0019%	1,499	0.0043%	48	Scale Inhibitor	72h-EC50 = 36.8 mg sodium sulfite/L (alga) NOEC of >8.41 mg sodium sulfite/L (Daphnia)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.59E-05	3.05E-11	8.88E-05	1.05E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium diacetate	126-96-5	1.01	941.81	0.0029%	951	0.0027%	30	pH buffer	96 h LC 50 for fish = 184.7 mg/L 48h EC 50 for daphnia > 141 mg/L 72 h EC50 for algae = 164 mg/L	Based on Acute: Low	Readily biodegradable	No. Based on a log Kow of -3.72 and a calculated BCF of 3.16	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium hydroxide	1310-73-2	1.515	1213.57	0.0037%	1,839	0.0053%	58	pH buffer	Measured acute endpoints for fish (196 mg/L). Measured chronic endpoint for Daphnia (240 mg/L)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	Acute toxicity only (irritant and corrosive), not systemically available in body	Acute toxicity only (irritant and corrosive), not systemically available in body	Acute toxicity only (irritant and corrosive), not systemically available in body	Acute toxicity only (irritant and corrosive), not systemically available in body	Acute toxicity only (irritant and corrosive), not systemically available in body
Sodium iodide	7681-82-5	3.67	0.33	0.0000%	1	0.0000%	0	Corrosion Inhibitor	96 hour LC50 for fish is > 860 mg/l 7 days NOEC for fish is 100 mg/L 48hrs-EC50 for Daphnia magna is 1.27 mg/L NOEC for algae is 66 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A.(Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium polyacrylate	9003-04-7	1.32	3013.30	0.0092%	3,978	0.0114%	126	Gelling Agent	96 hr LC50 for fish is >1000 mg/L NOEC from a chronic early life stage test for the fathead minnow is 56 mg/L 48 hr LC50 for Dapnia magna is >1000 mg/L NOEC for a 21day chronic reproductive test on Daphnia magna is 5.6 mg/L EC10 for Scenedesmus is 180 mg/L	Based on Chronic: Moderate to low	Sodium polyacrylate has limited biodegradation potential and thus meets the screening criteria for persistence.	Bioaccumulation of sodium polyacrylate is unlikely due to the high molecular weight of the polymer.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sorbitan monooleate polyoxyethylene derivative	9005-65-6	1.06	915.65	0.0028%	971	0.0028%	31	Surfactant	EC50 in algae was reported to be 100 mg/L	Based on Acute: Low	Not readily biodegradable	No. Based on a log Kow of -2.03 and a calculated BCF of 3.16	Tier 2	1.08E-05	1.77E-11	6.04E-05	7.12E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Tributyl tetradecyl phosphonium chloride	81741-28-8	0.95	936.32	0.0029%	890	0.0025%	28	Biocide	LC50: (96 hour) 0.46 mg/L (Oncorhynchus mykiss) LC50: (96 hour) 0.06 mg/l (Lepomis macrochirus) LC50: (96 hour) 0.58 mg/l (fish) TLM96: 1.6 mg/l (Crangon crangon) TLM48: 0.025 mg/l (Daphnia magna Modelled acute endpoint: Daphnia is 16.788 mg/L Fish is 1059.2530 mg/L	Based on Acute: Very high	Not available, however it has been observed to biodegrade in sediment.	Not bioaccumulative (Based on an estimated log Kow value of 6.26)	Tier 2	Acute toxicity only	Acute toxicity only	Acute toxicity only	Acute toxicity only	Acute toxicity only
Sodium perborate tetrahydrate	10486-00-7	0.65	3060.09	0.0093%	1,989	0.0057%	63	TBD	96hr LC50 for fish is estimated to be 2610 mg/L 48 hr LC50 for daphnids is estimated to be 1241 mg/L 96 hr EC50 for algae is estimated to be 444 mg/L	Based on Acute: Low	Readily biodegradable (read across)	Not bioaccumulative	Tier 2	4.44E-03	3.70E-06	2.48E-02	2.92E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
																Total Risk	**0.28**	The calculated risks associated with potential exposure to COPC identified in flowback water, where the HVFR Recipe is used and assuming 100% mass recovery is below the target of 1, respectively. Hence, chronic health risks are considered to be low and acceptable.

Notes
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using Commonwealth of Australia 2013 Ecotoxicity Assessment Guidelines (presented as Table 4 in the Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019))
3- Biodegradation assessed as per Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019) and Australian Government Department of Health National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
BCF - Bioconcentration Factor
NA - Not Applicable
TBD - To be determined
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DOE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures									
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well														
1319-33-1	Boronatrocalcite/Ulexite[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated[B]	0.5	D	1.21E-04	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated[B]	0.5	D	2.87E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
64-19-7	Acetic acid	12	D	5.56E-04	EPI				42	converted from RFD		1200	NICNAS (2017)	100	NICNAS (2017)
25322-68-3	Polyethylene glycol	8	D	2.14E-06	EPI				28	converted from RFD		8000	REACH	1000	D
7631-90-5	Sodium bisulfite[C]	10.5	D	4.16E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
104-55-2	Cinnamaldehyde	2	D	5.20E-03	EPI				7	converted from RFD		200	NTP (2004); REACH	100	D
67-56-1	Methanol	0.037	D	3.19E-04	EPI				0.13	converted from RFD		3.7	NICNAS (2017)	100	NICNAS (2017)
61788-90-7	Amine oxides, cocoalkyldimethyl	0.08	D	1.03E-01	EPI				0.28	converted from RFD		80	OECD (2001)	1000	D
100-52-7	Benzaldehyde	0.3	D	3.83E-03	EPI				1.05	converted from RFD		300	OECD (2002); REACH; NICNAS	1000	D
64-17-5	Ethanol	24	D	5.38E-04	EPI				84	converted from RFD		2400	NICNAS (2017)	100	NICNAS (2017)
64742-47-8	Hydrotreated light petroleum distillate	10	D	1.96E+00	EPI				35	converted from RFD		1000	NICNAS (2017)	100	NICNAS (2017)
61791-00-2	Fatty acids, tall-oil, ethoxylated	10	D	2.11E-02	EPI				35	converted from RFD		1000	REACH	100	D
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	0.5	D	7.14E-02	EPI				1.75	converted from RFD		50	USEPA (2010)	100	D
71-36-3	Butyl alcohol	1.25	D	2.31E-03	EPI				4.375	converted from RFD		125	OECD (2001)/NICNAS	100	D
68131-39-5	Alcohols, C12-15, ethoxylated[B]	0.5	D	1.48E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
68551-12-2	Alcohols, C12-16, ethoxylated[B]	0.5	D	8.97E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
107-13-1	Acrylonitrile	0.0025	D	1.16E-03	EPI				0.00875	converted from RFD		0.25	OECD (2005); NICNAS	100	D
111-42-2	Diethanolamine	0.014	D	4.51E-05	EPI				0.049	converted from RFD		14	REACH; OECD (2002); NICNAS	1000	D
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI				0.14	converted from RFD		4	NICNAS (2017)	100	NICNAS (2017)
102-71-6	Triethanol amine	1.25	D	4.93E-05	EPI				4.375	converted from RFD		125	NICNAS (2017)	100	NICNAS (2017)
7758-19-2	Chlorous acid, sodium salt	0.039	D	8.27E-09	EPI				0.1365	converted from RFD		3.9	NICNAS (2017)	100	NICNAS (2017)
12008-41-2	Disodium octaborate tetrahydrate[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
7775-27-1	Sodium persulfate	0.67	D	7.05E-07	EPI				2.345	converted from RFD		67	NICNAS (2017)	100	NICNAS (2017)
68439-54-3	Ethoxylated branched C13 alcohol	0.5	D	1.06E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)	25	JECFA	5.02E-02	EPI				87.5	converted from RFD		-	JECFA(1973); US FDA; FSANZ (2018)	-	-
9005-65-6	Sorbitan monooleate polyoxyethylene derivative	10	EFSA	3.54E-09	EPI				35	converted from RFD		-	EFSA (2017)	-	-
111-46-6	2,2''-oxydiethanol (diethylene glycol)	0.3	D	4.17E-05	EPI				1.05	converted from RFD		300	Health Council of the Netherlands (2007); NICNAS	1000	D
7631-90-5	Sodium bisulfate[C]	10.5	D	9.29E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
14808-60-7	Crystalline silica, quartz	Not toxic via oral/dermal exposure							0.003	USEPA (2019)		-	-	-	-
10486-00-7	Sodium perborate tetrahydrate	0.05	D	1.81E-06	EPI				0.175	converted from RFD		50	REACH	1000	D

Notes:

A - Read across data from Boric Acid

B - Read across data from Alcohol ethoxylates C6-C12

C - Read across data from Sodium Sulfite

References:

D - Derived (refer to individual Toxicity Profiles)

EFSA - European Food Safety Authority

EPI - USEPA Estimation Programs Interface (EPI) Suite

FSANZ - Food Standards Australia New Zealand

J- JECFA - Joint FAO/WHO Expert Committee on Food Additives

NICNAS - National Industrial Chemicals Notification and Assessment Scheme. Assessed at https://www.nicnas.gov.au/

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

NTP - US Department of Health and Serices National Toxicology Program

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - HVFR Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Toxicity Data				Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% Chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
64-19-7	Acetic acid		1.2E+01		1.2E+01	35.08	1.5E-07	1.2E-04	--	1.0E-05
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	58.31	2.4E-07	2.0E-04	--	4.1E-04
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	46.30	1.9E-07	1.6E-04	--	3.3E-04
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	0.04	1.6E-10	1.4E-07	--	2.7E-07
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	163.27	6.8E-07	5.7E-04	--	1.1E-03
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	52.75	2.2E-07	1.9E-04	--	3.7E-04
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	0.15	6.2E-10	5.2E-07	--	6.5E-06
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	0.10	4.1E-10	3.4E-07	--	1.1E-06
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	46.14	1.9E-07	1.6E-04	--	1.3E-04
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	0.70	2.9E-09	2.5E-06	--	1.2E-06
111-42-2	Diethanolamine		1.4E-02		1.4E-02	4.66	1.9E-08	1.6E-05	--	1.2E-03
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	0.68	2.8E-09	2.4E-06	--	8.0E-06
64-17-5	Ethanol		2.4E+01		2.4E+01	92.33	3.9E-07	3.2E-04	--	1.4E-05
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	62.67	2.6E-07	2.2E-04	--	2.2E-05
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	479.38	2.0E-06	1.7E-03	--	1.7E-04
67-56-1	Methanol		3.7E-02		3.7E-02	4.81	2.0E-08	1.7E-05	--	4.6E-04
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	13.14	5.5E-08	4.6E-05	--	5.8E-06
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)		2.5E+01		2.5E+01	33.81	1.4E-07	1.2E-04	--	4.7E-06
9005-65-6	Sorbitan monooleate polyoxyethylene derivative		1.0E+01		1.0E+01	30.86	1.3E-07	1.1E-04	--	1.1E-05
10486-00-7	Sodium perborate tetrahydrate		5.0E-02		5.0E-02	63.25	2.6E-07	2.2E-04	--	4.4E-03
68439-54-3	Ethoxylated branched C13 alcohol		5.0E-01		5.0E-01	25.94	1.1E-07	9.1E-05	--	1.8E-04
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	47.66	2.0E-07	1.7E-04	--	1.6E-05
								Total Risk (mixture)		**8.90E-03**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - HVFR Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = SAw*ET*CF*EF*ED / BW*AT	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
64-19-7	Acetic acid		1.2E+01		1.2E+01	5.6E-4	35.08	3.8E-08	3.2E-05	--	2.6E-06
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	2.9E-1	58.31	3.2E-05	2.7E-02	--	5.4E-02
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	1.5E-3	46.30	1.3E-07	1.1E-04	--	2.2E-04
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	9.0E-1	0.04	6.6E-08	5.6E-05	--	1.1E-04
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	1.2E-4	163.27	3.8E-08	3.2E-05	--	6.4E-05
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	7.1E-2	52.75	7.2E-06	6.1E-03	--	1.2E-02
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	1.0E-1	0.15	2.9E-08	2.5E-05	--	3.1E-04
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	3.8E-3	0.10	7.2E-10	6.0E-07	--	2.0E-06
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	2.3E-3	46.14	2.1E-07	1.7E-04	--	1.4E-04
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	5.2E-3	0.70	7.0E-09	5.9E-06	--	2.9E-06
111-42-2	Diethanolamine		1.4E-02		1.4E-02	4.5E-5	4.66	4.0E-10	3.4E-07	--	2.4E-05
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	4.2E-5	0.68	5.5E-11	4.6E-08	--	1.5E-07
64-17-5	Ethanol		2.4E+01		2.4E+01	5.4E-4	92.33	9.6E-08	8.0E-05	--	3.3E-06
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	2.1E-2	62.67	2.5E-06	2.1E-03	--	2.1E-04
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	2.0E+0	479.38	1.8E-03	1.5E+00	--	1.5E-01
67-56-1	Methanol		3.7E-02		3.7E-02	3.2E-4	4.81	3.0E-09	2.5E-06	--	6.7E-05
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	2.1E-6	13.14	5.4E-11	4.5E-08	--	5.7E-09
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)		2.5E+01		2.5E+01	5.0E-2	33.81	3.3E-06	2.7E-03	--	1.1E-04
9005-65-6	Sorbitan monooleate polyoxyethylene derivative		1.0E+01		1.0E+01	3.5E-9	30.86	2.1E-13	1.8E-10	--	1.8E-11
10486-00-7	Sodium perborate tetrahydrate		5.0E-02		5.0E-02	1.8E-6	63.25	2.2E-10	1.8E-07	--	3.7E-06
68439-54-3	Ethoxylated branched C13 alcohol		5.0E-01		5.0E-01	1.1E-3	25.94	5.3E-08	4.4E-05	--	8.9E-05
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	4.2E-9	47.66	3.8E-13	3.2E-10	--	3.1E-11
									Total Risk (mixture)		**2.19E-01**

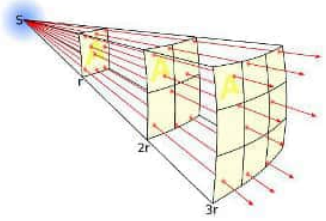
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - HVFR Recipe

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state concentrations
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water mg/L	Generation rate of chemical in volume mg/hr	Driftable Aerosol Emission Factor L/m^3
64-19-7	Acetic acid	35.08	12629.04069	2.500000E-03
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated	58.31	20991.25298	2.500000E-03
68131-39-5	Alcohols, C12-15, ethoxylatedB	46.30	16668.49372	2.500000E-03
68551-12-2	Alcohols, C12-16, ethoxylatedB	0.04	13.84454389	2.500000E-03
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB	163.27	58775.50834	2.500000E-03
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	52.75	18991.02585	2.500000E-03
61788-90-7	Amine oxides, cocoalkyldimethyl	0.15	53.27067097	2.500000E-03
100-52-7	Benzaldehyde	0.10	35.01861274	2.500000E-03
71-36-3	Butyl alcohol	46.14	16610.81728	2.500000E-03
104-55-2	Cinnamaldehyde	0.70	251.2913171	2.500000E-03
111-42-2	Diethanolamine	4.66	1676.321009	2.500000E-03
111-46-6	2,2"-oxydiethanol (diethylene glycol)	0.68	244.7772451	2.500000E-03
64-17-5	Ethanol	92.33	33238.54124	2.500000E-03
61791-00-2	Fatty acids, tall-oil, ethoxylated	62.67	22561.59975	2.500000E-03
64742-47-8	Hydrotreated light petroleum distillate	479.38	172575.2226	2.500000E-03
67-56-1	Methanol	4.81	1733.209245	2.500000E-03
25322-68-3	Polyethylene glycol	13.14	4728.6147	2.500000E-03
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)	33.81	12170.50102	2.500000E-03
9005-65-6	Sorbitan monooleate polyoxyethylene deriv	30.86	11111.21667	2.500000E-03
10486-00-7	Sodium perborate tetrahydrate	63.25	22770.58133	2.500000E-03
68439-54-3	Ethoxylated branched C13 alcohol	25.94	9336.793624	2.500000E-03
7631-90-5	Sodium bisulfiteC	47.66	17156.33574	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - HVFR Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.000	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
64-19-7	Acetic acid	3.51E+01	1.00	2.50E-03	4.20E+01	6.85E-05	2.40E-03	5.72E-05
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB	5.83E+01	1.00	2.50E-03	1.75E+00	6.85E-05	3.99E-03	2.28E-03
68131-39-5	Alcohols, C12-15, ethoxylatedB	4.63E+01	1.00	2.50E-03	1.75E+00	6.85E-05	3.17E-03	1.81E-03
68551-12-2	Alcohols, C12-16, ethoxylatedB	3.85E-02	1.00	2.50E-03	1.75E+00	6.85E-05	2.63E-06	1.51E-06
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB	1.63E+02	1.00	2.50E-03	1.75E+00	6.85E-05	1.12E-02	6.39E-03
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	5.28E+01	1.00	2.50E-03	1.75E+00	6.85E-05	3.61E-03	2.06E-03
61788-90-7	Amine oxides, cocoalkyldimethyl	1.48E-01	1.00	2.50E-03	2.80E-01	6.85E-05	1.01E-05	3.62E-05
100-52-7	Benzaldehyde	9.73E-02	1.00	2.50E-03	1.05E+00	6.85E-05	6.66E-06	6.35E-06
71-36-3	Butyl alcohol	4.61E+01	1.00	2.50E-03	4.38E+00	6.85E-05	3.16E-03	7.22E-04
104-55-2	Cinnamaldehyde	6.98E-01	1.00	2.50E-03	7.00E+00	6.85E-05	4.78E-05	6.83E-06
111-42-2	Diethanolamine	4.66E+00	1.00	2.50E-03	4.90E-02	6.85E-05	3.19E-04	6.51E-03
111-46-6	2,2"-oxydiethanol (diethylene glycol)	6.80E-01	1.00	2.50E-03	1.05E+00	6.85E-05	4.66E-05	4.44E-05
64-17-5	Ethanol	9.23E+01	1.00	2.50E-03	8.40E+01	6.85E-05	6.32E-03	7.53E-05
61791-00-2	Fatty acids, tall-oil, ethoxylated	6.27E+01	1.00	2.50E-03	3.50E+01	6.85E-05	4.29E-03	1.23E-04
64742-47-8	Hydrotreated light petroleum distillate	4.79E+02	1.00	2.50E-03	3.50E+01	6.85E-05	3.28E-02	9.38E-04
67-56-1	Methanol	4.81E+00	1.00	2.50E-03	1.30E-01	6.85E-05	3.30E-04	2.54E-03
25322-68-3	Polyethylene glycol	1.31E+01	1.00	2.50E-03	2.80E+01	6.85E-05	9.00E-04	3.21E-05
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)	3.38E+01	1.00	2.50E-03	8.75E+01	6.85E-05	2.32E-03	2.65E-05
9005-65-6	Sorbitan monooleate polyoxyethylene derivative	3.09E+01	1.00	2.50E-03	3.50E+01	6.85E-05	2.11E-03	6.04E-05
10486-00-7	Sodium perborate tetrahydrate	6.33E+01	1.00	2.50E-03	1.75E-01	6.85E-05	4.33E-03	2.48E-02
68439-54-3	Ethoxylated branched C13 alcohol	2.59E+01	1.00	2.50E-03	1.75E+00	6.85E-05	1.78E-03	1.02E-03
7631-90-5	Sodium bisulfiteC	4.77E+01	1.00	2.50E-03	3.68E+01	6.85E-05	3.26E-03	8.88E-05
							Total Risk (mixture)	**0.050**

Summary of Risk to Workers - HVFR Recipe
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Stimulation Fluid in Hydraulic Fracturing	
HVFR Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.0089
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.22
Inhalation of mist from the evaporation units	0.050
Total Risk	**0.28**

Appendix C

Chemical Risk Assessment Hydraulic Fracture Stimulation Fluid – HAL SW

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Choline Chloride	67-48-1	1.1	24720	0.0848%	27192	0.0869%	977	Clay Stabiliser	96-hour fish LC50 value is >100 mg/L 48-hour in vertebrate EC50 is 349 mg/L 72-hour EC50 to Pseudokirchneriella subcapitata is >1,000 mg/L 21-day Daphnia NOEC value is 30.2 mg/L	Based on Chronic: Low	Choline chloride is readily biodegradable and thus it does not meet the screening criteria for persistence.	Not Bioaccumulative (based on a measured log Kow of -3.77 and a calculated BCF of 0.59)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Hydrochloric acid	7647-01-0	1.152	23649	0.0811%	27244	0.0871%	979	Acid	Algae (acute) = 0.492 mg/L Daphnia (acute) = 0.492 mg/L Fish (acute) = 4.92 mg/L Daphnia (chronic) = 62 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only
Alcohols, C6-12, ethoxylated propoxylated	68937-66-6	0.94	10,206	0.0350%	9,593	0.0307%	345	Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) EC50 (48h) 0.14 mg/L (Daphnia magna) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) NOEC 4.4 mg/L (Pimephales promelas, juvenile)	Based on Chronic: Moderate	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	2.42E-03	1.35E-04	1.35E-02	1.60E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C10-16, ethoxylated propoxylated	69227-22-1	0.94	5,253	0.0180%	4,938	0.0158%	177	Friction Reducer, Surfactant	LC50 (96h) 0.59 mg/L (Pleuronectes platessa EC50 (48h) 0.14 mg/L (Daphnia magna) ErC50 (48h) 0.7 mg/L (Skeletonema costatum) ErC50 (16.9h) > 10 g/L (Pseudomonas putida)	Based on Acute: Very high	Expected to be readily biodegradable based on similar substances	Not Bio accumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	1.25E-03	1.64E-01	6.94E-03	1.73E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium polyacrylate	9003-04-7	1.32	3723	0.0128%	4914	0.0157%	177		96 hr LC50 for fish is >1000 mg/L NOEC from a chronic early life stage test for the fathead minnow is 56 mg/L 48 hr LC50 for Dapnia magna is >1000 mg/L NOEC for a 21day chronic reproductive test on Daphnia magna is 5.6 mg/L EC10 for Scenedesmus is 180 mg/L	Based on Chronic: Moderate to low	Sodium polyacrylate has limited biodegradation potential and thus meets the screening criteria for persistence.	Bioaccumulation of sodium polyacrylate is unlikely due to the high molecular weight of the polymer.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium Chloride	7647-14-5	2.165	3476	0.0119%	7525	0.0241%	270	Stabiliser	EC50 = 400 to 30000 mg/L EC50 Fish = 1290 mg/L NOEC = 314 mg/L (Daphnia)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value	Low chronic toxicity, insufficient data to establish toxicity value
Acrylamide acrylate copolymer	25987-30-8	0.75	3309	0.0113%	2482	0.0079%	89	Scale Inhibitor	96 hour LC50 for fish = 1 400 mg/L 48 hour EC50 for Daphnia magna = 1 200 mg/L 21 day EC50 for Daphnia magna = 680 mg/L 21 day NOEC for algae = 380 mg/L	Based on Chronic: Low	Polymers are not readily biodegradable, hence they meet the screening criteria for persistence.	Polymers are expected to have very high molecular weights and poor water solubility. They are not expected to be bioavailable.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Acetic acid	64-19-7	1.05	2859	0.0098%	3002	0.0096%	108	Acid	Acute endpoints: Fish = 75 mg/L, Daphnia EC50 = 32 mg/L Chronic endpoints: Daphnia = 150 mg/L	Based on Chronic: Low	Readily biodegradable	Not Bio accumulative (Based on log Kow = -0.136)	Tier 2	3.16E-05	8.07E-06	1.76E-04	2.15E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Tributyl tetradecyl phosphonium chloride	81741-28-8	0.95	2370	0.0081%	2251	0.0072%	81	Biocide	LC50: (96 hour) 0.46 mg/L (Oncorhynchus mykiss) LC50: (96 hour) 0.06 mg/l (Lepomis macrochirus) LC50: (96 hour) 0.58 mg/l (fish) TLM96: 1.6 mg/l (Crangon crangon) TLM48: 0.025 mg/l (Daphnia magna Modelled acute endpoint: Daphnia is 16.788 mg/L Fish is 1059.2530 mg/L	Based on Acute: Very high	Not available, however it has been observed to biodegrade in sediment.	Not bioaccumulative (Based on an estimated log Kow value of 6.26)	Tier 2	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only	NA. Acute toxity only
Polyethylene glycol	25322-68-3	1.21	2059	0.0071%	2491	0.0080%	89	Scale Inhibitor	LC50 = 100 mg/L (fish) LC50 = 1000 mg/L (invertebrates) EC 50 = 15.91 mg/L (algae)	Based on Acute: Moderate	Expected to be readily biodegradable	No based on BCF of 3.2	Tier 2	3.93E-05	3.87E-08	2.19E-04	2.58E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium bisulfite	7631-90-5	1.348	1876	0.0064%	2529	0.0081%	91	Scale Inhibitor	72h-EC50 = 36.8 mg sodium sulfite/L (alga) NOEC of >8.41 mg sodium sulfite/L (Daphnia)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	3.04E-05	5.81E-11	1.69E-04	2.00E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethylene glycol	107-21-1	1.11	1558	0.0053%	1729	0.0055%	62	Crosslinker	LC50 for fish = 22800 mg/L LC50 for Daphnia =7800 mg/L NOEC for Algae =100 mg/L	Based on Acute: Low	Readily biodegradable	No based on the measured log Kow of -1.36 and a measured BCF of 10	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Cinnamaldehyde	104-55-2	1.048	1459	0.0050%	1529	0.0049%	55	Corrosion Inhibitor	Danio rerio (Zebrafish) 96 h LC50 = 3.1 mg/L; Daphnia magna (Water flea) 48 h EC50 = 3.86 mg/L; Pseudokirchneriella subcapitata (Green algae) 72 h EC50 = 4.07 mg/L. 72 h NOEC value = 2.0 mg/L Pseudokirchneriella subcapitata (Green algae)	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	9.64E-05	2.31E-04	5.37E-04	8.64E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Diethylene glycol	111-46-6	1.12	736	0.0025%	825	0.0026%	30	Corrosion Inhibitor	LC 50 = >100 mg/L (fish, invertebrates, algae)	Based on Acute: Low	Readily biodegradable	No based on the estimated BCF of 3	Tier 2	3.47E-04	6.65E-06	1.93E-03	2.29E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Methanol	67-56-1	0.791	730	0.0025%	578	0.0018%	21	Corrosion Inhibitor, Surfactant	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	No based on the Log Kow of -0.74	Tier 2	1.96E-03	2.88E-04	1.09E-02	1.32E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amine oxides, cocoalkyldimethyl	61788-90-7	0.716	483	0.0017%	346	0.0011%	12	Corrosion Inhibitor	LC50/EC50/ErC50 values: 0.60-32 mg/L for fish 0.50-10.8 mg/L for Daphnia magna 0.010-5.30 mg/L for algae NOEC/ EC20: 0.010-1.72 mg/L for algae 0.28 mg/L for Daphnia 0.31 mg/L for fish	Based on Chronic: Very High	Readily biodegradable	No based on the calculated Log Kow of <2.7 and BCF <87	Tier 2	5.45E-04	2.58E-02	3.04E-03	2.94E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium hydroxide	1310-73-2	1.515	458	0.0016%	694	0.0022%	25	pH buffer	Measured acute endpoints for fish (196 mg/L). Measured chronic endpoint for Daphnia (240 mg/L)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body
Citric acid	77-92-9	1.542	336	0.0012%	518	0.0017%	19	Corrosion Inhibitor	LC50/EC50 > 100 mg/L (fish, daphnia, algae) 8 day NOEC = 425 mg/L (algae)	Based on Chronic: Low	Readily biodegradable	No based on low log Kow	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Benzaldehyde	100-52-7	1.0415	332	0.0011%	346	0.0011%	12	Corrosion Inhibitor	Acute LC50 for freshwater fish is 1.07 mg/L, freshwater invertebrates is 16.2 mg/L and EC10 for freshwater algae is 20 mg/L. Chronic NOEC for freshwater fish is 0.12 mg/L.	Based on Chronic: High	Expected to be readily biodegradable	No based on Log Pow of 1.4	Tier 2	1.45E-04	2.56E-04	8.10E-04	1.21E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ethanol	64-17-5	0.7864	328	0.0011%	258	0.0008%	9	Surfactant	LC50/EC50 > 1000 mg/L (fish, daphnia, algae) NOEC for invertebrates is 9.6 mg/L (10 day reproduction), plants it is 280 mg/L (7 day study)	Based on Chronic: High	Readily biodegradable	No based on calculated logBCF=0.5	Tier 2	1.36E-06	3.36E-07	7.56E-06	9.25E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hydrotreated light petroleum distillate	64742-47-8	0.8	303	0.0010%	242	0.0008%	9	Friction Reducer, Surfactant	96 hr LL50 was 2 to 5 mg/L (fish) 48 hr EL50 was 1.4 mg/L (daphnia) 21 d NOEL = 0.48 mg/L (daphnia)	Based on Chronic: High	Readily biodegradable	Yes based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight	Tier 2	3.05E-06	2.75E-03	1.70E-05	2.77E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Fatty acids, tall-oil, ethoxylated	61791-00-2	1.054	235	0.0008%	248	0.0008%	9	Surfactant	96h-LL50 > 100 mg/L (fish) 48h-EL50 = 12.41 mg/L (invertebrates) 72h-EL50 = 39.7 mg/L (algae) 72h-EL10 = 7.08 mg/L (algae)	Based on Acute: High	Readily biodegradable (read across)	No based on low BCF values of < 100 L/kg ww	Tier 2	3.12E-06	3.03E-05	1.74E-05	5.08E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	0.9	125	0.0004%	112	0.0004%	4	Surfactant	LC50 (96h) 6.7 mg/L (Danio rerio) (similar substance) LC50 (21d) = 0.1 mg/L (Daphnia magna) LC50 (48h) = 2.15 mg/L EC50 (72h) 2.2 mg/L (Scendesmus subspicatus) (similar substance)	Based on Chronic: High	Readily biodegradable (read across)	No Log Kow 3	Tier 2	2.83E-05	9.31E-04	1.58E-04	1.12E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Butyl alcohol	71-36-3	0.81	116	0.0004%	94	0.0003%	3	Surfactant	Fish, LC50 (96h) 1376 mg/l Invertebrates, EC50 (48h) 1328 mg/L) Algae, EC50 (96h) 225 mg/L EC10 (17h) Pseudomonas putida = 2476 mg/L Chronic NOECrepro (21d) = 4.1 mg/L for Daphnia magna	Based on Chronic: Moderate	Readily biodegradable	No based on low log Kow values of 1	Tier 2	9.45E-06	1.00E-05	5.26E-05	7.21E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-15, ethoxylated	68131-39-5	0.867	103	0.0004%	89	0.0003%	3	Friction Reducer, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	2.25E-05	1.53E-05	1.26E-04	1.63E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Alcohols, C12-16, ethoxylated	68551-12-2	0.97	69	0.0002%	67	0.0002%	2	Corrosion Inhibitor, Surfactant	96 h LC50 Oncorhynchus mykiss was 5 - 7 mg/L Lepomis macrochirus, NOEC (30 days) was 0.11 – 0.33 mg/L. Daphnia magna, EC50 (48 h) was 2.5 mg/L. Daphnia magna, NOEC (21 days) was 0.77 – 1.75 mg/L. Green algae, EC50 (96 h) was 1.4 mg/L. EC50 (3 h) for microorganisms was 140 mg/L.	Based on Chronic: High	Readily biodegradable	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.	Tier 2	1.68E-05	6.93E-03	9.36E-05	7.04E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium iodide	7681-82-5	3.67	47	0.0002%	171	0.0005%	6	Corrosion Inhibitor	96 hour LC50 for fish is > 860 mg/l 7 days NOEC for fish is 100 mg/L 48hrs-EC50 for Daphnia magna is 1.27 mg/L NOEC for algae is 66 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A.(Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Acrylonitrile	107-13-1	0.806	45	0.0002%	36	0.0001%	1	Surfactant	96h LC50 for freshwater fish = 10 - 20 mg/l 96h LC50 for saltwater fish 8.6 mg/l 48h EC50 for Daphnia = 7.6 mg/l 30d NOEC for fish of 0.17 mg/l	Based on Chronic: High	Biodegradable	No based on the low log Pow (0.00-0.30)	Tier 2	1.81E-03	9.67E-04	1.01E-02	1.29E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Diethanolamine	111-42-2	1.1	43	0.0001%	48	0.0002%	2	Breaker Activiator	Fish 96-h LC50 = 1370 mg/l Invertebrates 48-h EC50 = 55 mg/l Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l Microorganisms 16-h TTC = 16 mg/l Daphnia magna, the NOEC (21 days) was 0.78 mg/l	Based on Chronic: High	Readily biodegradable	No. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16	Tier 2	4.29E-04	8.89E-06	2.39E-03	2.83E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Glutaraldehyde	111-30-8	1.05	23	0.0001%	24	0.0001%	1	Biocide	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproducfn Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 2	7.47E-05	1.12E-05	4.16E-04	5.02E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
																Total Risk	**0.26**	The calculated risks associated with potential exposure to COPC identified in flowback water, where the SW Recipe is used and assuming 100% mass recovery is below the target of 1, respectively. Hence, chronic health risks are considered to be low and acceptable.

Notes
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using Commonwealth of Australia 2013 Ecotoxicity Assessment Guidelines (presented as Table 4 in the Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019)
3- Biodegradation assessed as per Northern Territory Government Draft Guideline for the Preparation of an Environment Management Plan under the Petroleum Regulations (2019) and Australian Government Department of Health National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
BCF - Bioconcentration Factor
NA - Not Applicable
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DOE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures									
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well														
1319-33-1	Boronatrocalcite/Ulexite[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylated[B]	0.5	D	1.21E-04	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
69227-22-1	Alcohols, C10-16, ethoxylated propoxylated[B]	0.5	D	2.87E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
64-19-7	Acetic acid	12	D	5.56E-04	EPI				42	converted from RFD		1200	NICNAS (2017)	100	NICNAS (2017)
25322-68-3	Polyethylene glycol	8	D	2.14E-06	EPI				28	converted from RFD		8000	REACH	1000	D
7631-90-5	Sodium bisulfite[C]	10.5	D	4.16E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
104-55-2	Cinnamaldehyde	2	D	5.20E-03	EPI				7	converted from RFD		200	NTP (2004); REACH	100	D
67-56-1	Methanol	0.037	D	3.19E-04	EPI				0.13	converted from RFD		3.7	NICNAS (2017)	100	NICNAS (2017)
61788-90-7	Amine oxides, cocoalkyldimethyl	0.08	D	1.03E-01	EPI				0.28	converted from RFD		80	OECD (2001)	1000	D
100-52-7	Benzaldehyde	0.3	D	3.83E-03	EPI				1.05	converted from RFD		300	OECD (2002); REACH; NICNAS	1000	D
64-17-5	Ethanol	24	D	5.38E-04	EPI				84	converted from RFD		2400	NICNAS (2017)	100	NICNAS (2017)
64742-47-8	Hydrotreated light petroleum distillate	10	D	1.96E+00	EPI				35	converted from RFD		1000	NICNAS (2017)	100	NICNAS (2017)
61791-00-2	Fatty acids, tall-oil, ethoxylated	10	D	2.11E-02	EPI				35	converted from RFD		1000	REACH	100	D
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	0.5	D	7.14E-02	EPI				1.75	converted from RFD		50	USEPA (2010)	100	D
71-36-3	Butyl alcohol	1.25	D	2.31E-03	EPI				4.375	converted from RFD		125	OECD (2001)/NICNAS	100	D
68131-39-5	Alcohols, C12-15, ethoxylated[B]	0.5	D	1.48E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
68551-12-2	Alcohols, C12-16, ethoxylated[B]	0.5	D	8.97E-01	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
107-13-1	Acrylonitrile	0.0025	D	1.16E-03	EPI				0.00875	converted from RFD		0.25	OECD (2005); NICNAS	100	D
111-42-2	Diethanolamine	0.014	D	4.51E-05	EPI				0.049	converted from RFD		14	REACH; OECD (2002); NICNAS	1000	D
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI				0.14	converted from RFD		4	NICNAS (2017)	100	NICNAS (2017)
102-71-6	Triethanol amine	1.25	D	4.93E-05	EPI				4.375	converted from RFD		125	NICNAS (2017)	100	NICNAS (2017)
7758-19-2	Chlorous acid, sodium salt	0.039	D	8.27E-09	EPI				0.1365	converted from RFD		3.9	NICNAS (2017)	100	NICNAS (2017)
12008-41-2	Disodium octaborate tetrahydrate[A]	0.096	D	9.14E-04	EPI (as boric acid)				0.336	converted from RFD		9.6	NICNAS (2017)	100	NICNAS (2017)
7775-27-1	Sodium persulfate	0.67	D	7.05E-07	EPI				2.345	converted from RFD		67	NICNAS (2017)	100	NICNAS (2017)
68439-54-3	Ethoxylated branched C13 alcohol	0.5	D	1.06E-03	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
1338-43-8	Sobitan, mono-9-octadecenoate, (Z)	25	JECFA	5.02E-02	EPI				87.5	converted from RFD		-	JECFA(1973); US FDA; FSANZ (2018)	-	-
9005-65-6	Sorbitan monooleate polyoxyethylene derivative	10	EFSA	3.54E-09	EPI				35	converted from RFD		-	EFSA (2017)	-	-
111-46-6	2,2''-oxydiethanol (diethylene glycol)	0.3	D	4.17E-05	EPI				1.05	converted from RFD		300	Health Council of the Netherlands (2007); NICNAS	1000	D
7631-90-5	Sodium bisulfate[C]	10.5	D	9.29E-09	EPI				36.75	converted from RFD		1050	NICNAS (2017)	100	NICNAS (2017)
14808-60-7	Crystalline silica, quartz	Not toxic via oral/dermal exposure							0.003	USEPA (2019)		-	-	-	-
10486-00-7	Sodium perborate tetrahydrate	0.05	D	1.81E-06	EPI				0.175	converted from RFD		50	REACH	1000	D

Notes:

A - Read across data from Boric Acid

B - Read across data from Alcohol ethoxylates C6-C12

C - Read across data from Sodium Sulfite

References:

D - Derived (refer to individual Toxicity Profiles)

EFSA - European Food Safety Authority

EPI - USEPA Estimation Programs Interface (EPI) Suite

FSANZ - Food Standards Australia New Zealand

J- JECFA - Joint FAO/WHO Expert Committee on Food Additives

NICNAS - National Industrial Chemicals Notification and Assessment Scheme. Assessed at https://www.nicnas.gov.au/

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

NTP - US Department of Health and Serices National Toxicology Program

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09**	**NonThreshold**
		3.5E-06	**Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Toxicity Data				Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% Chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	344.58	1.4E-06	1.2E-03	--	2.4E-03
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	177.36	7.4E-07	6.2E-04	--	1.2E-03
64-19-7	Acetic acid		1.2E+01		1.2E+01	107.82	4.5E-07	3.8E-04	--	3.2E-05
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	89.47	3.7E-07	3.1E-04	--	3.9E-05
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	90.84	3.8E-07	3.2E-04	--	3.0E-05
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	54.91	2.3E-07	1.9E-04	--	9.6E-05
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	29.63	1.2E-07	1.0E-04	--	3.5E-04
67-56-1	Methanol		3.7E-02		3.7E-02	20.75	8.7E-08	7.3E-05	--	2.0E-03
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	12.42	5.2E-08	4.4E-05	--	5.5E-04
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	12.42	5.2E-08	4.4E-05	--	1.5E-04
64-17-5	Ethanol		2.4E+01		2.4E+01	9.27	3.9E-08	3.3E-05	--	1.4E-06
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	8.69	3.6E-08	3.1E-05	--	3.1E-06
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	8.89	3.7E-08	3.1E-05	--	3.1E-06
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	4.03	1.7E-08	1.4E-05	--	2.8E-05
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	3.36	1.4E-08	1.2E-05	--	9.4E-06
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	3.21	1.3E-08	1.1E-05	--	2.3E-05
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	2.39	1.0E-08	8.4E-06	--	1.7E-05
107-13-1	Acrylonitrile		2.5E-03		2.5E-03	1.29	5.4E-09	4.5E-06	--	1.8E-03
111-42-2	Diethanolamine		1.4E-02		1.4E-02	1.71	7.1E-09	6.0E-06	--	4.3E-04
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	0.85	3.6E-09	3.0E-06	--	7.5E-05
								Total Risk (mixture)		**9.19E-03**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = $\frac{SAw*ET*CF*EF*ED}{BW*AT}$	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical		Toxicity Data				Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	Dermal Permeability	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB		5.0E-01		5.0E-01	1.2E-4	344.58	8.0E-08	6.7E-05	--	1.3E-04
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB		5.0E-01		5.0E-01	2.9E-1	177.36	9.8E-05	8.2E-02	--	1.6E-01
64-19-7	Acetic acid		1.2E+01		1.2E+01	5.6E-4	107.82	1.2E-07	9.7E-05	--	8.1E-06
25322-68-3	Polyethylene glycol		8.0E+00		8.0E+00	2.1E-6	89.47	3.7E-10	3.1E-07	--	3.9E-08
7631-90-5	Sodium bisulfiteC		1.1E+01		1.1E+01	4.2E-9	90.84	7.3E-13	6.1E-10	--	5.8E-11
104-55-2	Cinnamaldehyde		2.0E+00		2.0E+00	5.2E-3	54.91	5.5E-07	4.6E-04	--	2.3E-04
111-46-6	2,2"-oxydiethanol (diethylene glycol)		3.0E-01		3.0E-01	4.2E-5	29.63	2.4E-09	2.0E-06	--	6.7E-06
67-56-1	Methanol		3.7E-02		3.7E-02	3.2E-4	20.75	1.3E-08	1.1E-05	--	2.9E-04
61788-90-7	Amine oxides, cocoalkyldimethyl		8.0E-02		8.0E-02	1.0E-1	12.42	2.5E-06	2.1E-03	--	2.6E-02
100-52-7	Benzaldehyde		3.0E-01		3.0E-01	3.8E-3	12.42	9.1E-08	7.7E-05	--	2.6E-04
64-17-5	Ethanol		2.4E+01		2.4E+01	5.4E-4	9.27	9.6E-09	8.1E-06	--	3.4E-07
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	2.0E+0	8.69	3.3E-05	2.8E-02	--	2.8E-03
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	2.1E-2	8.89	3.6E-07	3.0E-04	--	3.0E-05
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)		5.0E-01		5.0E-01	7.1E-2	4.03	5.5E-07	4.7E-04	--	9.3E-04
71-36-3	Butyl alcohol		1.3E+00		1.3E+00	2.3E-3	3.36	1.5E-08	1.3E-05	--	1.0E-05
68131-39-5	Alcohols, C12-15, ethoxylatedB		5.0E-01		5.0E-01	1.5E-3	3.21	9.1E-09	7.7E-06	--	1.5E-05
68551-12-2	Alcohols, C12-16, ethoxylatedB		5.0E-01		5.0E-01	9.0E-1	2.39	4.1E-06	3.5E-03	--	6.9E-03
107-13-1	Acrylonitrile		2.5E-03		2.5E-03	1.2E-3	1.29	2.9E-09	2.4E-06	--	9.7E-04
111-42-2	Diethanolamine		1.4E-02		1.4E-02	4.5E-5	1.71	1.5E-10	1.2E-07	--	8.9E-06
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	3.3E-4	0.85	5.3E-10	4.5E-07	--	1.1E-05
									Total Risk (mixture)		**2.0E-1**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

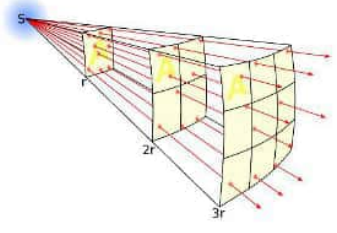
Aerosol Exposure - SW Recipe

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state concentrations were calculated. The 'inverse square law' was then applied to approximate the air concentration at a distance from the virtual air box. This law assumes that the density of the spray droplets is inversely proportional to the square of the distance from the source. That is, the further away a receptor is from the spray source, the density of the droplets (and therefore the concentration) will decrease.

An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.
2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
68937-66-6	Alcohols, C6-12, ethoxylated propoxyla	344.58	124049.7383	2.500000E-03
69227-22-1	Alcohols, C10-16, ethoxylated propoxyl	177.36	63849.13002	2.500000E-03
64-19-7	Acetic acid	107.82	38815.27443	2.500000E-03
25322-68-3	Polyethylene glycol	89.47	32209.40603	2.500000E-03
7631-90-5	Sodium bisulfiteC	90.84	32700.84622	2.500000E-03
104-55-2	Cinnamaldehyde	54.91	19768.14867	2.500000E-03
111-46-6	2,2"-oxydiethanol (diethylene glycol)	29.63	10665.31447	2.500000E-03
67-56-1	Methanol	20.75	7469.078692	2.500000E-03
61788-90-7	Amine oxides, cocoalkyldimethyl	12.42	4472.513177	2.500000E-03
100-52-7	Benzaldehyde	12.42	4470.713715	2.500000E-03
64-17-5	Ethanol	9.27	3338.494405	2.500000E-03
64742-47-8	Hydrotreated light petroleum distillate	8.69	3130.000401	2.500000E-03
61791-00-2	Fatty acids, tall-oil, ethoxylated	8.89	3201.205801	2.500000E-03
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyetl	4.03	1452.129696	2.500000E-03
71-36-3	Butyl alcohol	3.36	1210.554971	2.500000E-03
68131-39-5	Alcohols, C12-15, ethoxylatedB	3.21	1154.770361	2.500000E-03
68551-12-2	Alcohols, C12-16, ethoxylatedB	2.39	861.0898092	2.500000E-03
107-13-1	Acrylonitrile	1.29	464.4655534	2.500000E-03
111-42-2	Diethanolamine	1.71	615.1041839	2.500000E-03
111-30-8	Glutaraldehyde	0.85	306.4351619	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Aerosol for Threshold Effects/ADI)

CAS	Chemical	Concentration in Water	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Quotient (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
68937-66-6	Alcohols, C6-12, ethoxylated propoxylatedB	3.45E+02	1.00	2.50E-03	1.75E+00	6.85E-05	2.36E-02	1.35E-02
69227-22-1	Alcohols, C10-16, ethoxylated propoxylatedB	1.77E+02	1.00	2.50E-03	1.75E+00	6.85E-05	1.21E-02	6.94E-03
64-19-7	Acetic acid	1.08E+02	1.00	2.50E-03	4.20E+01	6.85E-05	7.38E-03	1.76E-04
25322-68-3	Polyethylene glycol	8.95E+01	1.00	2.50E-03	2.80E+01	6.85E-05	6.13E-03	2.19E-04
7631-90-5	Sodium bisulfiteC	9.08E+01	1.00	2.50E-03	3.68E+01	6.85E-05	6.22E-03	1.69E-04
104-55-2	Cinnamaldehyde	5.49E+01	1.00	2.50E-03	7.00E+00	6.85E-05	3.76E-03	5.37E-04
111-46-6	2,2''-oxydiethanol (diethylene glycol)	2.96E+01	1.00	2.50E-03	1.05E+00	6.85E-05	2.03E-03	1.93E-03
67-56-1	Methanol	2.07E+01	1.00	2.50E-03	1.30E-01	6.85E-05	1.42E-03	1.09E-02
61788-90-7	Amine oxides, cocoalkyldimethyl	1.24E+01	1.00	2.50E-03	2.80E-01	6.85E-05	8.51E-04	3.04E-03
100-52-7	Benzaldehyde	1.24E+01	1.00	2.50E-03	1.05E+00	6.85E-05	8.51E-04	8.10E-04
64-17-5	Ethanol	9.27E+00	1.00	2.50E-03	8.40E+01	6.85E-05	6.35E-04	7.56E-06
64742-47-8	Hydrotreated light petroleum distillate	8.69E+00	1.00	2.50E-03	3.50E+01	6.85E-05	5.96E-04	1.70E-05
61791-00-2	Fatty acids, tall-oil, ethoxylated	8.89E+00	1.00	2.50E-03	3.50E+01	6.85E-05	6.09E-04	1.74E-05
68155-20-4	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	4.03E+00	1.00	2.50E-03	1.75E+00	6.85E-05	2.76E-04	1.58E-04
71-36-3	Butyl alcohol	3.36E+00	1.00	2.50E-03	4.38E+00	6.85E-05	2.30E-04	5.26E-05
68131-39-5	Alcohols, C12-15, ethoxylatedB	3.21E+00	1.00	2.50E-03	1.75E+00	6.85E-05	2.20E-04	1.26E-04
68551-12-2	Alcohols, C12-16, ethoxylatedB	2.39E+00	1.00	2.50E-03	1.75E+00	6.85E-05	1.64E-04	9.36E-05
107-13-1	Acrylonitrile	1.29E+00	1.00	2.50E-03	8.75E-03	6.85E-05	8.84E-05	1.01E-02
111-42-2	Diethanolamine	1.71E+00	1.00	2.50E-03	4.90E-02	6.85E-05	1.17E-04	2.39E-03
111-30-8	Glutaraldehyde	8.51E-01	1.00	2.50E-03	1.40E-01	6.85E-05	5.83E-05	4.16E-04
							Total Risk (mixture)	**0.05**

Summary of Risk to Workers - SW Recipe
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Stimulation Fluid in Hydraulic Fracturing	
SW Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.01
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.20
Inhalation of mist from the evaporation units	0.05
Total Risk	**0.26**

Appendix D

Chemical Risk Assessment Hydraulic Fracture Stimulation Fluid – SLB Hybrid

SLB HVFR/SW Recipe

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Hydrochloric acid	7647-01-0	1.35	17,034	0.001136098	22,996	0.001	1,646	Algae = 0.492 mg/L Daphnia = 0.492 mg/L Fish = 4.92 mg/L Daphnia (chronic) = 62 mg/L	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA
2-hydroxy-N,N,N-trimethylethanaminium chloride	67-48-1	1.1	20,782	0.001386039	22,860	0.001	1,636	96-hour fish LC50 value is >100 mg/L 48-hour in vertebrate EC50 is 349 mg/L 72-hour EC50 to Pseudokirchneriella subcapitata is >1,000 mg/L 21-day Daphnia NOEC value is 30.2 mg/L	Based on Chronic: Low	Choline chloride is readily biodegradable and thus it does not meet the screening criteria for persistence.	Not Bioaccumulative (based on a measured log Kow of -3.77 and a calculated BCF of 0.59)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Guar gum	9000-30-0	1	10,461	0.00069769	10,461	0.001	749	lowest measured ecotoxicity endpoint for fish was reported to be 218 mg/L.	Based on Acute: Low	Guar gum is a naturally occurring polysaccharide which would be expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence	Not Bioaccumulative based on the molecular weight of guar gum (ranges from 200,000 to 300,000 daltons), and it is also water soluble.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Ethylene glycol	107-21-1	1.24	7,893	0.000526442	9,788	0.001	701	LC50 for fish = 22800 mg/L LC50 for Daphnia =7800 mg/L NOEC for Algae =100 mg/L	Based on Acute: Low	Readily biodegradable	No based on the measured log Kow of -1.36 and a measured BCF of 10	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
2-Propenoic acid, polymer with sodium phosphinate	129898-01-7	1.18	5,126	0.00034189	6,049	0.000	433	Aquatic Toxicity Acute Aquatic - Fish -96-hr LC50 Rianbow Trout - >1,000 mg/L -96-hr LC50 Zebra Fish - >1,000 mg/L Acute Aquatic - Invertebrate -24-hr EC50 Daphnia - 320 mg/L -72-hr EC50 - 130 mg/L	Based on acute: Low	The polymer is not readily biodegradable, hence it meets the screening criteria for persistence.	The polymer is expected to have a very high molecular weight and poor water solubility. It is not expected to be bioavailable, hence this polymer does not meet the criteria for bioaccumulation.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Ulexite	1319-33-1	1.36	4,157	0.000277258	5,654	0.000	405	Fish toxicity: Rainbow Trout (S.gairdneri) 24 day LC50 = 150.0 mg/B/L 36 day NOEC-LOEC = 0.75-1 mg/B/L Invertebrate toxicity: LC50 to Daphnia magna Straus = 133 mg B/L (48 h). 21-day NOEC-LOEC = 6-13 mg B/L.	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.48E-02	6.23E-03	8.25E-02	1.04E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Acrylamide sodium acrylate copolymer	25085-02-3	0.8	4,104	0.000273724	3,283	0.000	235	Limited information is available. The polymer is expected to be a low concern for toxicity to aquatic organisms. Due to its poor solubility and high molecular weight, it is not expected to be bioavailable. It does not contain any reactive functional groups.	No data	The polymer is not readily biodegradable, hence it meets the screening criteria for persistence	The polymer is expected to have a very high molecular weight and poor water solubility. It is not expected to be bioavailable, hence this polymer does not meet the criteria for bioaccumulation.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium bromate	7789-38-0	3.3	801	5.34218E-05	2,643	0.000	60	Short term toxicity to fish: 1- to 10-d LC50s ranging from 698.0 to 278.6 mg/l BrO3-, respectively for Juvenile spot. Short term toxicity to aquatic algae and cynobacteria: 72h EC50 value was 603.5 (189.3 – n.d.) mg/L for Yield. Short term toxicity to Invertebrates: 24hr LC50 of 112.7 mg/L Daphnia magna 48 hr LC50 of 55.3 mg/L Daphnia magna 72 hr LC50 of 46.8 mg/L Daphnia magna 96hr LC50 46.8 mg/L Daphnia magna 72 hr EC50 of 15954 mg/L for Isochrysis galbana (Haptophyte algae) 24 hr EC50 of 170 mg/L for Crassostrea gigas (Pacific oyster) larvae	Based on acute: Moderate	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Tier 2	7.02E-02	1.22E-07	3.91E-01	4.62E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium hydroxide	1310-73-2	1.3	1,997	0.000133176	2,596	0.000	186	Measured acute endpoints were available for fish (196 mg/L). Measured chronic endpoint were available for Daphnia (240 mg/L)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA
Diammonium peroxidisulphate	7727-54-0	1.98	1,078	7.18771E-05	2,134	0.000	153	Acute Aquatic - Fish -96-hr LC50 Oncorhynchus - 76.3 mg/L -48-hr EC50 Daphnia magnaL - 120 mg/L -72-hr EC10 Phaedactylum tricornutum - 320 mg/L Acute Aquatic - Invertebrate -Daphnia magna reproduction test - NOEC of 20.8 mg/L	Based on acute: Moderate	No. Not applicable, inorganic salt, ionic species ubiquitous in environment.	No. Not applicable, inorganic salt, ionic species ubiquitous in environment.	Tier 2	2.55E-02	1.18E-02	1.42E-01	1.80E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Poly(oxy-1,2-ethanediyl), alphahexyl-omega-hydroxy-	31726-34-8	1	1,663	0.000110883	1,663	0.000	119	Acute Aquatic - Fish -96-hr LC50 Oncorhynchus mykiss - 1,464 mg/L -96-hr LC50 Pimephales promelas - range from 1,580 mg/L - 2,137 mg/L -96 hr LC50 - Lepomis machrochirus - 1,490 mg/L Acute Aquatic - Invertebrate -48-hr EC50 Daphnia magna - range from - 881 mg/L - 2,650 mg/L Acute Aquatic - Algae and other aquatic plants -72-hr EC50 Pseudokirchneriella subcapitata - 911 mg/L -72-hr EC50 Selenastrum capricornutum - 720 mg/L Chronic Aquatic - Fish -21-day NOEC Brachydanio rerio - > 100 mg/L Chronic Aquatic - Invertebrate - 21-day NOEC Daphnia magna - 100 mg/L	Based on acute and chronic: Low	Readily biodegradable	Based on a log Kow value greater than 3, and a maximum BCF value of under 800 the substance is not bioaccumulative.	Tier 1	NA	NA	NA	NA	NA
Sodium Chloride	7647-14-5	1.18	1,025	6.83678E-05	1,210	0.000	87	EC50 = 400 to 30000 mg/L EC50 Fish = 1290 mg/L NOEC = 314 mg/L (Daphnia)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA
Glutaraldehyde	111-30-8	1.06	1,039	6.9302E-05	1,101	0.000	79	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduct'n Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 2	6.92E-03	1.04E-03	3.86E-02	4.65E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium Tetraborate Decahydrate	1303-96-4	1.36	460	3.06494E-05	625	0.000	45	Fish toxicity: Rainbow Trout (S.gairdneri) 24 day LC50 = 150.0 mg/B/L 36 day NOEC-LOEC = 0.75-1 mg/B/L Invertebrate toxicity: LC50 to Daphnia magna Straus = 133 mg B/L (48 h). 21-day NOEC-LOEC = 6-13 mg B/L.	Based on Chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.64E-03	6.88E-04	9.12E-03	1.14E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Calcium Chloride	10043-52-4	1.18	527	3.5118E-05	621	0.000	44	Acute Toxicity 96-hr LC50 value was 4,630 mg/L in fathead minnow (Pimephales promelas) 48-hr EC50 was 1,062 mg/L for Daphnia magna 72-hr EC50 = >4,000 for fresh water algae 72-hr EC50 = 2,900 mg/L for fresh water algae (biomass) Chronic Toxicity 21-day NOEC = 160 mg/L for Daphnia magna	Based on acute and chronic: Low	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Tier 1	NA	NA	NA	NA	NA
Vinylidene chloride/methylacrylate copolymer	25038-72-6	2	234	1.55772E-05	467	0.000	33	No data	No data	The polymers are synthetic addition polymers with stable carbon-chain backbones. If released to the environment, the polymers in this group are not expected to undergo rapid degradation	The polymer is expected to have a very high molecular weight and poor water solubility. Therefore, this polymer is considered to be not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
but-2-enedioic acid	110-17-8	1.36	109	7.29627E-06	149	0.000	11	Acute Aquatic -96-h LC50 Danio rerio - >100 mg/L -48-h EC50 daphnia magna - >100 mg/L -72-h EC50 Pseudokirchneriella subcapitata - >100 mg/L -48-hr EC50 Daphnia magna - 62,630 mg/L	Based on acute: Low	Fumaric acid is readily biodegradable and as such not persistent in the environment.	Based on the measured log Kow of <3 Fumaric acid is not bioaccumulative.	Tier 1	NA	NA	NA	NA	NA

SLB HVFR/SW Recipe

Chemical Name	CAS Number	Density (kg/L)	Volume of Chemical (L)	Volume Fraction (%v/v)	Chemical Mass in Fluid (kg)	Mass Fraction (% w/w)	Concentration in Injected Fluid (mg/L)	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Dicoco dimethyl quaternary ammonium chloride	61789-77-3	1	69	4.62013E-06	69	0.000	5.0	Short term toxicity data: Fish Lepomis macrochirus (Bluegill) 96 h LC50 = 1.04 mg/L Invertabrate Daphnia magna (Water flea) 48 h LC50 = 0.16 mg/L Algae Pseudokirchneriella subcapitata (Green algae) 96 h EC50 = 0.46 mg/L Long term toxicity data: Invertebrates Daphnia magna (Water flea) 21 d NOEC = 0.38 mg/L Algae Pseudokirchneriella subcapitata (Green algae) 96 h NOEC = 0.16 mg/L	Based on chronic: High	Not Persistent (Not P). Based on results obtained from biodegradation studies, all chemicals in this group are categorised as Not Persistent.	Not Bioaccumulative (Not B). Based on the available measured bioconcentration data, all chemicals in this group are categorised as Not Bioaccumulative.	Tier 2	1.74E-04	1.43E-02	9.70E-04	1.54E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Diethylene glycol	111-46-6	1.18	55	3.68601E-06	65	0.000	4.7	LC 50 = >100 mg/L (fish, invertebrates, algae)	Based on Acute: Low	Readily biodegradable	No based on the estimated BCF of 3	Tier 1	NA	NA	NA	NA	NA
Potassium Chloride	7447-40-7	1.19	28	1.843E-06	33	0.000	2.4	96 h LC50 in Pimephales promelas = 880 mg/L 48 h LC50 Lepomis macrochirus, Oncorhyncusmykiss and Ictalurus punctatus = 720 - 2010 mg/L 48 h EC50 Daphnia magna and Ceriodaphnia dubia were 660 and 630 mg/L respectively NOEC for Daphnia is 373 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Non-crystalline silica (impurity)	7631-86-9	1	26	1.74202E-06	26	0.000	1.9	Acute Aquatic -96-h LL0 Danio-rerio - 10,000 mg/L -24-h ECL50 Daphnia magna ->10,000 mg/L -72hr-NOEL (Scenedesmus subspicatus) - 10,000 mg/L	Based on acute: Low	Not applicable, inorganic substance, ubiquitous in environment.	Not applicable, inorganic substance, ubiquitous in environment.	Tier 1	NA	NA	NA	NA	NA
Talc	14807-96-6	2	7	4.79686E-07	14	0.000	1.0	No data	Based on low bioavailability: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Propan-2-ol	67-63-0	1	14	9.34125E-07	14	0.000	1.0	Short term toxicity data: 96-hour LC50 in Pimephales promelas is 9,640 mg/L 24- hour EC50 in Daphnia magna is >10,000 mg/L Long term toxicity data: 16- and 21-day NOEC values of 141 and 30 mg/L, respectively, for the freshwater invertebrate Daphnia magna 7-day toxicity threshold value of 1,800 mg/L for freshwater algae	Based on acute and chronic: Low	Expected to be readily biodegradable.	No. Based on a measured log Kow of 0.05 and a calculated BCF of 1, the substance is not bioaccumulative.	Tier 1	NA	NA	NA	NA	NA
Methanol	67-56-1	0.95	9	6.31165E-07	9	0.000	0.6	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	Not bioaccumulative based on the Log Kow of -0.74	Tier 1	NA	NA	NA	NA	NA
Diutan	595585-15-2	1.43	5	3.53453E-07	8	0.000	0.5	Acute Aquatic -96-h LC50 freshwater fish > 100 mg/L -48-h EC50 freshwater Daphnia >100 mg/L -72 h EC50 Freshwater algae > 100 mg/L	Based on acute: Low	Diutan expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence	Based on the molecular weight, water solubility and Kow value (log Kow -2.76) the polymer is not expected to bioaccumulate	Tier 1	NA	NA	NA	NA	NA
Diutan gum	125005-87-0	1.4	5	3.53453E-07	7	0.000	0.5	Acute Aquatic -96-h LC50 freshwater fish > 100 mg/L -48-h EC50 freshwater Daphnia >100 mg/L -72 h EC50 Freshwater algae > 100 mg/L	Based on acute: Low	Diutan expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence	Based on the molecular weight, water solubility and Kow value (log Kow -2.76) the polymer is not expected to bioaccumulate	Tier 1	NA	NA	NA	NA	NA
Fatty acids, tall-oil (CAS proprietary)		0.91	7	4.79686E-07	7	0.000	0.5	Acute Aquatic: fish 96h-LL50 > 100 mg/L aquatic invertebrates 48h-EL50 = 12.41 mg/L algae 72h-EL50 = 39.7 mg/L	Based on acute: Moderate	Expected to be readily biodegradable.	No based on estimated BCF values of < 100 L/kg	Tier 2	1.65E-07	1.60E-06	9.17E-07	2.68E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
poly(tetrafluoroethylene)	9002-84-0	2	3	2.01973E-07	6	0.000	0.4	No data	No data	Polymers are not expected to be readily biodegradable.	The polymer is not expected to bioaccumulate because of its poor water solubility and high molecular weight	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Thiourea, polymer with formaldehyde and 1-phenylethanone	68527-49-1	0.92	5	3.53453E-07	5	0.000	0.3	Fish: LC50 (96h) Morone saxatilis 6.18 mg/L LC50 (6d) embryos of Danio rerio 6.9 mg/L NOEC (28d) Oryzias latipes ≥ 48 mg/L Aquatic invertebrates: EC50 (48h) Daphnia pulex 5.8 mg/L NOEC (21 d) Daphnia magna > 6.4 mg/L Algae: EC50 (72h) Desmodesmus subspicatus 4.89 mg/L	Based on acute: High	Expected to be readily biodegradable.	No. Based on data for formaldehyde, due to the low log Kow (0.35), accumulation in organisms is not to be expected.	Tier 2	1.23E-06	5.64E-07	6.83E-06	8.62E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Aliphatic alcohols, ethoxylated #2 (proprietary CAS)		0.9	5	3.02959E-07	4	0.000	0.3	Toxicity to fish: LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96) 1.4 mg/L (Pimephales promelas) (similar substance) NOEC 4.4 mg/L (Pimephales promelas, juvenile) Toxicity to invertebrates: EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance) Toxicity to algae: EC50 (72h) 0.75 mg/L (Pseudokirchnerella subcapitata) (similar substance) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) (similar substance) CD10 8 mg/L (Pseudokirchneriella subapitata) EC10 2 mg/L (Brachionus calyciflorus) Toxicity to microorganisms: EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance)	Based on Chronic: Moderate	Expected to be readily biodegradable based on similar substances	Not Bioaccumulative (Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8)	Tier 2	2.06E-06	2.71E-04	1.15E-05	2.85E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Prop-2-yn-1-ol	107-19-7	0.87	2	1.26233E-07	2	0.000	0.1	LC50 (96h) of 1.53 mg/L for fish EC50 (48h) of 3.36 mg/L for invertebrates ErC50 (72h) >100 mg/L for algae	Based on acute: High	No. Expected to be readily biodegradable	No. As the Log KoW -0.35 @ 25 °C 59 (Log Pow < 4.5), it is not expected to be bioaccumulative.	Tier 2	8.28E-05	1.62E-05	4.61E-04	5.60E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hexadec-1-ene	629-73-2	0.88	1	7.57398E-08	1	0.000	0.1	Short term toxicity 96-hr LC50 > solubility Actual concentration negligible. Fish 96-hr LL0 = 1000 mg/L (nominal) Long term toxicity: NOEC (21 days) 19.4 µg/L (invertebrates)	Based on chronic: Very high	Expected to be readily biodegradable.	Not bioaccumulative	Tier 2	2.51E-06	2.28E-02	1.40E-05	2.28E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
															Total Risk	**8.42E-01**	The calculated risk associated with potential exposure to COPC identified in flowback water, where the SLB HVFR/SW recipe is used and assuming 100% mass recovery is below the target of 1. Hence, chronic health risks are considered to be low and acceptable.

Notes
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
BCF - Bioconcentration Factor
NA - Not Applicable
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures					
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Threshold Chronic TC or RfC (mg/m^3)		NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well										
1319-33-1	Boronatrocalcite/Ulexite[A]	0.096	D	9.14E-04	EPI (as boric acid)	0.336	converted from RFD	9.6	NICNAS (2017)	100	NICNAS (2017)
61791-00-2	Fatty acids, tall-oil, ethoxylated	10	D	2.11E-02	EPI	35	converted from RFD	1000	REACH	100	D
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI	0.14	converted from RFD	4	NICNAS (2017)	100	NICNAS (2017)
7789-38-0	Sodium bromate	0.003	A	3.78E-09	EPI	0.0105	converted from RFD	30	NHMRC (2021)	10000	D
61789-77-3	Dicoco dimethyl quaternary ammonium chloride	0.1	D	1.78E-01	EPI	0.350	converted from RFD	100	OECD (1996)	1000	D
629-73-2	Hexadec-1-ene	0.1	D	1.97E+01	EPI	0.350	converted from RFD	100	REACH	1000	D
7727-54-0	Diammonium peroxidisulphate	0.021	D	1.00E-03	EPI	0.074	converted from RFD	2.1	NICNAS (2017)	100	NICNAS (2017)
68951-67-7	Aliphatic alcohols, ethoxylated #2	0.5	D	2.87E-01	EPI	1.75	converted from RFD	50	NICNAS (2017)	100	NICNAS (2017)
1303-96-4	Sodium Tetraborate Decahydrate	0.096	D	9.14E-04	EPI (as boric acid)	0.336	converted from RFD	9.6	NICNAS (2017)	100	NICNAS (2017)
68527-49-1	Thiourea, polymer with formaldehyde and 1-phenylethanone	1	D	1.00E-03	EPI	3.5	converted from RFD	1000	NICNAS, NCBI, REACH	1000	D
107-19-7	Prop-2-yn-1-ol	0.005	D	4.24E-04	EPI	0.0175	converted from RFD	5	REACH, NCBI	1000	D

Notes:

A - Read across data from Boric Acid

#2 - Read across data from Alcohol ethoxylates C6-C12

References:

D - Derived (refer to individual Toxicity Profiles)

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - HVFR/SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical		Toxicity Data				Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% Chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
1319-33-1	Boronatrocalcite/UlexiteA		9.6E-02		9.6E-02	404.72	1.7E-06	1.4E-03	--	1.5E-02
7789-38-0	Sodium bromate		3.0E-03		3.0E-03	60.00	2.5E-07	2.1E-04	--	7.0E-02
7727-54-0	Diammonium peroxidisulphate		2.1E-02		2.1E-02	152.75	6.4E-07	5.4E-04	--	2.6E-02
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	78.85	3.3E-07	2.8E-04	--	6.9E-03
1303-96-4	Sodium Tetraborate Decahydrate		9.6E-02		9.6E-02	44.74	1.9E-07	1.6E-04	--	1.6E-03
61789-77-3	Dicoco dimethyl quaternary ammonium chloride		1.0E-01		1.0E-01	4.96	2.1E-08	1.7E-05	--	1.7E-04
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	0.47	2.0E-09	1.6E-06	--	1.6E-07
68527-49-1	Thiourea, polymer with formaldehyde and 1-phenylethanone		1.0E+00		1.0E+00	0.35	1.5E-09	1.2E-06	--	1.2E-06
68951-67-7	Aliphatic alcohols, ethoxylated #2		5.0E-01		5.0E-01	0.29	1.2E-09	1.0E-06	--	2.1E-06
107-19-7	Prop-2-yn-1-ol		5.0E-03		5.0E-03	0.12	4.9E-10	4.1E-07	--	8.3E-05
629-73-2	Hexadec-1-ene		1.0E-01		1.0E-01	0.07	3.0E-10	2.5E-07	--	2.5E-06
								Total Risk (mixture)		**1.19E-01**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - HVFR/SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = SAw*ET*CF*EF*ED / BW*AT	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

	Chemical	Toxicity Data					Concentration	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	Dermal Permeability	in Water	NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
1319-33-1	Boronatrocalcite/UlexiteA		9.6E-02		9.6E-02	9.1E-4	404.72	7.1E-07	6.0E-04	--	6.2E-03
7789-38-0	Sodium bromate		3.0E-03		3.0E-03	3.8E-9	60.00	4.4E-13	3.7E-10	--	1.2E-07
7727-54-0	Diammonium peroxidisulphate		2.1E-02		2.1E-02	1.0E-3	152.75	2.9E-07	2.5E-04	--	1.2E-02
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	3.3E-4	78.85	4.9E-08	4.1E-05	--	1.0E-03
1303-96-4	Sodium Tetraborate Decahydrate		9.6E-02		9.6E-02	9.1E-4	44.74	7.9E-08	6.6E-05	--	6.9E-04
61789-77-3	Dicoco dimethyl quaternary ammonium chloride		1.0E-01		1.0E-01	1.8E-1	4.96	1.7E-06	1.4E-03	--	1.4E-02
61791-00-2	Fatty acids, tall-oil, ethoxylated		1.0E+01		1.0E+01	2.1E-2	0.47	1.9E-08	1.6E-05	--	1.6E-06
68527-49-1	Thiourea, polymer with formaldehyde and 1-phenylethanone		1.0E+00		1.0E+00	1.0E-3	0.35	6.7E-10	5.6E-07	--	5.6E-07
68951-67-7	Aliphatic alcohols, ethoxylated #2		5.0E-01		5.0E-01	2.9E-1	0.29	1.6E-07	1.4E-04	--	2.7E-04
107-19-7	Prop-2-yn-1-ol		5.0E-03		5.0E-03	4.2E-4	0.12	9.6E-11	8.1E-08	--	1.6E-05
629-73-2	Hexadec-1-ene		1.0E-01		1.0E-01	2.0E+1	0.07	2.7E-06	2.3E-03	--	2.3E-02
									Total Risk (mixture)		**5.7E-02**

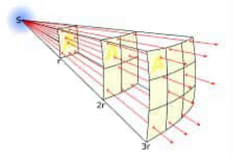
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - HVFR/SW Recipe

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
1319-33-1	Boronatrocalcite/UlexiteA	404.72	145697.8836	2.500000E-03
7789-38-0	Sodium bromate	60.00	21600	2.500000E-03
7727-54-0	Diammonium peroxidisulphate	152.75	54990.23214	2.500000E-03
111-30-8	Glutaraldehyde	78.85	28384.49093	2.500000E-03
1303-96-4	Sodium Tetraborate Decahydrate	44.74	16106.10369	2.500000E-03
61789-77-3	Dicoco dimethyl quaternary ammo	4.96	1785.188109	2.500000E-03
61791-00-2	Fatty acids, tall-oil, ethoxylated	0.47	168.6661334	2.500000E-03
68527-49-1	Thiourea, polymer with formaldehy	0.35	125.6460265	2.500000E-03
68951-67-7	Aliphatic alcohols, ethoxylated #2	0.29	105.3553638	2.500000E-03
107-19-7	Prop-2-yn-1-ol	0.12	42.43479931	2.500000E-03
629-73-2	Hexadec-1-ene	0.07	25.75353337	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - HVFR/SW Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
1319-33-1	Boronatrocalcite/UlexiteA	404.72	2.00	2.50E-03	3.36E-01	6.85E-05	2.77E-02	8.3E-02
7789-38-0	Sodium bromate	60.00	3.00	2.50E-03	1.05E-02	6.85E-05	4.11E-03	3.9E-01
7727-54-0	Diammonium peroxidisulphate	152.75	4.00	2.50E-03	7.35E-02	6.85E-05	1.05E-02	1.4E-01
111-30-8	Glutaraldehyde	78.85	6.00	2.50E-03	1.40E-01	6.85E-05	5.40E-03	3.9E-02
1303-96-4	Sodium Tetraborate Decahydrate	44.74	7.00	2.50E-03	3.36E-01	6.85E-05	3.06E-03	9.1E-03
61789-77-3	Dicoco dimethyl quaternary ammonium chloride	4.96	10.00	2.50E-03	3.50E-01	6.85E-05	3.40E-04	9.7E-04
61791-00-2	Fatty acids, tall-oil, ethoxylated	0.47	17.00	2.50E-03	3.50E+01	6.85E-05	3.21E-05	9.2E-07
68527-49-1	Thiourea, polymer with formaldehyde and 1-phenylethanone	0.35	18.00	2.50E-03	3.50E+00	6.85E-05	2.39E-05	6.8E-06
68951-67-7	Aliphatic alcohols, ethoxylated #2	0.29	19.00	2.50E-03	1.75E+00	6.85E-05	2.00E-05	1.1E-05
107-19-7	Prop-2-yn-1-ol	0.12	20.00	2.50E-03	1.75E-02	6.85E-05	8.07E-06	4.6E-04
629-73-2	Hexadec-1-ene	0.07	21.00	2.50E-03	3.50E-01	6.85E-05	4.90E-06	1.4E-05
							Total Threshold Risk (mixture)	**6.65E-01**

Summary of Risk to Workers - HVFR/SW Recipe
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Stimulation Fluid in Hydraulic Fracturing	
HYBRID Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.12
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.06
Inhalation of mist from the evaporation units	0.67
Total Risk	**0.8**

Appendix E

Chemical Risk Assessment – Drilling Fluid

Chemical Name	CAS Number	Concentration in Injected Fluid (mg/L)	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Alcohol, C11-14, ethoxylated	78330-21-9	1.5	96 h LC50, Oncorhynchus mykiss = 5 - 7 mg/L 30 d Lepomis macrochirus, NOEC = 0.11 – 0.33 mg/L. 48 h EC50 Daphnia magna = 2.5 mg/L. 21 d NOEC Daphnia magna = 0.77 – 1.75 mg/L. 96 h EC50 (green algae) = 1.4 mg/L EC50 (3 h) for microorganisms = 140 mg/L	Based on chronic: High	Readily biodegradable	Not bioaccumulative	Tier 2	1.1E-05	6.16E-03	2.9E-07	6.2E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Performatrol	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Tier 1	NA	NA	NA	NA	NA
Citric Acid, monohydrate	77-92-9	1	96 h LC50 fish = 440 to 1,516 mg/L 24 h EC50 value for invertebrates is 85 mg/L 7 d toxic limit concentration values for algae = 300 to 640 mg/L 8 d freshwater static test for the algae Scenedesmus quadricauda, NOEC = 425 mg/L	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Distillates, hydrotreated light	64742-47-8	1.5	Lowest acute endpoint for Daphnia = 0.018 mg/L (modelled)	Based on acute: Very high	Readily biodegradable	Yes based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight	Tier 2	5.3E-07	4.75E-04	2.9E-06	4.8E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Glutaraldehyde	111-30-8	0.3	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduct'n Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 2	2.6E-05	3.94E-06	1.5E-04	1.8E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Glyoxal <1%	107-22-2	2.2	96 h-LC50 fish = 215 mg/L Invertebrates EC50 > 100 mg/L NOEC fish = 119 mg/L (a.i.)	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 2	5.8E-05	1.57E-06	3.2E-04	3.8E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Methanol	67-56-1	0.3	Acute LC50s = 15,400 to 29,400 mg/L Invertebrates, chronic NOEC = 32,000 mg/L.	Based on acute: Low	Readily biodegradable	No based on the Log Kow of -0.74	Tier 2	2.8E-05	4.16E-06	1.6E-04	1.9E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Nitrilotriacetic acid, trisodium salt monohydrate	5064-31-3	1	Fish 96 h LC50 = 98 - 487 mg/L Fish NOEC = 54 mg/L Invertebrates NOEC = 9.3 mg/L	Based on chronic: Moderate	Readily biodegradable	No based on the Log Pow of -13.2	Tier 2	3.5E-04	1.83E-12	2.0E-03	2.3E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Plagioclase Feldspar/Kaolinite	1332-58-7	10	Daphnia pulex (water flea) 24- and 48-h LC50 >1.1 g/L P. trilineatum 12-h LC50 = 170 mg/L O. fasciatus 12-h LC50 = 710 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA
Poly Anionic Cellulose	9004-32-4	1.5	96 h LC50 for Brachydanio rerio is >2,500 mg/L 48 h LC50 for Daphnia magna is >5,000 mg/L; 96 h EC50 for Selenastrum capricornutum is 500 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Potassium Chloride	7447-40-7	18	96 h LC50 in Pimephales promelas = 880 mg/L 48 h LC50 Lepomis macrochirus, Oncorhyncusmykiss and Ictalurus punctatus = 720 - 2010 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Potassium Hydroxide	1310-58-3	0.3	96-hour fish LC50 value = 80 mg/L 48-hr invertebrate EC50 value = 40 mg/L 120-hr algae EC50 value = 1337 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA. Acute toxicity only (irritant and corrosive), not systemically available in body
Quartz/Cristobite	14808-60-7	10	acute data >10 g/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA. Not toxic via oral exposure as not absorbed via GI tract	NA. Not toxic via dermal exposure.	2.3E-01	2.3E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Smectite	12199-37-0	10	96 hr Oncorhynchus mykiss (Rainbow Trout) LC50 = 19000 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA
Sodium Bicarbonate	144-55-8	0.5	21 d Daphnia NOEC = 576 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium Carbonate	497-19-8	0.29	96-hour LC50 Bluegill sunfish (Lepomis macrochirus) = 300 mg/L 96-hour LC50 to mosquitofish (Gambusia affinis) = 740 mg/L 48-hour EC50 to the invertebrate Ceriodaphnia cf. dubia = 200 to 227 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	1.1E-05	1.49E-10	5.9E-05	6.9E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sodium Chloride	7647-14-5	17.61	acute endpoint for Fish = 1290 mg/L NOEC for Daphnia = 314 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium erythorbate	6381-77-7	0.2	96 h LC50 Fish > 100 mg/L 48 h EC50 Daphnia magna = 84 - 100 mg/L 72 h NOEC alga = 20 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Sodium hydroxide	1310-73-2	0.3	Measured acute endpoints for fish = 196 mg/L Measured chronic endpoint for Daphnia = 240 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	NA	NA	NA	NA	NA. Acute toxicity only (irritant and corrosive), not systemically available in body
Starch	9005-25-8	4	Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	NA	NA	NA	NA	NA
Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione	533-74-4	4	Daphnia magna (Water flea), 48 h, static, EC50 = 0.3 mg/L Salmo gairdneri (Rainbow trout), 96 h, static, LC50 = 0.16 mg/L Ankistrodesmus bribaianus (Green alga), 72 h, static, EC50 = 1.08 mg/L Colinus virginianus (Bobwhite quail), 21 d, LD50 = 415 mg/kg bw Colinus virginianus (Bobwhite quail), 25 weeks, NOEL = 100 mg/kg food	Based on acute: Very high	Expected to be readily biodegradable	Not bioaccumulative	Tier 2	2.8E-03	6.53E-04	1.6E-02	1.9E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Xanthan Gum	11138-66-2	1.5	Acute Fish (measured) = 420 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Guanidine, hydrochloride (1:1)	50-01-1	7	96-h-LC50 for fish = 690 mg/L NOEC for fish = 181 mg/L EC50 for Daphnia = 70.2 mg/L NOEC for Daphnia = 2.9 mg/L EC50 for algae = 33.5 mg/L NOEC for algae = 6.3 mg/L	Based on chronic: Moderate	Expected to be readily biodegradable	Not bioaccumulative	Tier 2	2.5E-04	4.37E-09	1.4E-06	2.5E-04	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Polyacrylamide	38193-60-1	1.5	LC50 = 357 mg/L (fish) LC50 = 212 mg/L (invertebrates) EC 50 = >1000 mg/L (algae)	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	NA	NA	NA	NA	NA
Calcium Carbonate	1317-65-3	15	96h EC50 for fish >100mg/L 48 h EC50 for Daphnia >100 mg/L 72 h ERC50 for algae >14 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Barite	13462-86-7	0.12	Long-term toxicity data are available for three trophic levels: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.15 mg/L (Algae)	Based on chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethanol	4719-04-4	0.00101	LC50 for fish 240.04 mg/L LC50 for invertebrates 60.67 mg/L EC50 for freshwater algae: 6.6 mg/L	Based on acute: High	Expected to be readily biodegradable.	Not bioaccumulative	Tier 2	5.5E-08	1.86E-12	3.1E-07	3.6E-07	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Ammonium hydrogensulfite	10192-30-0	0.00071	Algae NOEC/EC10 = 28 mg SO32-/L Invertebrates NOEC/EC10 = ≥8.41 mg SO32-/L Fish NOEC/EC10 = 50 mg SO32-/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 2	2.2E-08	6.36E-13	1.2E-07	1.5E-07	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Sulphur Dioxide (Impurity)	7446-09-5	0.00071	Sulfur dioxide is not present as a substance. It is formed during decomposition. Sulphur dioxide is a gaseous substance and does not remain present in the aquatic environment.	NA	NA	NA	NA	NA	NA	NA	NA	NA
Partially hydrolysed polyacrylamide	9003-05-8	0.00117	Fathead minnow LC50: 810 mg/L Rainbow trout LC50: > 100 mg/L Bluegill sunfish LC50: >300 mg/L Daphnia magna LC50: 470 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Polyanionic cellulose, low viscosity	9004-32-4	0.00338	Brachydanio rerio 96-hour LC50 >2,500 mg/L Daphnia magna 48-hour EC50 >5,000 mg/L Daphnia magna 48-hour EC50 87.26 mg/L Selenastrum capricornutum 96-hour EC50 500 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Barium sulphate	7727-43-7	0.08743	Long-term toxicity data are available for three trophic levels: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.15 mg/L (Algae)	Based on chronic: Moderate	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues	68909-77-3	0.005	LC50 (96 h) for fish: 681.2 mg/L EC50 for daphnids: > 122 mg/L EC50(72h) for algae: 45 mg/L	Based on acute: Moderate	Not readily biodegradable	Not bioaccumulative	Tier 2	1.8E-08	1.11E-11	9.8E-08	1.2E-07	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Distillates (Fischer-Tropsch), C8-26 - Branched and Linear	848301-67-7	0.0000001	Short-term toxicity: NOEC (48 h): 1000 mg/L (fish) LC50 (7 day): >100000 mg/L (fish) EL50 (72 h): >1000 mg/L (invertebrates) EL50 (48 h): 1000 mg/L (crustaceans) EL50 (72 h): 1000 mg/L (algae) Long-term toxicity: NOEL (33 day): >100 mg/L (fish) NOEL (21 day): ≤100 mg/L (invertebrates)	Based on acute: Low	Expected to be readily biodegradable	No. Based on log BCF of 3.17 or BCF of 1479.	Tier 2	1.8E-12	1.10E-09	9.8E-12	1.1E-09	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine	68990-47-6	0.007	Short term toxicity: LC50 (4 days): 100 mg/L (fish) NOEC (4 days): 100 mg/L (fish) LOEC (4 days): 100 mg/L (fish) IC50 (48 h): 100 mg/L (invertebrates)	Based on acute: Low	Not readily biodegradable	Yes. Based on the estimated Log Kow of 11 (Log Kow > 4.2).	Tier 2	2.5E-08	1.14E-08	1.4E-07	1.7E-07	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
(2-methoxymethylethoxy)propanol	34590-94-8	0.007	Short term toxicity data: EC50s/LC50s >1000 mg/l in daphnia (48 hr), fish (96 hr) and algae (7 days). Long term toxicity data: NOEC: 0.5 mg/L (daphnia)	Based on chronic: High	Expected to be readily biodegradable	Not bioaccumulative. Based on the Log Kow of 0.004 at 25 °C (Log Kow < 4.2).	Tier 2	2.5E-08	1.54E-09	1.4E-07	1.6E-07	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).

Chemical Name	CAS Number	Concentration in Injected Fluid (mg/L)	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
1-tetradecene	1120-36-1	0.0000001	Short term toxicity: LC50 (4 days): 3.4 µg/L (fish) EC50 (48 h): 2.8 µg/L (invertebrates) EC50 (4 days): 4.5 µg/L (algae)	Based on chronic: Low	Expected to be readily biodegradable.	Yes. Based on the estimated Log Kow of 7.3 (Log Kow > 4.2)	Tier 2	3.5E-12	1.02E-08	2.0E-11	1.0E-08	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Amides, tall oil fatty N,N-bis (hydroxyethyl)	68155-20-4	0.0000001	Based on read across: Daphnia: EC50 (24-hour): 3.3 mg active matter/l Daphnia: 48-hour LC50 = 2.15 and 2.64 mg/l 21 d NOEC = 0.08 mg/L	Based on chronic: Very high	Expected to be readily biodegradable.	Not bioaccumulative. Based on BAF = 108 and log Kow of 3 (estimated)	Tier 2	4.7E-13	1.54E-11	2.6E-12	1.8E-11	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Fatty acids, tall-oil, reaction products with polyethylenepolyamines	68910-93-0	0.0000001	Short term toxicity data: 96h-LL50 > 100 mg/L (fish) 48h-EL50 = 12.41 mg/L (invertebrates) 72h-EL50 = 39.7 mg/L (algae)	Based on acute: Moderate	Expected to be readily biodegradable.	Not bioaccumulative	Tier 2	3.5E-13	1.63E-13	2.0E-12	2.5E-12	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Phosphoric ester of ethoxylated fatty alcohol	68585-36-4	0.0000001	Short term toxicity data: 96h-LL50 > 100 mg/L (fish) 48h-EL50 = 12.41 mg/L (invertebrates) 72h-EL50 = 39.7 mg/L (algae)	Based on acute: Moderate	Expected to be readily biodegradable.	Not bioaccumulative	Tier 2	3.5E-13	1.63E-13	2.0E-12	2.5E-12	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Hexadec-1-ene	629-73-2	0.0000001	Short term toxicity 96-hr LC50 > solubility Actual concentration negligible. Fish 96-hr LL0 = 1000 mg/L (nominal)	Based on chronic: Very high	Expected to be readily biodegradable.	Not bioaccumulative	Tier 2	3.5E-12	3.18E-08	2.0E-11	3.2E-08	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Distillates (petroleum), hydrotreated heavy naphthenic	64742-52-5	0.0000001	Short term toxicity data: LL50 was > 100 mg/L (fish) EL50 was >10,000 mg/L (invertebrates) Long term toxicity data: 21 day NOEL: 10 mg/L (invertebrates)	Based on chronic: Low	Not readily biodegradable	Yes. Calculated BCF for constituents of this substance range between 0.4 and 71100 L/kg	Tier 2	4.4E-13	5.09E-08	2.4E-12	5.1E-08	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Lead	7439-92-1	0.0000001	Short-term toxicity data: LC50 (96 h) 40.8 µg/L (Fish) LC50 (48 h) 26 µg/L (invertebrates) EC50 (72 h) 20.5 µg/L (algae)	Based on chronic: Very high	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (below ADWG and ANZECC)	NA	NA	NA	NA	NA
Graphite	7782-42-5	0.0000001	The short-term toxicity: LC50 > 100 mg/L for the LC50 and NOEC > 100 mg/L (fish) EC50 > 100 mg/L for the EC50 and NOEC > 100 mg/L for the NOEC (daphnids)	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Talc	14807-96-6	0.0000001	No data	Based on low bioavailability: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Mineral oil	8042-47-5	0.0000001	Rainbow trout 96 hr LL50 (48 h) 100 mg/L	Based on acute: Low	N.A.(UVCB)	No. Not readily biodegradable based on read across study.	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Copper	7440-50-8	0.0000001	Fish: 2.6 µg/L (Ptylocheilus oregonensis, from 7-day LC50) 131 µg/L (Pimephales promelas, 7-day LC50) Crustaceans: 1.7 µg/L (D. pulex and G. pulex, NOEC, reproduction & mortality) 12.1 µg/L (Hyalella azteca, from 10 to 14-day LC50).	Based on chronic: Very high	N.A. (Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Zinc	7440-66-6	0.0000001	Fish: 24 µg/L (Oncorhynchus tshawytscha; from LC50) Amphibians: Ambystoma opacum, 180 µg/L (from LOEC) Crustaceans: 5.5 µg/L (C. dubia; from LC50)	Based on acute: Very high	N.A. (Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Calcium oxide	1305-78-8	0.0000001	Oncorhynchus mykiss 96-hour LC50: 50.6 mg/L Daphnia magna 48-hour EC50: 49.1 mg/L Pseudokirchneriella subcapitata 72 hour EC10: 79.22 mg/L Crangon septemspinosa 14-day: EC10 of 32 mg/L	Based on acute: Moderate	N.A. (Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Distillates (petroleum), hydrotreated light naphthenic < 3% DMS	64742-53-6	0.0000001	Short term toxicity data: LL50 was > 100 mg/L (fish) EL50 was >10,000 mg/L (invertebrates) Long term toxicity data: 21 day NOEL: 10 mg/L (invertebrates)	Based on chronic: Low	Not readily biodegradable	Yes. Calculated BCF for constituents of this substance range between 0.4 and 71100 L/kg	Tier 2	4.4E-13	3.96E-10	2.4E-12	4.0E-10	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Aluminum not powder, dust or fume	7429-90-5	0.0000001	8-day LC50 0.17 mg/L (fish) 8-day LC50 of 2.28 mg/L (amphibian)	Based on chronic: High	N.A. (Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Distillates (petroleum), straight-run middle	64741-44-2	0.0000001	96h LL50 21 mg/L (fish) NOEL: 0.068 mg/L (fish) 48h EL50 68 mg/L (daphnia) 21 d NOEL: 0.167 mg/L (daphnia) 72 h ErL50: 22 mg/L (algae)	Based on chronic: High	Expected to be readily biodegradable.	Yes. Log Kow values in the range 3.9 to greater than 6.	Tier 2	1.2E-11	7.32E-09	6.5E-11	7.4E-09	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Bitumen	8052-42-4	0.0000001	Short term toxicity: LL50 (4 days): 1 g/L (fish) LL50 (48 h): 1 g/L (invertebrates) EL50 (72 h): 1 g/L (algae) Long term toxicity: LL50 (28 days): 1 g/L (fish)	Based on chronic: Low	Expected to be readily biodegradable.	N.A. (UVCB)	Tier 2	1.8E-12	0.00E+00	9.8E-12	1.2E-11	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Copper (II) Oxide	1317-38-0	0.0000001	Fish: 2.6 µg/L (Ptylocheilus oregonensis, from 7-day LC50) 131 µg/L (Pimephales promelas, 7-day LC50) Crustaceans: 1.7 µg/L (D. pulex and G. pulex, NOEC, reproduction & mortality) 12.1 µg/L (Hyalella azteca, from 10 to 14-day LC50).	Based on chronic: Very high	N.A. (Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters,	68457-79-4	0.0000001	Short term toxicity: LC50 (4 days): 46 mg/L (fish) LL50 (4 days): 4.5 mg/L (fish) EL50 (48 h): 23 mg/L (invertebrates) EL50 (72 h): 21 mg/L (algae) Long term toxicity: NOEC (21 days): 0.4 mg/L (invertebrates)	Based on chronic: High	Not readily biodegradable	Not bioaccumulative. Based on the measured log Kow value of less than 3.	Tier 2	2.2E-12	3.10E-09	1.2E-11	3.1E-09	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Tetrasodium ethylenediaminetetraacetate	64-02-8	0.0000001	Danio rerio: 35 d-NOEC > 26.8 mg/L Daphnia magna: 21d-NOEC = 22 mg/L; Scenedesmus subspicatus: 72h-EC10 = > 100 mg/L. For Na2EDTA, Daphnia magna: 21d-NOEC = 25 mg/L	Based on chronic: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	NA	NA	NA	NA	NA
										Total Risk	**3E-01**	The calculated risk associated with potential exposure to COPC identified in flowback water, where drilling fluid is used and assuming 100% mass recovery is below the target of 1, respectively. Hence, chronic health risks are considered to be low and acceptable.

Notes
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
BCF - Bioconcentration Factor
NA - Not Applicable
MOE - Margin of Exposure
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures								
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well														
67-56-1	Methanol	0.037	D	3.19E-04	EPI				0.13	converted from RFD		3.7	NICNAS (2017)	100	NICNAS (2017)
64742-47-8	Hydrotreated light petroleum distillate	10	D	1.96E+00	EPI				35	converted from RFD		1000	NICNAS (2017)	100	NICNAS (2017)
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI				0.14	converted from RFD		4	NICNAS (2017)	100	NICNAS (2017)
14808-60-7	Crystalline silica, quartz	Not toxic via oral/dermal exposure							0.003	USEPA (2019)		-			
78330-21-9	Alcohol, C11-14, ethoxylated[B]	0.5	D	1.27E+00	EPI				1.75	converted from RFD		50	NICNAS (2017)	100	NICNAS (2017)
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	1	D	1.38E-06	EPI				3.5	converted from RFD		1000	REACH	1000	D
107-22-2	Glyoxal <1% (Ethanedial)	0.133	D	5.88E-05	EPI				0.4655	converted from RFD		13.3	NICNAS (2017)	100	NICNAS (2017)
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate	0.01	D	1.13E-11	EPI				0.035	converted from RFD		10	ADWG (2018)	1000	ADWG (2018)
497-19-8	Sodium Carbonate	0.0967	D	3.08E-08	EPI				0.338	converted from RFD		9.67	NICNAS (2017)	100	NICNAS (2017)
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione	0.005	D	5.05E-04	EPI				0.018	converted from RFD		0.5	NRA (1997)	100	NRA (1997)
50-01-1	Guanidine, hydrochloride (1:1)	0.1	D	3.86E-08	EPI				0.350	converted from RFD		100	REACH	1000	D
34590-94-8	(2-methoxymethylethoxy)propanol	1	D	1.36E-04	EPI				3.500	converted from RFD		1000	REACH	1000	D
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)	0.75	D	7.14E-02	EPI				2.625	converted from RFD		750	REACH	1000	D
64741-44-2	Distillates (petroleum), straight-run middle	0.03	D	1.36E+00	EPI				0.105	converted from RFD		30	REACH	1000	D
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts	0.16	D	3.07E+00	EPI				0.560	converted from RFD		160	REACH	1000	D
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano	0.064	D	7.29E-08	EPI				0.224	converted from RFD		64	REACH	1000	D
10192-30-0	Ammonium hydrogensulfite	0.113	D	6.26E-08	EPI				0.396	converted from RFD		113	REACH	1000	D
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear	0.2	D	1.36E+00	EPI				0.700	converted from RFD		200	REACH	1000	D
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues	1	D	1.38E-06	EPI				3.500	converted from RFD		1000	REACH	1000	D
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine	1	D	1.01E-03	EPI				3.500	converted from RFD		1000	REACH	1000	D
1120-36-1	1-tetradecene	0.1	D	6.29E+00	EPI				0.350	converted from RFD		100	REACH	1000	D
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines	1	D	1.01E-03	EPI				3.500	converted from RFD		1000	REACH	1000	D
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol	1	D	1.01E-03	EPI				3.500	converted from RFD		1000	REACH	1000	D
629-73-2	Hexadec-1-ene	0.1	D	1.97E+01	EPI				0.350	converted from RFD		100	REACH	1000	D
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic	0.8	D	2.52E+02	EPI				2.800	converted from RFD		800	USEPA (2011)	1000	D
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO	0.8	D	1.96E+00	EPI				2.800	converted from RFD		800	USEPA (2011)	1000	D
8052-42-4	Bitumen	0.2	D	1.00E-03	EPI				0.700	converted from RFD		200	REACH	1000	D

Notes:

A - Read across data from Boric Acid

B - Read across data from Alcohol ethoxylates C6-C12

C - Read across data from Sodium Sulfite

References:

D - Derived (refer to individual Toxicity Profiles)

EFSA - European Food Safety Authority

EPI - USEPA Estimation Programs Interface (EPI) Suite

J- JECFA - Joint FAO/WHO Expert Committee on Food Additives

NICNAS - National Industrial Chemicals Notification and Assessment Scheme. Assessed at https://www.nicnas.gov.au/

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

NTP - US Department of Health and Serices National Toxicology Program

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - Drilling Fluids

Chronic Exposures

	General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
	Exposure Parameters			
	Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
	Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Use of Drilling	Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
	Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
	Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
	Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
	Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
	Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09**	**NonThreshold**
			3.5E-06	**Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

	Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% Chronic TDI)	Toxicity Data: Chronic TDI Allowable for Assessment (TDI-Background)	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
		(mg/kg-day)$^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
67-56-1	Methanol		3.7E-02		3.7E-02	0.30	1.3E-09	1.1E-06	--	2.8E-05
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	1.50	6.3E-09	5.3E-06	--	5.3E-07
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	0.30	1.3E-09	1.1E-06	--	2.6E-05
78330-21-9	Alcohol, C11-14, ethoxylatedB		5.0E-01		5.0E-01	1.50	6.3E-09	5.3E-06	--	1.1E-05
107-22-2	Glyoxal <1% (Ethanedial)		1.3E-01		1.3E-01	2.20	9.2E-09	7.7E-06	--	5.8E-05
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate		1.0E-02		1.0E-02	1.00	4.2E-09	3.5E-06	--	3.5E-04
497-19-8	Sodium Carbonate		9.7E-02		9.7E-02	0.29	1.2E-09	1.0E-06	--	1.1E-05
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione		5.0E-03		5.0E-03	4.00	1.7E-08	1.4E-05	--	2.8E-03
50-01-1	Guanidine, hydrochloride (1:1)		1.0E-01		1.0E-01	7.00	2.9E-08	2.5E-05	--	2.5E-04
34590-94-8	(2-methoxymethylethoxy)propanol		1.0E+00		1.0E+00	0.007	2.9E-11	2.5E-08	--	2.5E-08
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)		7.5E-01		7.5E-01	0.0000001	4.2E-16	3.5E-13	--	4.7E-13
64741-44-2	Distillates (petroleum), straight-run middle		3.0E-02		3.0E-02	0.0000001	4.2E-16	3.5E-13	--	1.2E-11
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts		1.6E-01		1.6E-01	0.0000001	4.2E-16	3.5E-13	--	2.2E-12
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano		6.4E-02		6.4E-02	0.00101	4.2E-12	3.5E-09	--	5.5E-08
10192-30-0	Ammonium hydrogensulfite		1.1E-01		1.1E-01	0.00071	3.0E-12	2.5E-09	--	2.2E-08
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear		2.0E-01		2.0E-01	0.0000001	4.2E-16	3.5E-13	--	1.8E-12
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues		1.0E+00		1.0E+00	0.005	2.1E-11	1.8E-08	--	1.8E-08
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine		1.0E+00		1.0E+00	0.007	2.9E-11	2.5E-08	--	2.5E-08
1120-36-1	1-tetradecene		1.0E-01		1.0E-01	0.0000001	4.2E-16	3.5E-13	--	3.5E-12
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines		1.0E+00		1.0E+00	0.0000001	4.2E-16	3.5E-13	--	3.5E-13
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol		1.0E+00		1.0E+00	0.0000001	4.2E-16	3.5E-13	--	3.5E-13
629-73-2	Hexadec-1-ene		1.0E-01		1.0E-01	0.0000001	4.2E-16	3.5E-13	--	3.5E-12
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic		8.0E-01		8.0E-01	0.0000001	4.2E-16	3.5E-13	--	4.4E-13
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO		8.0E-01		8.0E-01	0.0000001	4.2E-16	3.5E-13	--	4.4E-13
8052-42-4	Bitumen		2.0E-01		2.0E-01	0.0000001	4.2E-16	3.5E-13	--	1.8E-12
								Total Risk (mixture)	--	**3.5E-03**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - Drilling Fluids

Chronic Exposures

	General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
	Exposure Parameters			
	Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
	Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Use of Drilling	Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
	Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
	Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
	Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
	Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
	Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
	Intake Factor = SAw*ET*CF*EF*ED / BW*AT	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

	Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
		Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
67-56-1	Methanol		3.7E-02		3.7E-02	3.2E-4	0.30	1.8E-10	1.5E-07	--	4.2E-06
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	2.0E+0	1.50	5.7E-06	4.8E-03	--	4.8E-04
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	3.3E-4	0.30	1.9E-10	1.6E-07	--	3.9E-06
78330-21-9	Alcohol, C11-14, ethoxylatedB		5.0E-01		5.0E-01	1.3E+0	1.50	3.7E-06	3.1E-03	--	6.2E-03
107-22-2	Glyoxal <1% (Ethanedial)		1.3E-01		1.3E-01	5.9E-5	2.20	2.5E-10	2.1E-07	--	1.6E-06
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate		1.0E-02		1.0E-02	1.1E-11	1.00	2.2E-17	1.8E-14	--	1.8E-12
497-19-8	Sodium Carbonate		9.7E-02		9.7E-02	3.1E-8	0.29	1.7E-14	1.4E-11	--	1.5E-10
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione		5.0E-03		5.0E-03	5.1E-4	4.00	3.9E-09	3.3E-06	--	6.5E-04
50-01-1	Guanidine, hydrochloride (1:1)		1.0E-01		1.0E-01	3.9E-8	7.00	5.2E-13	4.4E-10	--	4.4E-09
34590-94-8	(2-methoxymethylethoxy)propanol		1.0E+00		1.0E+00	1.4E-4	0.007	1.8E-12	1.5E-09	--	1.5E-09
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)		7.5E-01		7.5E-01	7.1E-2	0.0000001	1.4E-14	1.2E-11	--	1.5E-11
64741-44-2	Distillates (petroleum), straight-run middle		3.0E-02		3.0E-02	1.4E+0	0.0000001	2.6E-13	2.2E-10	--	7.3E-09
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts		1.6E-01		1.6E-01	3.1E+0	0.0000001	5.9E-13	5.0E-10	--	3.1E-09
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano		6.4E-02		6.4E-02	7.3E-8	0.00101	1.4E-16	1.2E-13	--	1.9E-12
10192-30-0	Ammonium hydrogensulfite		1.1E-01		1.1E-01	6.3E-8	0.00071	8.5E-17	7.2E-14	--	6.4E-13
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear		2.0E-01		2.0E-01	1.4E+0	0.0000001	2.6E-13	2.2E-10	--	1.1E-09
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues		1.0E+00		1.0E+00	1.4E-6	0.005	1.3E-14	1.1E-11	--	1.1E-11
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine		1.0E+00		1.0E+00	1.0E-3	0.007	1.4E-11	1.1E-08	--	1.1E-08
1120-36-1	1-tetradecene		1.0E-01		1.0E-01	6.3E+0	0.0000001	1.2E-12	1.0E-09	--	1.0E-08
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines		1.0E+00		1.0E+00	1.0E-3	0.0000001	1.9E-16	1.6E-13	--	1.6E-13
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol		1.0E+00		1.0E+00	1.0E-3	0.0000001	1.9E-16	1.6E-13	--	1.6E-13
629-73-2	Hexadec-1-ene		1.0E-01		1.0E-01	2.0E+1	0.0000001	3.8E-12	3.2E-09	--	3.2E-08
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic		8.0E-01		8.0E-01	2.5E+2	0.0000001	4.8E-11	4.1E-08	--	5.1E-08
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO		8.0E-01		8.0E-01	2.0E+0	0.0000001	3.8E-13	3.2E-10	--	4.0E-10
8052-42-4	Bitumen										
									Total Risk (mixture)		**7.3E-03**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

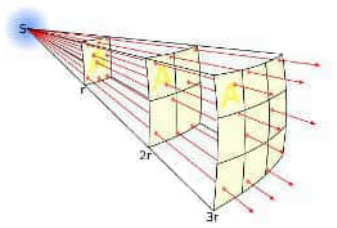
Aerosol Exposure - Drilling Fluids

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state concentrations were
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

Use of Drilling Fluid

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
67-56-1	Methanol	0.30	108	2.5E-03
64742-47-8	Hydrotreated light petroleum distillate	1.50	540	2.5E-03
111-30-8	Glutaraldehyde	0.30	108	2.5E-03
78330-21-9	Alcohol, C11-14, ethoxylatedB	0.01	2.6	2.5E-03
107-22-2	Glyoxal <1% (Ethanedial)	2.20	792	2.5E-03
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate	1.00	360	2.5E-03
497-19-8	Sodium Carbonate	0.29	104.4	2.5E-03
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione	4.00	1440	2.5E-03
50-01-1	Guanidine, hydrochloride (1:1)	7.00	2520	2.5E-03
14808-60-7	Crystalline silica, quartz	10.00	3600	2.5E-03
34590-94-8	(2-methoxymethylethoxy)propanol	0.007	2.52	2.5E-03
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)	0.0000001	0.000036	2.5E-03
64741-44-2	Distillates (petroleum), straight-run middle	0.0000001	0.000036	2.5E-03
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts	0.0000001	0.000036	2.5E-03
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano	0.00101	0.3636	2.5E-03
10192-30-0	Ammonium hydrogensulfite	0.00071	0.2556	2.5E-03
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear	0.0000001	0.000036	2.5E-03
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues	0.0050000	1.8	2.5E-03
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine	0.0070000	2.52	2.5E-03
1120-36-1	1-tetradecene	0.0000001	0.000036	2.5E-03
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines	0.0000001	0.000036	2.5E-03
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol	0.0000001	0.000036	2.5E-03
629-73-2	Hexadec-1-ene	0.0000001	0.000036	2.5E-03
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic	0.0000001	0.000036	2.5E-03
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO	0.0000001	0.000036	2.5E-03
8052-42-4	Bitumen	0.0000001	0.000036	2.5E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - Drilling Fluids

Chronic Exposures

Use of Drilli

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
67-56-1	Methanol	0.3	1.00	2.50E-03	1.30E-01	6.85E-05	2.05E-05	1.58E-04
64742-47-8	Hydrotreated light petroleum distillate	1.5	1.00	2.50E-03	3.50E+01	6.85E-05	1.03E-04	2.94E-06
111-30-8	Glutaraldehyde	0.3	1.00	2.50E-03	1.40E-01	6.85E-05	2.05E-05	1.47E-04
78330-21-9	Alcohol, C11-14, ethoxylatedB	0.0	1.00	2.50E-03	1.75E+00	6.85E-05	5.00E-07	2.85E-07
107-22-2	Glyoxal <1% (Ethanedial)	2.2	1.00	2.50E-03	4.66E-01	6.85E-05	1.51E-04	3.24E-04
5064-31-3	Nitrilotriacetic acid, trisodium salt monohydrate	1	1.00	2.50E-03	3.50E-02	6.85E-05	6.85E-05	1.96E-03
497-19-8	Sodium Carbonate	0.29	1.00	2.50E-03	3.38E-01	6.85E-05	1.99E-05	5.87E-05
533-74-4	Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione	4	1.00	2.50E-03	1.75E-02	6.85E-05	2.74E-04	1.57E-02
50-01-1	Guanidine, hydrochloride (1:1)	0	1.00	2.50E-03	3.50E-01	6.85E-05	5.00E-07	1.43E-06
14808-60-7	Crystalline silica, quartz	10	1.00	2.50E-03	3.00E-03	6.85E-05	6.85E-04	2.28E-01
34590-94-8	(2-methoxymethylethoxy)propanol	0.007	1.00	2.50E-03	3.50E+00	6.85E-05	4.79E-07	1.37E-07
68155-20-4	Amides, tall oil fatty N,N-bis (hydroxyethyl)	0.0000001	1.00	2.50E-03	2.63E+00	6.85E-05	6.85E-12	2.61E-12
64741-44-2	Distillates (petroleum), straight-run middle	0.0000001	1.00	2.50E-03	1.05E-01	6.85E-05	6.85E-12	6.52E-11
68457-79-4	Phosphorodithioic acid, mixed o,o-bis(iso-bu and pentyl) esters, zinc salts	0.0000001	1.00	2.50E-03	5.60E-01	6.85E-05	6.85E-12	1.22E-11
4719-04-4	Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethano	0.00101	1.00	2.50E-03	2.24E-01	6.85E-05	6.92E-08	3.09E-07
10192-30-0	Ammonium hydrogensulfite	0.00071	1.00	2.50E-03	3.96E-01	6.85E-05	4.86E-08	1.23E-07
848301-67-7	Distillates (Fischer-Tropsch), C8-26 - Branched and Linear	0.0000001	1.00	2.50E-03	7.00E-01	6.85E-05	6.85E-12	9.78E-12
68909-77-3	Filming amine Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. Residues	0.005	1.00	2.50E-03	3.50E+00	6.85E-05	3.42E-07	9.78E-08
68990-47-6	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine	0.007	1.00	2.50E-03	3.50E+00	6.85E-05	4.79E-07	1.37E-07
1120-36-1	1-tetradecene	0.0000001	1.00	2.50E-03	3.50E-01	6.85E-05	6.85E-12	1.96E-11
68910-93-0	Fatty acids, tall-oil, reaction products with polyethylenepolyamines	0.0000001	1.00	2.50E-03	3.50E+00	6.85E-05	6.85E-12	1.96E-12
68585-36-4	Phosphoric ester of ethoxylated fatty alcohol	0.0000001	1.00	2.50E-03	3.50E+00	6.85E-05	6.85E-12	1.96E-12
629-73-2	Hexadec-1-ene	0.0000001	1.00	2.50E-03	3.50E-01	6.85E-05	6.85E-12	1.96E-11
64742-52-5	Distillates (petroleum), hydrotreated heavy naphthenic	0.0000001	1.00	2.50E-03	2.80E+00	6.85E-05	6.85E-12	2.45E-12
64742-53-6	Distillates (petroleum), hydrotreated light naphthenic < 3% DMSO	0.0000001	1.00	2.50E-03	2.80E+00	6.85E-05	6.85E-12	2.45E-12
8052-42-4	Bitumen	0.0000001	1.00	2.50E-03	7.00E-01	6.85E-05	6.85E-12	9.78E-12
							Total Threshold Risk (mixture)	**0.25**

Summary of Risk to Workers - Drilling Fluids
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Drilling Fluid	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.004
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.007
Inhalation of mist from the evaporation units	0.2
Total Risk	**0.3**

AECOM

Newpark Drilling Fluid Recipe

Client Name: Tamboran
Project Name: Beetaloo Chem

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Oxirane, 2-methyl-, polymer with oxirane, di-(9Z)-9-octadecenoate	67167-17-3	400L	543	Defoamer	Polymer of low concern to the environment.	Based on NICNAS: Low	No data	No data	Tier 1 (NICNAS IMAP)	The risk was classified as low as it is a polymer of low concern. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Fatty acids, tall-oil	61790-12-3	400L	29	Defoamer	Pimephales promelas: 96-hour LL50 >1,000 (WAF) Daphnia magna: 48-hour EL50 >1,000 (WAF) Selenastrum capricornutum: 72-hour EL50 854.90 (WAF)	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Poly Anionic Cellulose	9004-32-4	775 kg	5,085	Shale Stabiliser	96 h LC50 for Brachydanio rerio is >2,500 mg/L 48 h LC50 for Daphnia magna is >5,000 mg/L; 96 h EC50 for Selenastrum capricornutum is 500 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS IMAP)	The risk was classified as low based on acute data. It is not expected to be readily biodegradable however it is not expected to be bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Acetic acid, ethenyl ester, polymer with ethenol	25213-24-5	775 kg	2,286	Shale Stabiliser	Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.	Based on NICNAS: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS IMAP)	The risk was classified as low based on NICNAS assessment. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Barium Sulphate	7727-43-7	61,800 kg	111,994	Weighting Agent	Short-term toxicity: 96 hrs LC50: >3.5 mg/L (Fish) 48 hrs LC50: 14.5 mg/L (Invertebrates) 72 hrs EC50: 1.15 mg/L (Algae) Long-term toxicity: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.19 mg/L (Algae)	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Crystalline silica, quartz	14808-60-7	--	2,286	Weighting Agent	No acute toxicity to fish, Daphnia, or algae, though some physical effects were observed with loading rates of greater than or equal to 10 g/L (OECD 2004). Any harmful effects to aquatic ecosystems are therefore not ecotoxicological in nature. No chronic toxicity data were identified.	Based on Acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	The risk was classified as low based on acute data. The substance is not classified as PBT. It is noted that the substance is hazardous to human health via the inhalation pathways and as such OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Calcium Chloride	10043-52-4	332,000 kg	429,550	Desiccant, Dust Control Agent	Acute Toxicity 96-hr LC50 value was 4,630 mg/L in fathead minnow (Pimephales promelas) 48-hr EC50 was 1,062 mg/L for Daphnia magna 72-hr EC50 = >4,000 for fresh water algae 72-hr EC50 = 2,900 mg/L for fresh water algae (biomass) Chronic Toxicity 21-day NOEC = 160 mg/L for Daphnia magna	Based on acute and chronic: Low	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Tier 1	The risk was classified as low based on chronic data and acute data. The substance is inorganic and ubiquitous in the environment. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium Chloride	7647-14-5	332,000 kg	97	Desiccant, Dust Control Agent	EC50 = 400 to 30000 mg/L EC50 Fish = 1290 mg/L NOEC = 314 mg/L (Daphnia)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	The risk was classified as low based on chronic data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium hydroxide	1310-73-2	100 kg	286	Scrubbing Agent	Measured acute endpoints were available for fish (196 mg/L). Measured chronic endpoint were available for Daphnia (240 mg/L)	Based on Chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	The risk was classified as low based on chronic data. The substance is not classified as PBT. Management of this chemical is addressed in the EMP to prevent accidental release. OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body	NA. Acute toxicity only (irritant and corrosive), not systemically available in body
Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	68909-77-3	--	2,286	Corrosion Inhibitor	Leuciscus idus, Fish LC50 (96 h) = 681.2 mg/L Daphnia EC50 = 122 mg/L Green alga ErC50 (72h) = 45 mg/L Microorganism > 1000 mg/L	Based on acute: Low	Not readily biodegradable.	No based on the Log Pow of 0.565	Tier 2	The risk was classified as low based on acute data. It is not expected to be readily biodegradable however it is not a bioaccummulative substance. A Tier 2 assessment is required.	8.03E-04	5.10E-07	4.47E-03	5.28E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Calcium Carbonate	471-34-1	--	113,251	Weighting Agent	96h EC50 for fish >100mg/L 48 h EC50 for Daphnia >100 mg/L 72 h ERC50 for algae >14 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS IMAP)	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Citric Acid, monohydrate	77-92-9	375kg	857	Drilling Fluid Additive	96 h LC50 fish = 440 to 1,516 mg/L 24 h EC50 value for invertebrates is 85 mg/L 7 d toxic limit concentration values for algae = 300 to 640 mg/L 8 d freshwater static test for the algae Scenedesmus quadricauda, NOEC = 425 mg/L	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Starch	9005-25-8	26,880kg	22,856	Fluid Loss Control Additive	Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Xanthan Gum	11138-66-2	--	4,286	Viscosifier	Acute Fish (measured) = 420 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS IMAP)	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Polyethylene Glycol	25322-68-3	--	1,429	Defoamer	Fish LC50 = 100 mg/L Invertebrates LC50 = 1000 mg/L Algae EC 50 = 15.91 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Octan-2-ol	123-96-6	--	1,429	Defoamer	96h-LC50 for fish = 18.57 mg/L 48h-EC50 for invertebrates = 30 mg/L 72h-ErC50 for algae = 48 mg/L 72h-NOErC for algae = 8.7 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Organic Fibres / Cellulose	9004-34-6	3400kg	28,570	Lost Circulation Material	Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.	Based on NICNAS: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS IMAP)	The risk was classified as low based on NICNAS assessment. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Poly(oxy-1,2-ethanediyl), alpha-octyl-omega-hydroxy-	27252-75-1	--	514	Lubricant	48h EC50 Invertebrates: 40 mg/L 72h EC50 Algae: 14 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Distillates, hydrotreated light	64742-47-8	--	60	Lubricant	Lowest acute endpoint for Daphnia = 0.018 mg/L (modelled)	Based on acute: Very high	Readily biodegradable	Yes based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight	Tier 2	The risk was classified as very high based on acute data. The substance is expected to be readily biodegradable, but is considered to have a potential to bioaccumulate. A Tier 2 assessment is required.	2.11E-05	1.90E-02	1.17E-04	1.91E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Starch, carboxymethyl ether, sodium salt	9063-38-1	--	19,999	Filtration Control Agent	Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Glutaraldehyde	111-30-8	1775L	357	Biocide	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproductn Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 2	The risk was classified as moderate based on chronic data . The exposure concentration is above the respective ecotoxicity values. A Tier 2 assessment is required.	3.14E-02	4.69E-03	1.75E-01	2.11E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
Methanol	67-56-1	1775L	14	Biocide	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) Chronic toxicity study to invertebrates, NOEC was 32,000 mg/L	Based on Chronic: Low	Readily biodegradable	Not bioaccumulative based on the Log Kow of -0.74	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Poly(oxy-1,2-ethanediyl), alpha-hydro-omega-hydroxy-, mono(2-(4,5-dihydro-2-nortall-oil alkyl-1H-imidazol-1-yl)ethyl) ethers	68909-09-1	--	571	Corrosion Inhibitor	Fish (Cyprinodon variegatus) 96 h LC50 > 0.53 mg/L Invertebrate (Acartia tonsa) 48 h LC50 = 3.81 mg/L Invertebrate (Corophium volutator) 10 d LC50 ≥ 13,471 mg/L Algal Toxicity (Skeletonema costatum) 72 h ErC50 = 0.53 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Acetic acid	64-19-7	--	286	Corrosion Inhibitor	Acute endpoints: Fish = 75 mg/L (measured), Daphnia EC50 = 32 mg/L Chronic endpoints: Daphnia = 150 mg/L (measured)	Based on chronic: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Magnesium Oxide	1309-48-4	13,250kg	8,057	PH Indicator	96-hour LC50: 306.79 mg/L (Fish) 96-hour EC50: 170.6 mg/L (Invertebrates) 72-hour EC50: >100 mg/L (Algae)	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS IMAP)	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Calcium Oxide	1305-78-8	13,250kg	300	PH Indicator	Oncorhynchus mykiss 96-hour LC50: 50.6 mg/L Daphnia magna 48-hour EC50: 49.1 mg/L Pseudokirchneriella subcapitata 72 hour EC10: 79.22 mg/L A 42-day Oncorhynchus mykiss test showed that enhanced Ca2+ diets (60 mg Ca2+) had no effects on survival. A 14-day Crangon septemspinosa test showed an EC10 of 32 mg/L.	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Non-crystalline silica (impurity)	7631-86-9	13,250kg	214	PH Indicator	Acute Aquatic -96-h LL0 Danio-rerio - 10,000 mg/L -24-h ECL50 Daphnia magna ->10,000 mg/L -72hr-NOEL (Scenedesmus subspicatus) - 10,000 mg/L	Based on acute: Low	Not applicable, inorganic substance, ubiquitous in environment.	Not applicable, inorganic substance, ubiquitous in environment.	Tier 1	The risk was classified as low based on acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values. It is noted that the substance is hazardous to human health via the inhalation pathways and as such OH&S procedures implemented by Tamboran will minimise human health exposure. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
2,2',2"- Nitrilotriethanol (TRIETHANOLAMINE)	102-71-6	8200L	6,000	Corrosion Inhibitor	Fish 96h-LC50 of 11,800 mg/L Daphnia 24h-EC50 of 1,390 mg/L Daphnia 21 day NOEC of 16 mg/L Alga EC50 910 mg/L	Based on chronic: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Ethanamine, N-ethyl-N-hydroxy-	3710-84-7	8200L	1,628	Corrosion Inhibitor	96 hr LC50 (fish): 134 mg/L 48 hr EC50 (invertebrates): 8.2 mg/L 72 hr EC50 (algae): 101 mg/L 28 days NOEC (microorganisms): 100 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Ethanolamine	141-43-5	8200L	429	Corrosion Inhibitor	Acute toxicity: 96 h LC50 (fish): 105 mg/L 48 h EC50 (invertebrates): 27.04 mg/L 72 h ErC50 (algae): 2.8 mg/L Chronic toxicity: 41 d NOEC (fish): 1.24 mg/L 21 d NOEC (invertebrates): 0.85 mg/L 72 h ErC10 (algae): 0.7 mg/L	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium Glycolate (impurity)	2836-32-0	775kg	34	Filtration Control Agent	Green algae (Pseudokirchneriella subcapitata) 72-hr EC50 (growth) = 44.0 mg/L Fathead minnows (Pimephales promelas) . 96-hr LC50 = 164 mg/L. Water fleas (Daphnia magna) 48-hr EC50 = 141 mg/L	Based on acute: Moderate	Glycolic acid is readily biodegradable and as such not persistent in the environment.	Based on the measured log Kow of -1.11 and an estimated BCF of 3. Glycolic acid is not bioaccumulative.	Tier 1	The risk was classified as moderate based on acute data. The substance is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA

AECOM

Newpark Drilling Fluid Recipe

Client Name: Tamboran
Project Name: Beetaloo Chem

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Hexanedinitrile, hydrogenated, high-boiling fraction	68411-90-5	--	8,811	Shale Inhibitor	96 hr LC50 (fish): 670 mg/L 48 hr EC50 (invertebrates): 1189 mg/L 72 hr EC50/NOEC (algae): >97.4 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Calcium Carbonate (Limestone)	1317-65-3	81,650kg	127,408	Bridging Agent, Weighting Agent	Acute ecotoxicological endpoint values for aquatic organisms generally greatly exceed 100 mg/L (LMC 2014), indicating very low toxicity.	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Disodium Pyrophosphate	7758-16-9	200kg	1,429	Acidifier, Buffering Agent	96h LC50 (fish): > 100 mg/l 48h EC50 (invertebrates): 100 mg/L 72h EC50 (algae): 100 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS)	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium Carbonate	497-19-8	150kg	714	Drilling Aid	96-hour LC50 Bluegill sunfish (Lepomis macrochirus) = 300 mg/L 96-hour LC50 to mosquitofish (Gambusia affinis) = 740 mg/L 48-hour EC50 to the invertebrate Ceriodaphnia cf. dubia = 200 to 227 mg/L	Based on acute: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium Sulphite	7757-83-7	325kg	1,400	Reducing Agent	Acute toxicity: 96h LC50 Fish: 149.6 mg/L 48h EC50 Invertebrate: 74.9 mg/L 72h EC50 Algae: 36.8 mg/L Chronic toxicity: NOEC Algae: 28 mg/L NOEC Invertebrates: ≥8.41 mg/L NOEC Fish: 50 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium Sulphate	7757-82-6	325kg	26	Reducing Agent	Algae: EC50 120h = 1,900 mg/l. Invertebrates (Daphnia magna): EC50 48h = 4,580 mg/l Fish LC50 96h = 7,960 mg/l	Based on acute: Low	N.A.(Inorganic)	Not bioaccumulative	Tier 1 (NICNAS)	The risk was classified as low based on acute data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Diethanolamine	111-42-2	13,000L	2,571	Solvent	Pimephales promelas (fish) 96-h LC50 = 1370 mg/l (nominal) Daphnia magna (invertebrates) 48-h EC50 = 55 mg/l (nominal) Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l (nominal) Pseudomonas sp. (microorganisms) 16-h TTC = 16 mg/l (nominal) Daphnia magna, the NOEC (21 days) was 0.78 mg/l (nominal, based on analytical verification).	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Sodium erythorbate	6381-77-7	2000kg	2,857	Oxygen Scavenger	96 h LC50 Fish > 100 mg/L 48 h EC50 Daphnia magna = 84 - 100 mg/L 72 h NOEC alga = 20 mg/L	Based on acute: Low	Not readily biodegradable	Not bioaccumulative	Tier 1 (NICNAS)	The risk was classified as low. It is not expected to be readily biodegradable however it is not a bioaccumulative substance. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Methyl alpha-D-glucopyranoside	97-30-3	--	1,371	Spotting Additive	LC50 (96 hr) for fish: 1 770 g/L LOEC (48 h) for invertebrates: 100 mg/L LOEC (72 h) for algae: 125.3 mg/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
1,2,3-Propanetriol, homopolymer	25618-55-7	--	1,307	Spotting Additive	LC50 (96 hrs) for fish: 500 mg/L EC50 (48 h) for invertebrates: 1 g/L EC50/NOEC (72 h) for algae: 1 g/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
1,2,3-Propanetriol, homopolymer, (Z)-9-octadecenoate	9007-48-1	--	1,263	Spotting Additive	LC50 (96 hrs) for fish: 500 mg/L EC50 (48 h) for invertebrates: 1 g/L EC50/NOEC (72 h) for algae: 1 g/L	Based on acute: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on acute data and it is expected to be readily biodegradable and not bioaccumulative. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
1-Dodecene, dimer	62132-67-6	--	680	Spotting Additive	LL50 (96 hrs) for fish: 1 g/L EL50 (48 h) for invertebrates: 1 g/L EL50 (48 h) for algae: 1 g/L 21 day NOELR for invertebrates: 125 mg/L WAF.	Based on chronic: Low	Not readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
													Total Risk	**2.4E-01**	The calculated risk associated with potential exposure to COPC identified in flowback water, where the SLB HYBRID recipe is used and assuming 100% mass recovery is below the target of 1, respectively. Hence, chronic health risks are considered to be low and acceptable.

Notes
-- information not available
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
BCF - Bioconcentration Factor
NA - Not Applicable
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures										
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well															
111-30-8	Glutaraldehyde	0.04	D	3.25E-04	EPI				0.14	converted from RFD		4	NICNAS (2017)	100	NICNAS (2017)
64742-47-8	Distillates, hydrotreated light	1	D	1.96E+00	EPI				3.5	converted from RFD		1000	OECD (2012)	1000	D
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	10	D	1.38E-06	EPI				35	converted from RFD		1000	OECD (2012)	100	D

References:

D - Derived (refer to individual Toxicity Profiles)

EPI - USEPA Estimation Programs Interface (EPI) Suite

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - Newpark Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09**	**NonThreshold**
		3.5E-06	**Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% Chronic TDI)	Toxicity Data: Chronic TDI Allowable for Assessment (TDI-Background)	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
		(mg/kg-day)$^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholi		1.0E+01		1.0E+01	2285.60	9.6E-06	8.0E-03	--	8.0E-04
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	60.00	2.5E-07	2.1E-04	--	2.1E-05
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	357.13	1.5E-06	1.3E-03	--	3.1E-02
								Total Risk (mixture)		**3.22E-02**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - Newpark Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = SAw*ET*CF*EF*ED / BW*AT	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% chronic TDI)	Toxicity Data: Chronic TDI Allowable for Assessment (TDI-Background)	Toxicity Data: Dermal Permeability	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
		$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine de		1.0E+01		1.0E+01	1.4E-6	2285.60	6.1E-09	5.1E-06	--	5.10E-07
64742-47-8	Hydrotreated light petroleum distillate		1.0E+01		1.0E+01	2.0E+0	60.00	2.3E-04	1.9E-01	--	1.90E-02
111-30-8	Glutaraldehyde		4.0E-02		4.0E-02	3.3E-4	357.13	2.2E-07	1.9E-04	--	4.69E-03
									Total Risk (mixture)		**2.37E-02**

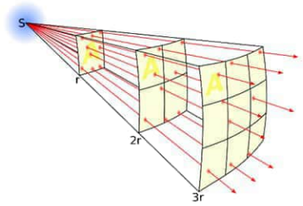
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - Newpark Recipe

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state concentrations
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with	2285.60	822816	2.500000E-03
64742-47-8	Hydrotreated light petroleum distillate	60.00	21600	2.500000E-03
111-30-8	Glutaraldehyde	357.13	128565	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - Newpark Recipe

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.000	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Threshold Intake and Risk Calculations: Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
68909-77-3	Ethanol, 2,2'-oxybis-, reaction products with ammoni	2.29E+03	1.00	2.50E-03	3.50E+01	6.85E-05	1.57E-01	4.47E-03
64742-47-8	Hydrotreated light petroleum distillate	6.00E+01	1.00	2.50E-03	3.50E+01	6.85E-05	4.11E-03	1.17E-04
111-30-8	Glutaraldehyde	3.57E+02	1.00	2.50E-03	1.40E-01	6.85E-05	2.45E-02	1.75E-01
							Total Risk (mixture)	**1.79E-01**

Summary of Risk to Workers - Newpark Recipe
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Stimulation Fluid in Hydraulic Fracturing	
HVFR Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	3.2E-02
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	2.4E-02
Inhalation of mist from the evaporation units	1.8E-01
Total Risk	**2.4E-01**

Appendix F

Chemical Risk Assessment - Tracers

Human Health Screening Assessment
Chemical Tracers

Tracer Name	Concentration in Injected Fluid (mg/L)	Ecotoxicity	Toxicity	Persistence	Bioaccummulative	Tier 1 Screening Assessment	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
CFT (20 chemicals)	0.75	Algae EC50 = 33.1 mg/L Fish LC50 = 44.6 mg/L Daphnia EC50 > 100 mg/L Algae EC10 = 3.4 mg/L Fish NOEC 28 d = 120 mg/L Daphnia NOEC 21 d = 25 mg/L	Based on chronic: Low	Expected to be readily biodegradable	No based on calculated log Kow of 1.87	Tier 2	3.19E-06	1.01E-05	1.78E-05	3.11E-05	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
GFT (15 chemicals)	1.35	Fish 96h LC50 > 100 mg/L Invertebrates 48h EC50 > 0.1 mg/L Microorganism 3h EC50 > 100 mg/L Fish 96h NOEC = 1000 mg/L	Based on chronic: Low	Not readily biodegradable	Yes based on calculated log Kow of > 4.5	Tier 2	4.74E-06	1.04E-03	2.64E-05	1.08E-03	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
WFT (1 chemical)	200,000	LC50 fish (96 h) > 120 mg/L EC50 daphnia (48h) > 125 mg/L EC50 plants (48h) > 125 mg/L	Based on acute: Low	Not readily biodegradable	No based on log Kow of -10.7	Tier 2	2.34E-01	1.23E-02	NA. Not volatile	2.46E-01	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
WFT (1 chemical)	200,000	Fish 96 h LC50 = 87 mg/L Daphnia 48 h EC50 = 182 mg/L Algae ErC50 > 100 mg/L	Based on acute: Low	Expected to be readily biodegradable	No based on log Kow of 0.07	Tier 2	7.02E-02	6.66E-12	NA. Not volatile	7.02E-02	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).

Toxicity and Dermal Absorption Parameters

C = calculated from chronic value, Ch = chronic value adopted

CAS#	Chemical	Oral/Dermal Exposures				Inhalation Exposures									
		Threshold Chronic TDI or RfD (mg/kg/day)		Dermal Permeability (cm/hr)	Reference	Inhalation Unit Risk $(ug/m^3)^{-1}$	Non-Threshold Slope Factor $(mg/kg/day)^{-1}$		Threshold Chronic TC or RfC (mg/m^3)		NOAEC or LOAEC (mg/m^3)	NOAEL or LOAEL (mg/kg bw/d)	Reference	UF	Reference
	COPC in Hydraulic Fracturing Fluid Injected into Well														
	CFT	0.825	D	6.88E-03	EPI				2.8875	converted from RFD		825.0	OECD (2004)	1000	D
	GFT	1	D	4.79E-01	EPI				3.5	converted from RFD		1000	REACH	1000	D
	WFT	3	EFSA	1.14E-04	EPI				-	Not volatile		-	-	-	-
	WFT	10	JECFA	2.06E-13	EPI				-	Not volatile		-	-	-	-

Notes:

A - Read across data from Boric Acid

B - Read across data from Alcohol ethoxylates C6-C12

C - Read across data from Sodium Sulfite

References:

D - Derived (refer to individual Toxicity Profiles)

EFSA - European Food Safety Authority

EPI - USEPA Estimation Programs Interface (EPI) Suite

FSANZ - Food Standards Australia New Zealand

J- JECFA - Joint FAO/WHO Expert Committee on Food Additives

NICNAS - National Industrial Chemicals Notification and Assessment Scheme. Assessed at https://www.nicnas.gov.au/

NICNAS (2017) - Department of the Environment and Energy 2017 , National assessment of chemicals associatedwith coal seam gas extraction in Australia, prepared by the National Industrial ChemicalsNotification and Assessment Scheme

NTP - US Department of Health and Serices National Toxicology Program

OECD - Organisation for Economic Co-operation and Development Screening Information Data Set (SIDS)

REACH - ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - CFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% Chronic TDI)	Toxicity Data: Chronic TDI Allowable for Assessment (TDI-Background)	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
CFT		8.3E-01		8.3E-01	0.75	3.1E-09	2.6E-06	--	3.2E-06
							Total Risk (mixture)	**--**	**3.19E-06**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - CFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = $\frac{SAw*ET*CF*EF*ED}{BW*AT}$	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
	Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
CFT		8.3E-01		8.3E-01	6.9E-3	0.75	9.9E-09	8.3E-06	--	1.0E-05
								Total Risk (mixture)		**1.01E-05**

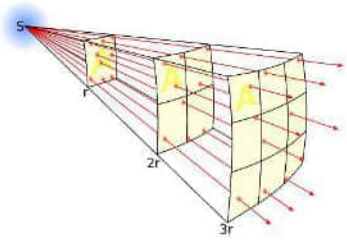
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - CFT

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\ \left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
	CFT	0.75	270	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - CFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

						Threshold Intake and Risk Calculations		
CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
	CFT	0.8	1.00	2.50E-03	2.89E+00	6.85E-05	5.14E-05	1.78E-05
							Total Threshold Risk (mixture)	**1.78E-05**

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - GFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% Chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
GFT		1.0E+00		1.0E+00	1.35	5.6E-09	4.7E-06	--	4.7E-06
							Total Risk (mixture)	--	**4.74E-06**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - GFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = $\frac{SAw*ET*CF*EF*ED}{BW*AT}$	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
	Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
GFT		1.0E+00		1.0E+00	4.8E-1	1.35	1.2E-06	1.0E-03	--	1.04E-03
								Total Risk (mixture)		**1.0E-03**

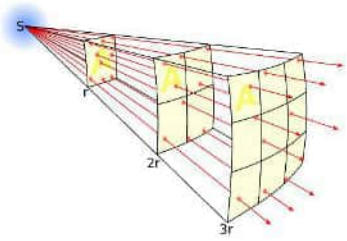
Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Aerosol Exposure - GFT

The concentration of COPC in aerosol spray was estimated by calculating the concentration for driftable droplets using a mixed box model in which steady state
An emission factor for driftable aerosol was estimated using the algorithm presented below.

Emission Factor for Driftable Aerosol Algorithm

$$Emission\ Factor_{driftable\ aerosol}\ \left(\frac{L}{m^3}\right) = \frac{Box\ Centre^2(m) \times \left(\frac{Spray\ Vol\ \left(\frac{L}{hr}\right) \times Aerosol_{driftable}(\%)}{BoxVR\ \left(\frac{m^3}{hr}\right)}\right)}{BoxDistance^2\ (m)}$$



Aerosol Exposure Modelling Notes:

1) The inhalation of chemicals in mist/aerosol resultant from irrigation activities is dependent upon the concentration in water, the amount of water used per unit time, how close a person stands to the spray generation, how long they are in a position of exposure and the extent of spray drift (determined by the size of the water droplets and speed/direction of the wind). These equations are applicable for non-volatile contaminants that are inhaled.

2) These equations calculate the concentration for driftable droplets using a simple well mixed box model in which steady state air concentrations are calculated. The 'Inverse square law' is then applied to approximate the air concentration at a distance from the virtual air box. This law assumes the further away a receptor is from the spray source, the density of the droplets will decrease. The density of the spray droplets is inversely proportional to the square of the distance from the source.

Parameter	Units	Value	Description
Spray box length	m	3	Assume a 'spray box' of 3 m long.
Spray box width	m	3	Assume a 'spray box' of 3 m wide.
Box Centre	m	1.5	Distance to centre of box is 1.5 m.
$Box_{Distance}$	m	2	Distance the irrigation worker is from the 'spray box'. Assumed a distance of 2 m.
$Aerosol_{driftable}$	unitless	0.2	Proportion of aerosol spray that drifts outside the 'spray box' and available for exposure. Assumed 0.2, based on a droplet size of 400 – 500 µm that falls approximately 0.3 m in less than 10 seconds, with a lateral drift of approximately 3.5 m in a 5 km/hr wind (i.e. a light breeze) (Grisso et al. 2013).
Spray Volume	L/hr	1800.0	1800 L/min, irrigation value adopted from NZ MtE (2011) Appendix 5A.
Wind speed	m/hr	9000	Based on windspeed of 2.5 m/sec
BoxVR	m^3/hr	81000.0	Ventilation rate of spray in the 'spray box'. Assumed to be 81,000 m3/hr based on a wind speed of 9000 m/hr, and a 'spray box' dimension of 3 x 3 m.

CAS	Chemical	Concentration in Water	Generation rate of chemical in volume	Driftable Aerosol Emission Factor
		mg/L	mg/hr	L/m^3
	GFT	1.35	486	2.500000E-03

Exposure to Chemicals via Inhalation of Mist from the Evaporation Units - GFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Inhalation of Mist by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	240	Exposure for 5 days per week minus 4 weeks holidays
Exposure Duration (ED)	years	1	Maximum duration that the flowback tank will be on-site
Exposure Time (ET)	hr/day	1	Professional judgement for irrigation exposure. Assume worker to be near tank for 1 hours every working day.
Driftable aerosol emission factor (EMF)	L/m3	2.50E-03	Calculated
Aerosol Inhalation Bioavailability (AAF)	unitless	1.0	Assume 100% bioavailability
Averaging Time - Threshold (AT)	years	1.0	USEPA 1989 and CSMS 1996
$ITF_{inh,w,shwr} = \frac{EmF \times AAF \times ET_{iw} \times EF \times ED}{365\ \frac{days}{year} \times 24\ \frac{hours}{day} \times AT}$			

Daily Intake = Concentration in Water x Intake Factor (ref: USEPA 1989)
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

						Threshold Intake and Risk Calculations		
CAS	Chemical	Groundwater Concentration	Aerosol Inhalation Bioavailability	Driftable Aerosol Emission Factor	RfC (Background Corrected)	Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)
		mg/L	(unitless)	(L/m^3)	(mg/m^3)	(L/m^3)	(mg/m^3)	(unitless)
64742-47-8	GFT	1.4	1.00	2.50E-03	3.50E+00	6.85E-05	9.25E-05	2.64E-05
							Total Threshold Risk (mixture)	**2.64E-05**

Exposure to Chemicals via Incidental Ingestion of Flowback fluid - WFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Ingestion of Flowback Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Ingestion Rate (IRw)	L/day or L/hr	0.005	Assume Incidental ingestion of 5 ml (1 tsp) of water per day during fraccing.
Bioavailability (B)	-	100%	Assume 100% bioavailability via ingestion of chemicals in water.
Intake Factor = IRw*ET*B*EF*ED / BW*AT	L/kg/day	**4.2E-09** **3.5E-06**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Intake Factor (ref: USEPA 1989)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data: Non-Threshold Slope Factor	Toxicity Data: Chronic Threshold TDI	Toxicity Data: Background Intake (% Chronic TDI)	Toxicity Data: Chronic TDI Allowable for Assessment (TDI-Background)	Concentration in Water	Daily Intake: NonThreshold	Daily Intake: Threshold	Calculated Risk: NonThreshold Risk	Calculated Risk: Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
WFT		3.0E+00		3.0E+00	200000	8.4E-04	7.0E-01	--	2.3E-01
WFT		1.0E+01		1.0E+01	200000	8.4E-04	7.0E-01	--	7.0E-02
							Total Risk (mixture)	**--**	**3.04E-01**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Dermal Exposure to Chemicals via Contact with Flow Back Water - WFT

Chronic Exposures

General Data/ Equations	Units	Exposure Calculations (RME) Dermal Contact with Flow Back Water by Workers	
Exposure Parameters			
Exposure Frequency (EF)	days/year	20	Assume work 5 days per week for 1 month during the fraccing period
Exposure Duration (ED)	years	0.083	Maximum duration of the frac. Works will be complete in one month.
Body Weight (BW)	kg	78	Average male and female adults as per enHealth 2012
Averaging Time - NonThreshold (ATc)	days	25550	USEPA 1989 and CSMS 1996
Averaging Time - Threshold (ATn)	days	30.42	USEPA 1989 and CSMS 1996
Surface Area (SAw)	cm^2	2300	Hands and forearms exposed (enHealth 2012) Occupational HSE would require long pants and closed shoes on Australian work sites; forearms conservatively included
Exposure Time (ET)	hr/day	1	Assume contact with flow back water for 1 hours per day
Conversion Factor (CF)	L/cm^3	1.E-03	Conversion of units
Intake Factor = $\frac{SAw*ET*CF*EF*ED}{BW*AT}$	L-hr/(cm-kg-day)	**1.9E-06** **1.6E-03**	**NonThreshold** **Threshold**

Daily Intake from Water = Concentration in Water x Dermal Permeability x Intake Factor (ref: USEPA 1989, 2004)
NonThreshold Risk = Daily Intake from Water for NonThreshold Effects x Slope Factor
Hazard Quotients = (Daily Intake from Water for Threshold Effects/ADI)

Chemical	Toxicity Data				Dermal Permeability	Concentration in Water	Daily Intake		Calculated Risk	
	Non-Threshold Slope Factor	Chronic Threshold TDI	Background Intake (% chronic TDI)	Chronic TDI Allowable for Assessment (TDI-Background)			NonThreshold	Threshold	NonThreshold Risk	Chronic Hazard Quotient
	$(mg/kg\text{-}day)^{-1}$	(mg/kg/day)		(mg/kg/day)	(cm/hr)	(mg/L)	(mg/kg/day)	(mg/kg/day)	(unitless)	(unitless)
WFT		3.0E+00		3.0E+00	1.1E-4	200000.00	4.4E-05	3.7E-02	--	1.2E-02
WFT		1.0E+01		1.0E+01	2.1E-13	200000.00	7.9E-14	6.7E-11	--	6.7E-12
								Total Risk (mixture)		**1.23E-02**

Note:
This scenario is deemed protective of the following scenarios due to the less frequent and short duration of exposures:
- Worker exposure during a spill (i.e.a couple breaks on a tank and releases product onto the worker) or leak scenarios

Summary of Risk to Workers - Chemical Tracers
Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway	Calculated HI 100% Mass Return
Use of Chemical Tracers in Hydraulic Fracturing	
CFT Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.0000032
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.000010
Inhalation of mist from the evaporation units	0.000018
Total Risk	**0.00003**
GFT Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.0000047
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.0010
Inhalation of mist from the evaporation units	0.000026
Total Risk	**0.001**
WFT Recipe	
Workers	
Ingestion of Chemicals via Incidental Contact with Flowback Water	0.30
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water	0.012
Inhalation of mist from the evaporation units	-
Total Risk	**0.3**

Appendix G

Toxicological Profiles for Halliburton and Schlumberger Recipes

Toxicity Summary - Prop-2-yn-1-ol

Chemical and Physical Properties [1,2]	
CAS number	107-19-7
Molecular formula	C3H4O
Molecular weight	56.06
Solubility in water	1,000 g/L at 20 °C
Melting point	-52 - -48 °C
Boiling point	112 - 115 °C at 101.325 - 101.33 kPa
Vapour pressure	10.84 - 66.37 hPa at 20 - 50 °C
Henrys law constant	0.117 Pa m^3/mol
Explosive potential	Non-explosive
Flammability potential	Flammable
Colour/Form	Colourless liquid with a mild geranium-like odour at 20°C and 1013.25 hPa
Overview	Prop-2-yn-1-ol or propargyl alcohol is a terminal acetylenic compound that is prop-2-yne substituted by a hydroxy group at position 1. It has a role as a Saccharomyces cerevisiae metabolite and an antifungal agent. It is a terminal acetylenic compound, a volatile organic compound and a propynol. It is used to make other chemicals, as a corrosion inhibitor and a soil fumigant.
Environmental Fate [2]	
Soil/Water/Air	Propargyl alcohol's production and use as a corrosion inhibitor, solvent stabilizer, and laboratory reagent may result in its release to the environment through various waste streams. Its former use as a soil fumigant would have resulted in its direct release to the environment. If released to air, an extrapolated vapuor pressure of 15.6 mm Hg at 25 °C indicates propargyl alcohol will exist solely as a vapour in the atmosphere. Vapour-phase propargyl alcohol will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 37 hours. Propargyl alcohol can also be degraded in the atmosphere by reaction with ozone; however, the rate of this reaction is too slow to be environmentally relevant. Propargyl alcohol does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight. If released to soil, propargyl alcohol is expected to have very high mobility based upon an estimated Koc of 14. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 1.1X10-6 atm-cu m/mole. Propargyl alcohol may volatilize from dry soil surfaces based upon its extrapolated vapour pressure. The biodegradation half-life of propargyl alcohol was 12.6 and 13 days in an alkaline sandy silt loam from Texas and an acidic sandy loam from Mississippi, respectively. If released into water, propargyl alcohol is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is expected to be an important fate process based upon this compound's estimated Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 16 and 176 days, respectively. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions.
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	The lowest NOAEL derived from repeated dose oral toxicity studies in rats (28-d and 90-d) was 5 mg/kg bw/d. A NOAEL (local and systemic) of 10-20 mg/kg bw/d (highest test dose) was derived from a subchronic dermal toxicity study in rabbits. From the results of repeated dose inhalation toxicity study in rats and mice a

	systemic NOAEC of 9.4 mg/m^3 (4 ppm), a subchronic local NOAEC of 4 ppm and a chronic local LOAEC of 8 ppm was established.
Carcinogenicity	Considering the incidences and distribution of the few benign neoplasms observed in rats and/or mice following 2-year inhalation exposure to Propargyl alcohol vapour, and with special regard to the very weak but still equivocal evidence of carcinogenic activity when referring to respiratory epithelial adenoma, adenomas are supposed to form solely as a reaction to the described sustained damage and inflammation of the respiratory epithelium. It is concluded that Propargyl alcohol has no carcinogenic potential overall.
Mutagenicity/ Genotoxicity	Propargyl alcohol is not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Propargyl alcohol is not considered to cause toxicological relevant effects on fertility.
Acute Toxicity	The LD50/LC50 values derived from the key-studies were: LD50 (oral, rat) 56.4 mg/kg bw, LD50 (dermal, rabbit) 88 mg/kg bw, LC50 (2 h inhalation, rat) 2000 mg/m^3.
Irritation	Based on the results of the corresponding key studies, Propargyl alcohol is considered to be corrosive after application on skin (destruction of full thickness skin after >= 5 min exposure) and eye.
Sensitisation	Propargyl alcohol was not a skin sensitizer.
Health Effects Summary	Propargyl alcohol is considered to be toxic following acute oral, dermal or inhalation exposure.
Key Study/Critical Effect for Screening Criteria	The lowest NOAEL derived from repeated dose oral toxicity studies in rats (28-d and 90-d) of 5 mg/kg bw/d was considered the most sensitive endpoint.
Ecological Toxicity [1]	
Aquatic Toxicity	Acute tests on all three trophic levels were performed to examine the aquatic toxicity of Prop-2-yn-1-ol. Fish and aquatic invertebrates turned out to be the most sensitive species revealing an LC50 (96h) of 1.53 mg/L and an EC50 (48h) of 3.36 mg/L, respectively. Algae were found to be less sensitive than fish and invertebrates providing an ErC50 (72h) >100 mg/L. Thus, Prop-2-yn-1-ol is considered acutely toxic for aquatic organisms.
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 1000 is applied to the lowest LC50 of 1.53 mg/L (fish). A PNECaqua of 0.002 mg/L was derived.
Current Regulatory Controls [2,3,4]	
Australian Hazard Classification	Flammable liquid – category 3 Acute toxicity – category 3 Acute toxicity – category 3 Acute toxicity – category 3 Hazardous to the aquatic environment (chronic) – category 2 Skin corrosion – category 1B
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	10 Hr Time-Weighted Avg: 1 ppm (2 mg/cu m). Skin designation.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.

PBT Assessment [1,2]	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable
B/vB criteria fulfilled?	No. As the Log KoW -0.35 @ 25 °C 59 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 of Prop-2-yn-1-ol is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

References

1. ECHA REACH, Prop-2-yn-1-ol. Retrieved 2021: https://echa.europa.eu/.
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.
3. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Thiourea, polymer with formaldehyde and 1-phenylethanone

Chemical and Physical Properties [1,2]	
CAS number	68527-49-1
Molecular formula	C10H14N2O2S
Molecular weight	226.30
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	In the absence of available data for thiourea, polymer with formaldehyde and 1-phenylethanone, the assessment on polymers containing formaldehyde monomers from NICNAS has been used in addition to read across data from Phenol, formaldehyde polymer (CAS 9003-35-4). The polymers in this group may be used in the production of formaldehyde resin products and non-resin consumer products such as cosmetics and household cleaning products. In these applications, the formaldehyde resin and/or products manufactured may contain free formaldehyde or may release some or all the formaldehyde they contain (formaldehyde donors). The hazardous properties of free formaldehyde or released formaldehyde are expected to dominate the toxicity profile of these polymers despite minor differences in individual solubility in biological system.
Environmental Fate	
Soil/Water/Air	Biodegradation experiment was conducted for determining the biodegradability of CAS 9003-35-4 (Tisler et al, 1997). The study was performed according to guideline ISO DIS 9408 (Ultimate Aerobic Biodegradability - Method by Determining the Oxygen Demand in a Closed Respirometer) under aerobic conditions. Settled municipal waste water was used as a test inoculum for the study. The percent degradation of test chemical was determined by using industrial waste water samples of test chemical and parameter used was biological oxygen demand. More than 60 % degradation was observed in 10 days of in diluted samples and 80% degradation observed in 10 days of diluted samples. On the basis of this percent degradability value, it is concluded that test chemical is readily biodegradable in nature. The Log Kow (Log Pow) was determined to be 2.8 @ 25 °C This log Koc value indicates that the test chemical has a moderate sorption to soil and sediment and therefore have slow migration potential to ground water.
Human Health Toxicity Summary [1,2,6]	
Chronic Repeated Dose Toxicity	Chronic toxicity oral study for the 50 -60% structurally and functionally similar read across test compounds were studied in male and female Osborne-Mendel rats. The test compounds was fed through the diet at a concentration of 0, 5000, 10000 or 20000 ppm (0, 250, 500 or 1000 mg/Kg bw) for 2 years. The animals were observed weekly for weight, food intake and general condition. Haematological examinations were made at termination. These examinations included white cell counts, red cell counts, haemoglobins and haematocrits. No effects were noted in the treated animals at the mentioned dose level. Based on the observations made, the no observed Adverse Effect Level (NOAEL) for the two test chemicals using Osborne-Mendel rats for a duration of 1 year is considered to be 1000 mg/Kg bw.

	Formaldehyde, oligomeric reaction products with phenol has very low vapour pressure of 3.186 Pa (0.0239 mmHg). Also, the test chemical has a particle size distribution of 53-150 micron, so the potential for the generation of inhalable vapours is very low.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	The data available for the target chemical based on its read across substance and applying weight of evidence Phenol-formaldehyde resin (9003-35-4) does not exhibit gene mutation in vitro. Hence the test chemical is not likely to classify as a gene mutant in vitro.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Reproductive /chronic oral toxicity study for the CAS 9003-35-4 was performed on male and female Osborne-Mendel rats. 12 male and 12 female were used in each dose group. The test material was fed through the diet at a concentration of 0, 5000, 10000 or 20000 ppm (0, 250, 500 or 1000 mg/Kg bw) for 2 years. Animals were checked for clinical signs, Food consumption and body weight every week. At the termination of the experiments the rats were sacrificed and exsanguinated. The tissues of all the rats were examined macroscopically at the time of sacrifice. The viscera were removed and the liver, kidneys, spleen, heart, and testes were weighed. These organs, the remaining abdominal and thoracic viscera, and one hind leg, for bone, bone marrow, and muscle, were preserved in 10% buffered formalin-saline solution for histopathological examination. For routine histopathology, sections were embedded in paraffin wax and stained with haematoxylin and eosin.No treatment-related clinical signs and premature deaths were observed. No relevant necropsy findings were noted. No effects on testes weight was noted in treated rats at dose concentration 1000mg/kg bw, Based on the observations made, the no observed Adverse Effect Level (NOAEL) for the test chemical using Osborne-Mendel rats for a duration of 2 year is considered to be 1000 mg/Kg bw. Thus, comparing this value with the criteria of CLP regulation test material is not likely to classify as reproductive toxicant.
Acute Toxicity	The acute oral toxicity dose (LD50) was considered based on different studies conducted on rats and mice for the test chemical. The LD50 value is >5000 mg/kg bw, for acute oral toxicity. The acute Inhalation toxicity dose (LC50) was considered based on different studies conducted on rats and mice for the test chemical. The studies concluded that the LC50 value is >5 mg/L (>5000 mg/m^3), for acute inhalation toxicity. The acute dermal toxicity dose (LD50) was considered based on different studies conducted on rats and rabbits for the test chemical. The studies concluded that the LD50 value is >2000 mg/kg bw, for acute dermal toxicity.
Irritation	Breathing formaldehyde vapour can result in irritation of nerves in the eyes and nose, which may cause burning, stinging or itching sensations, a sore throat, teary eyes, blocked sinuses, runny nose, and sneezing.
Sensitisation	No data available.
Health Effects Summary	If the polymers in this group do not readily release free formaldehyde, none of the polymers are expected to have significant health effects. However, where the polymers in this group degrade to free formaldehyde or are capable of releasing formaldehyde, the critical health effects for risk characterisation include sensory irritation and allergic skin reactions.
Key Study/Critical Effect for Screening Criteria	There are no data available on the health hazards of the polymers in this group. However, it is considered that the formaldehyde released from the decomposition of these polymer resins will be the critical driver of toxicity. Sensory irritation is defined as irritation of the nerve endings in the eyes and nose and can produce symptoms such as stinging or burning sensations in the eyes, nose and/or a sore throat. The level of formaldehyde in the air at which these symptoms have been known to start to occur is 0.5 parts per million (ppm). The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 1000 mg/kg bw/day from the 1 year repeated oral toxicity study.

Ecological Toxicity [3]	
Aquatic Toxicity	Based on aquatic toxicity data for formaldehyde: Fish: LC50 (96h) Morone saxatilis 6.18 mg/L LC50 (6d) embryos of Danio rerio 6.9 mg/L NOEC (28d) Oryzias latipes ≥ 48 mg/L Aquatic invertebrates: EC50 (48h) Daphnia pulex 5.8 mg/L NOEC (21 d) Daphnia magna > 6.4 mg/L Algae: EC50 (72h) Desmodesmus subspicatus 4.89 mg/L
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest NOEC of 6.4 mg/L (invertebrates). A PNECaqua of 0.64 mg/L was derived.
Current Regulatory Controls [4,5]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	Safe Work Australia has an exposure standard for formaldehyde. Where the polymers in this group contain free formaldehyde or release formaldehyde, exposure standards of 1.2 mg/m^3 (1 part per million) time weighted average (TWA) and 2.5 mg/m^3 (2 parts per million) short term exposure limit (STEL) apply.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. Based on data for formaldehyde, the substance is expected to be biodegradable.
B/vB criteria fulfilled?	No. Based on data for formaldehyde, due to the low log Kow (0.35), accumulation in organisms is not to be expected.
T criteria fulfilled?	No. Based on data for formaldehyde, the acute and chronic toxicity is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

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Toxicity Summary - Sodium bromate

Chemical and Physical Properties [1,2,4,5]	
CAS number	7789-38-0
Molecular formula	BrHO3.Na
Molecular weight	150.90 g/mol
Solubility in water	36.4 g/100 mL at 20 ºC
Melting point	350 ºC
Boiling point	Decomposes at 381 ºC
Vapour pressure	Negligible
Henrys law constant	Negligible
Explosive potential	Risk of fire and explosion on contact with combustible substances or reducing agents.
Flammability potential	Not combustible but enhances combustion of other substances. Gives off irritating or toxic fumes (or gases) in a fire.
Colour/Form	Colourless crystals
Overview	The toxicological effects of these chemicals are mediated primarily through the bromate ion. Following dissociation in water, sodium (Na+) cations are released, which are naturally occurring species and do not contribute to toxicity. Sodium bromate is used in cleaning/washing agents, surface treatments, paints, lacquers and varnishes, and in cosmetics as an oxidising agent. These chemicals dissociate in water and bromate ion is rapidly absorbed from the gastrointestinal tract, at least in part unchanged. It is distributed throughout the body appearing in plasma and urine unchanged and in other tissues as bromide. Bromate is reduced to bromide in several body tissues. Most bromate is excreted in the urine either as bromate or bromide, but some may leave the body in the faeces. Bromine has been detected in adipose tissue of mice following long-term treatment with bromate (US EPA, 2001; REACHb). Sodium bromate and potassium bromate produce similar effects and these chemicals are roughly equivalent in the delivery of bromate ions. Information on potassium bromate has been included in this toxicological profile.
Environmental Fate [1,2,5]	
Soil/Water/Air	Sodium bromate can be assumed to have a negligible vapour pressure, and it is therefore not expected to partition to air. Similar to many inorganic salts, sodium bromate is highly soluble in water and dissociates rapidly (primarily ionic bonds) to release the bromate ion. The bromate ion is expected to have high mobility in water and relatively little bromate is expected to partition to sediments and soils. Bromate ions found in sediments and soils are expected to be mobile in these compartments. Butler et al. (2005a) indicated that bromate is persistent in water even if this ion is thermodynamically unstable (e.g., Takeno 2005) and subject to slow biological reduction under natural conditions. In aqueous solution, bromate is highly stable at room temperature, does not volatilize and is not removed by boiling (Butler et al. 2005a). A number of studies have demonstrated that bromate can be reduced to bromide in soil, using enriched microbial communities and an appropriate carbon source (Rodgers 1980; Butler et al. 2005b). Furthermore, Rodgers (1980) observed 60% to nearly 100% conversion of BrO_3^- to Br^- following 14-day incubation, at 25°C,

	of aerobic and anaerobic soils, both amended and unamended with glucose. These results suggest that natural attenuation of bromate in soil is possible. Considering published information and experimental evidence for metabolic transformation, potassium bromate does not meet the bioaccumulation criteria (BAF, BCF ≥5000)

Human Health Toxicity Summary [1,2,3,4,5,6]	
Chronic Repeated Dose Toxicity	A number of repeated dose oral toxicity studies in animals indicate that the kidney is the major target organ of bromate-associated toxicity, leading to carcinogenicity. Specific non-cancer effects included degenerative, necrotic, nephropathic, and regenerative changes in the kidney. In a repeated dose toxicity study, potassium bromate was administered in the drinking water at concentrations of 0, 150, 300, 600, 1250, 2500, 5000, or 10000 mg/L to male and female Fischer 344 (F344) rats (10/sex/group) for 13 weeks. All animals exposed to >1250 mg/L died within seven weeks. Significant inhibition of body weight gain was observed in males exposed to 600 or 1250 mg/L. Various-sized droplets and regenerative changes were observed in the renal tubules of treated males. A no observed adverse effect level (NOAEL) of 300 mg/L was determined (US EPA, 2001; NTP, 2007; REACHb). In a chronic toxicity/carcinogenicity study, potassium bromate was administered at 0, 250, and 500 ppm concentrations to F344 rats (53/sex/group) for 110 weeks. Daily intake of potassium bromate was equivalent to 12.5 and 27.5 mg/kg bw/day in males and 12.5 and 25.5 mg/kg bw/day in females, respectively. As the growth of males in the high dose group was severely inhibited, the concentration in this group was reduced to 400 ppm at week 60. Body weight gain was significantly reduced in high-dose males, but not in the other treated groups. Survival was reduced in high-dose males by about week 60 and in low-dose males by about week 100. No effect on survival was observed in treated female rats. A variety of non-cancer effects were reported, including: degenerative, necrotic, and regenerative changes in renal tubules; formation of hyaline droplets; thickening of transitional epithelium of the renal pelvis; papillary hyperplasia; and papillary growth. It was noted that the lesions were more extensive in degree and distribution in treated rats compared with controls, especially males. However, in the absence of information on the incidence of these lesions or on the statistical significance of these findings, a NOAEL for non-cancer effects could not be determined (US EPA, 2001; Health Canada, 2010). In another chronic study, potassium bromate was administered to male F344 rats and male B6C3F1 mice in drinking water at concentrations of 0, 0.02, 0.1, 0.2, and 0.4 g/L and 0, 0.08, 0.4, and 0.8 g/L, respectively, for 100 weeks. The doses were equal to 0, 1.5, 7.9, 16.9, and 37.5 mg/kg bw/day and 0, 9.1, 42.4, and 77.8 mg/kg bw/day, respectively, for rats and mice. In male rats, a statistically significant decrease in the mean body weight and survival was noted at the termination of the study at 0.4 g/L. The decrease in survival and body weight was attributed to an excessive mesothelioma burden. The effects on survival and body weight in rats indicate that the maximum tolerated dose (MTD) was reached in this study. A significant dose-dependent increase in the incidence of urothelial hyperplasia was noted in rats in the 0.1 g/L and higher dose groups. Foci of mineralisation of the renal papilla and eosinophilic droplets in the proximal tubule epithelium were also noted, without any information on dose levels. There were no other treatment-related non-neoplastic effects observed in any other tissue examined. On the basis of kidney effects in male rats, a NOAEL of 0.02 g/L (20 ppm; 1.5 mg/kg bw/day) was determined (US EPA, 2001; Health Canada, 2010). These results also indicate that male B6C3F1 mice may be less sensitive to the effects of bromate exposure than rats. Bromate in drinking water had no effect on the body weights and survival of male mice. There was no increased incidence of non-neoplastic lesion in any tissue examined. Therefore, the highest tested dose of 0.8 g/L (77.8 mg/kg bw/day) is a NOAEL for male mice (US EPA, 2001; Health Canada, 2010).

Carcinogenicity	Potassium bromate is currently classified as hazardous as a Category 2 carcinogen with the risk phrase 'May cause cancer' (T; R45) in the HSIS (Safe Work Australia). The available data support this classification (Health Canada, 1999; US EPA, 2001; WHO, 2005; REACHa). Considering that potassium bromate and sodium bromate will produce similar effects through bromate ions, a classification similar to the above is also recommended for sodium bromate. This is supported by the classification of 'bromate moiety' as a carcinogen by other regulatory agencies (Health Canada, 1999; US EPA, 2001; WHO, 2005). The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence in humans for the carcinogenicity of potassium bromate. However, there is sufficient evidence in experimental animals for its carcinogenicity and it is classified as possibly carcinogenic to humans (Group 2B) (IARC, 1999). Health Canada has classified the bromate moiety as 'probably carcinogenic to humans, based on sufficient evidence in animals and no data in humans' (Health Canada, 1999). The US EPA has also classified the bromate moiety as a 'probable human carcinogen based on no evidence in humans, but adequate evidence of carcinogenicity in male and female rats' (Group B2 carcinogen) under previous guidelines and as a 'likely human carcinogen by the oral route of exposure, insufficient data for evaluation by the inhalation route' under current guidelines (US EPA, 2001). Recently, the World Health Organization (WHO) evaluated the bromate moiety under the WHO Guidelines for Drinking-water Quality and stated that 'the weight of evidence from rat bioassays clearly indicates that bromate has the potential to be a human carcinogen' (WHO, 2005). Several studies have been conducted in animals by oral administration to evaluate the carcinogenic effects of potassium bromate. The kidney is the major target organ of bromate-associated toxicity, rats are more sensitive than mice to bromate treatment and specific non-cancer effects include degeneration, necrosis, nephropathic, and regenerative changes in kidneys. The chemical produced tumours in kidneys (renal tubular tumours - adenomas and carcinomas) and the thyroid (follicular cell adenomas and carcinomas) and peritoneal mesotheliomas in males rats. However, only kidney tumours were developed in female rats and these were observed in the absence of the significant toxicity observed in the male rats. The chemical also produced a low incidence of renal cell tumours in male mice and the incidence of renal tubular tumours was marginally increased in male Syrian hamsters (IRIS, 2001; US EAP, 2001; WHO, 2005; Health Canada, 2010). The exact mode of action for induction of tumours is not clear. However, considering the detection of 8-hydroxydeoxyguanosine in kidneys of rodents, the role of oxidative stress has been suggested in the formation of kidney tumours. The evidence is insufficient to establish lipid peroxidation and free radical production as key events responsible for the induction of kidney tumours. Even though the role of cell proliferation has also been proposed in the induction of tumours, the mechanism involving cell proliferation remains to be elucidated. Although bromate is mutagenic in bacteria and causes chromosomal aberrations, the role of mutation in the induction of tumours has also been questioned. The US EPA has suggested the predominant mode of action is DNA reactivity at low doses, considering the detection of tumours at relatively early time points and the positive response of bromate in a variety of genotoxicity assays (US EPA, 2001; WHO, 2005; Health Canada, 2010).
Mutagenicity/ Genotoxicity	Although potassium bromate has been found to be genotoxic in a variety of assays (in vitro, in vivo), results were not sufficient to support its classification. The genotoxicity of potassium bromate has recently been linked to oxidative stress (US EPA, 2001; Health Canada, 2001; REACHa; REACHb).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Limited data are available on the reproductive or developmental effects. However, the available information indicated that these chemicals are not likely to have specific reproductive or developmental effects.

Acute Toxicity	Oral Potassium bromate is classified as hazardous with the risk phrase 'Toxic if swallowed' (T; R25) in the Hazardous Substances Information System (HSIS) (Safe Work Australia). The available data (median lethal dose—LD50—157 mg/kg bw) support this classification (REACHa). Data are not available for sodium bromate. Considering that both chemicals will produce similar effects through bromate ions, a classification similar to the above is also recommended for sodium bromate (NTP, 2007; Health Canada, 2010; REACHb). Dermal No data are available. Inhalation No data are available. Observation in humans A number of cases of acute bromate toxicity have been reported in humans following accidental or intentional ingestion of permanent hair wave neutralising solution. These products usually contain either 2 % potassium bromate or 10 % sodium bromate. Bromate intoxication leads to gastrointestinal symptoms (abdominal pain, nausea, vomiting, diarrhoea), central nervous system depression, renal failure, and hearing loss. Although these effects are usually reversible, death from renal failure may ensue if medical intervention is not successful. Hearing loss is usually irreversible (US EPA, 2001; NTP, 2007; HSDB; REACHb).
Irritation	Skin Irritation Although limited data are available, the available information indicates that these chemicals are not likely to be corrosive. The purpose of the available study was to identify potential of potassium bromate for skin corrosion using an in vitro method. The study was conducted according to Organisation for Economic Co-operation and Development (OECD) Test Guideline (TG) 431, using a human skin model. The study consisted of a topical exposure of potassium bromate to a human reconstructed model followed by a cell viability test. Potassium bromate was not considered to possess a corrosive potential (REACHa). Eye Irritation Although limited data are available, the available information indicates that these chemicals are not likely to be eye irritants. An eye irritation study was conducted according to OECD TG 437: Bovine Corneal Opacity and Permeability Test Method for Identifying Ocular Corrosives and Severe Irritants. In this test, the damage is assessed by quantitative measurements of changes in corneal opacity and permeability with an opacitometer and a visible light spectrophotometer, respectively. Potassium bromate caused weak opacity but no permeability of the cornea compared with the results of the negative control group. The chemical was considered to be a mild eye irritant (REACHa).
Sensitisation	The available data on potassium bromate indicate that these chemicals are not likely to be skin sensitisers. In a skin sensitisation study conducted according to OECD TG 429 (local lymph node assay—LLNA), potassium bromate (CAS No. 7758-01-2) at 1.25 %, 2.5 %, and 7.5 % (w/v) concentration was applied topically at the dorsum of each ear of female CBA mice once daily on three consecutive days. A further group of mice was treated with the positive control item and a control group of mice was also treated with the vehicle only. Stimulation Indices (S.I.) of 0.90, 0.53, and 0.64 were determined with the test item at concentrations of 1.25, 2.5, and 7.5 % (w/v), respectively. The EC3 value could not be calculated, since none of the tested concentrations induced an S.I. of greater than three. Potassium bromate was not considered to be a skin sensitiser (REACHa).
Health Effects Summary	The critical health effects for risk characterisation include systemic long-term effects of carcinogenicity and systemic acute effects from oral exposure to these chemicals.

Key Study/Critical Effect for Screening Criteria	The Australian Drinking Water guideline for Bromate (0.02 mg/L health) may apply.
Ecological Toxicity [1,5]	
Aquatic Toxicity	Short term toxicity to fish: 1- to 10-d LC50s ranging from 698.0 to 278.6 mg/l BrO3-, respectively for Juvenile spot. Short term toxicity to aquatic algae and cynobacteria: 72h EC50 value was 603.5 (189.3 – n.d.) mg/L for Yield. Short term toxicity to Invertebrates: <24hr LC50 of 112.7 mg/L Daphnia magna 48 hr LC50 of 55.3 mg/L Daphnia magna 72 hr LC50 of 46.8 mg/L Daphnia magna 96hr LC50 46.8 mg/L Daphnia magna 72 hr EC50 of 15954 mg/L for Isochrysis galbana (Haptophyte algae) 24 hr EC50 of 170 mg/L for Crassostrea gigas (Pacific oyster) larvae
Determination of PNEC aquatic	A predicted no-effect concentration (PNEC) was derived from the lowest acceptable toxicity value identified for a freshwater organism—an acute LC50 for Daphnia Magna of 46.8 mg/L. An assessment factor of 100 was applied to account for uncertainties associated with inter- and intra-species variability and extrapolation from a laboratory LC50 to a chronic no-effect value in the field. This calculation resulted in a PNEC of 0.468 mg/L.
Current Regulatory Controls [2,6]	
Australian Hazard Classification	Potassium bromate (CAS No. 7758-01-2) is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): T; R25 (acute toxicity) T; R45 Carc. Cat 2 (carcinogenicity)
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	Potassium bromate (CAS No. 7758-01-2) has a Workplace Environmental Exposure Level (WEEL) of 0.1 mg/m^3 time weighted average (TWA) in the United States of America (USA).
Australian Food Standards	No data available
Australian Drinking Water Guidelines	Based on health considerations, the concentration of bromate in drinking water should not exceed 0.02 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1,5]	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
T criteria fulfilled?	Not applicable. Acute toxicity data >1 mg/L, thus this substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

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Toxicity Summary - Calcium chloride

Chemical and Physical Properties [1,4]	
CAS number	10043-52-4
Molecular formula	$CaCl_2$
Molecular weight	110.98
Solubility in water	81.3 g/100 g water at 25 °C
Melting point	775 °C
Boiling point	1935 °C
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	No data found
Flammability potential	No data found
Colour/Form	Odourless white powder
Overview	Calcium chloride is easily dissociated into calcium and chloride ions in water. Both ions are essential elements in animals and humans. Calcium is essential for the formation of skeletal structure, neural transmission, muscle contraction, coagulation of the blood, and a range of other physiological functions. Chloride is required for regulating intracellular osmotic pressure and buffering.
Environmental Fate [2,3]	
Soil/Water/Air	Calcium chloride is soluble in water and its vapour pressure is negligible. When released into the environment calcium chloride is distributed into the water in the form of calcium and chloride ions. Calcium chloride is not expected to be absorbed in soil due to its dissociation properties and high water solubility. The chloride ion is mobile in soil and eventually drains into surface water because it is readily dissolved in water. Calcium chloride is not expected to undergo photolysis or biodegradation. Considering its dissociation properties, calcium chloride is not expected to accumulate in living organisms.
Human Health Toxicity Summary [4]	
Chronic Repeated Dose Toxicity	No reliable repeated dose oral studies are available. In one study, which was not conducted according to OECD guidelines, 40-day-old rats were fed 20 mg/g of anhydrous calcium chloride for 12 months (Pamukcu, Yalciner & Bryan, 1977). No differences in mortality, weight gain, or daily food consumption were observed between the test and the control groups. No neoplastic lesions were observed in the gastrointestinal tract, urinary tract, liver, heart, brain or spleen of the animals. Based on food consumption, the daily intake of calcium chloride was estimated to be 440 mg. Considering that 1 mg/g in the diet is equivalent to 100 and 50 mg/kg bw/day for young and old rats, respectively, the dose used in this study corresponded to 1000 to 2000 mg/kg bw/day.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vitro study, conducted according to OECD guidelines, doses of calcium chloride up to 5 mg/plate were examined in a Salmonella typhimurium mutation test using strains TA92, TA94, TA98, TA100, TA1535 and TA1537 with metabolic activation (Ishidate et al., 1984). In another reverse mutation test, doses up to 10 mg/plate were examined using S. typhimurium strains TA97 and TA102 with or without metabolic activation (Fujita & Sasaki, 1987). No significant increases in mutation frequencies were observed in either study. In two additional bacterial genotoxicity studies, which were not conducted according to OECD test guidelines, no DNA damage was reported at calcium chloride concentrations of up to 0.5 molar (Kanematsu et al., 1980; Olivier & Marzin, 1987). An in vitro chromosome aberration test comparable to OECD test guidelines, using Chinese hamster lung cells (CHL), has also been reported. Cells were exposed to

	calcium chloride at doses up to 4 mg/mL for 48 hours without metabolic activation. No significant increases in polyploid formation or structural chromosome aberration were observed (Ishidate et al., 1984).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data are available on the effects of calcium chloride on fertility. In a series of developmental toxicity studies conducted comparably to OECD TG 414, the effects of calcium chloride on embryo-lethality and teratogenicity were studied in mice, rats and rabbits at different dose levels. The maximum doses of calcium chloride were 189, 176, and 169 mg/kg bw/day in mice, rats and rabbits, respectively. Calcium chloride had no discernible effect on implantation or on maternal or foetal survival. There were no differences in numbers of abnormalities in soft or skeletal tissues between test and control animals. The studies concluded that calcium chloride up to 189 mg/kg bw/day in the mouse, 176 mg/kg bw/day in the rat and 169 mg/kg bw/day in the rabbit had no developmentally toxic effects (Food and Drug Research Laboratories, 1974).
Acute Toxicity	Calcium chloride has low acute toxicity following oral exposure in animal tests. Acute oral toxicity of calcium chloride has been tested in several mice, rat and rabbit studies. The oral lethal median doses (LD50s) values range from 2120–3798 (male) and 2361–4179 (female) mg/kg bw in rats to 2045 (male) and 1940 (female) mg/kg bw in mice (Akatsuka, 1997). Calcium chloride has low acute toxicity from dermal exposure. An acute dermal toxicity study was conducted in rabbits by a scientifically accepted method (Carreon et al., 1981). No adverse effects were observed and no deaths occurred up to 5000 mg/kg bw, the highest applied dose. No significant change was found either at gross necropsy examination or at the site of application except for some skin lesions (see Skin irritation). The dermal LD50 from this study was >5000 mg/kg bw. Reliable studies on acute inhalation toxicity of calcium chloride are not available. In one study, rats were exposed to 40 and 160 mg/m^3 anhydrous calcium chloride (CAS No. 10043-52-4) for four hours. Signs of irritation of the trachea were observed in the animals. No deaths were reported (Sukhanov et al., 1990). However, the reliability of this study is questioned due to insufficient information on the form of calcium chloride and methodology used.
Irritation	No data are available. However, signs of irritation of the trachea were observed in animals in an acute inhalation study (Sukhanov et al., 1990), indicating that calcium chloride is likely to be a respiratory irritant. In studies conducted according to OECD test guidelines, no or only slight skin irritation were observed in rabbits from four-hour exposures to anhydrous calcium chloride (CAS No. 10043-52-4), calcium chloride dihydrate (CAS No. 10035-04-8), and/or calcium chloride hexahydrate (CAS No. 7774-34-7) (Koopman and Pot, 1986b-e). Rabbits exposed for 24 hours to anhydrous calcium chloride and solid or 38 % calcium chloride dihydrate solution had slight to moderate irritation on intact skin and more severe irritation on abraded skin (Norris, 1971a, b; Carreon, Yano & New, 1981). Anhydrous calcium chloride was a severe irritant to rabbit eyes. The cornea and conjunctivae were moderately to severely irritated from one hour until 14 days after treatment, and were still moderately irritated 21 days after treatment. Hydrated forms of calcium chloride were less irritating to the eyes. With the dihydrate form, the cornea and conjunctivae were moderately irritated from one hour to 72 hours post application, and in one rabbit for up to 14 days. The hexahydrate caused slight to moderate irritation of the cornea and conjuntivae, which persisted for up to 48 hours, and in one rabbit, for up to 14 days. The 33 % and 38 % solutions of calcium chloride were slight to moderate eye irritants causing diffuse corneal opacity and slight to moderate conjunctival redness. Slight to moderate chemosis was also observed in some, but not all, rabbits (Norris, 1971a, b; Koopman & Pot, 1986f-i).

Sensitisation	No data available
Health Effects Summary	The critical health effects for risk characterisation are local effects (severe eye irritation). Observations in humans suggest that calcium chloride may be a slight respiratory irritant. From limited repeat dose data in rats, intakes of up to 2000 mg/kg bw/day via diet were without effect. Calcium chloride is neither genotoxic nor carcinogenic, nor a developmental toxicant. In the absence of an appropriate No-Observed-Adverse-Effect Level (NOAEL), the highest dose tested in the oral study (2 000 mg/kg bw/day) is used for human health risk assessment.
Key Study/Critical Effect for Screening Criteria	In the absence of an appropriate No-Observed-Adverse-Effect Level (NOAEL), the highest dose tested in the oral study (2 000 mg/kg bw/day) is used for human health risk assessment.
Ecological Toxicity [2,3]	
Aquatic Toxicity	Several studies on acute toxicity to fish have been reported. The lowest 96-hr LC50 value was 4,630 mg/L in fathead minnow (Pimephales promelas). No chronic toxicity studies on fish conducted under standard guidelines have been reported. There are seven acute toxicity data available for Daphnia. Two of these studies were conducted according to international or national guidelines, giving the 48-hr EC50 of 2,400 mg/L for Daphnia magna and the 48-hr LC50 of 1,830 mg/L for Ceriodaphnia sp. The lowest 48-hr EC50 was 1,062 mg/L for Daphnia magna. The chronic effect of 21-day exposure on reproduction of Daphnia magna has been investigated as a long-term study. The concentration required for 16% and 50% inhibition of reproduction (EC16 and EC50) were 320 and 610 mg/L, respectively. The NOEC = EC16/2 = 320/2 = 160 mg/L. There is one study with fresh water algae, Selenastrum capricornutum, which was conducted according to OECD TG 201. The 72-hr EC50 and EC20 obtained on the basis of growth rate from the study were >4,000 and 2,700 mg/L, respectively. The 72-hr EC50 and EC20 obtained on the basis of biomass from the study were 2,900 and 1,000 mg/L, respectively. The NOECs are calculated as EC20/2, which corresponds to 1,350 and 500 mg/L for growth rate and biomass, respectively.
Determination of PNEC aquatic	Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (4,630 mg/L), Daphnia (1,062 mg/L), and algae (2,900 mg/L). Results from a chronic Daphnia study (NOEC = 160 mg/L) and algae study (NOECs = 1,350 and 500 mg/L for growth rate and biomass, respectively) are also available. On the basis that the data consists of short-term results from three trophic levels and chronic studies on Daphnia and algae, an assessment factor of 50 has been applied to the lowest reported NOEC of 160 mg/L for Daphnia.
Current Regulatory Controls [4]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): • an occupational exposure limit (OEL) of 5 mg/m^3 for calcium chloride (CAS No. 10043-52-4) in Canada; and • an OEL of 2 mg/m^3 for calcium chloride (CAS No. 10043-52-4) in Latvia.
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)

T criteria fulfilled?	No chronic toxicity data exist on calcium chloride; however, the acute EC(L)50s are >0.1 mg/L in fish, invertebrates and algae. Thus, calcium chloride does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

References

1. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. IUCLID (2002) IUCLID Data Set for Calcium chloride (CASRN 10043-52-4), UNEP Publications.
3. OECD-SIDS (2002) Screening Information Dataset (SIDS) Initial Assessment Report for Calcium chloride (CASRN 10043-52-4), UNEP Publications.
4. National Industrial Chemicals Notification and Assessment Scheme (NICNAS), IMAP Single Assessment Report, Calcium chloride (CaCl2): Human health tier II assessment, Retrieved 2018: https://www.nicnas.gov.au/

Diammonium Peroxidisulphate

Chemical and Physical Properties [2]	
CAS number	7727-54-0
Molecular formula	$H_8N_2O_8S_2$
Molecular weight	--
Solubility in water	228.2 g/mol
Melting point	Decomposition temperature 120 °C
Boiling point	Decomposes
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	Not explosive.
Flammability potential	Not flammable.
Colour/Form	White granules
Overview	Ammonium persulfate is distributed into the water compartment in the ionic form of the ammonium cation and persulfate ion. The persulfate anion will readily hydrolyze (decompose) into sulfate ions. Diammonium peroxidisulphate is a widely used reagent in biochemistry and molecular biology for the preparation of polyacrylamide gels and is also used in hair bleach
Environmental Fate[1,4,5]	
Soil/Water/Air	The inorganic persulfates are soluble in water and their vapour pressures are negligible. Ammonium persulfate will be distributed into the water compartment in the ionic form of the ammonium cation and persulfate anion. Ammonium persulfate is expected to degrade in the environment mainly via hydrolysis, but metal catalyzed decomposition, and reactions with organic chemicals in the soil or water also are possible. Persulfates are not expected to adsorb to soil due to its dissociation properties, instability (hydrolysis) and high water solubility. Persulfates should behave as free ions or decompose into sulfate ions. In soils, upon decomposition, the cation could form more stable sulfate or bisulfate salts. Persulfates are not expected to bioaccumulate in the soil or in aqueous solution. They will decompose into inorganic sulfate or bisulfate
Human Health Toxicity Summary [1,3,4,5,6]	
Chronic Repeated Dose Toxicity	28-day repeated dose oral (dietary) toxicity studies in rats were conducted and the NOAELs for sodium and ammonium salts were 41 mg/kg bw/day and the top dose of 137 mg/kg bw/day, respectively (FMC Corporation 1979a, 1979c). A well-conducted 90-day inhalation study of ammonium persulfate revealed evidence of inflammation of the airways, reduced body weight gain, rales, increased respiratory rate and increased lung weights at the LOAEL of 25 mg/m^3 (FMC 1998). A NOAEL of 5 mg/m^3 was identified by the OECD (2005) based on sporadic rales and respiratory effects seen (in females only) at the NOAEL of 10.3 mg/m^3. No long term dermal studies were available. In humans, pulmonary function tests conducted on employees of a persulfate production facility indicated no adverse effects on pulmonary function at workplace levels, measured at 0.5 mg/m^3 (FMC Corporation 1992). Follow-up of these same employees indicated that exposure at 0.5 mg/m^3 had no long-term effects on pulmonary function (Greaves 1997).
Carcinogenicity	NA - not listed on Chemical Carcinogenesis Research Information System (CCRIS) or International Agency for Research on Cancer (IARC) Databases, or documented by US EPA. In a non-guideline dermal study, female SENCAR mice were exposed twice weekly to 0.2 mL of a 200 mg/mL solution of ammonium

	persulfate for 51 weeks (Kurokawa et al. 1984). It was concluded that ammonium persulfate is neither a tumour promoter nor a complete carcinogen when applied to the skin.
Mutagenicity/ Genotoxicity	Ammonium persulfates are not genotoxic. Negative results for mutagenicity are available from Ames tests in S. typhimurium strains TA97 or TA102 (Ishidate 1984) for ammonium persulfate. Ammonium persulfate was not clastogenic to Chinese hamster fibroblasts in the absence of metabolic activation in a chromosome aberration test (Ishidate et al. 1988).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a developmental/reproduction study with ammonium persulfate in rats (OECD 421), no effects on reproductive performance, fertility, fetal anomalies, fetal viability, spermatogenesis, spermatogenic cycle were reported up to 250 mg/kg/day. Dose levels were chosen based on the acute lethality studies for the ammonium salt and on a 90-day repeat-dose study in rats with the sodium salt (high dose: 225 mg/kg/day). In the developmental/reproduction study, animals were dosed prior to and during mating through gestation until lactation day 4. There was a transient depression in pup body weight at the 250 mg/kg dose level on lactation day 0 which resolved by day 4. This effect was not considered adverse. Based on the available data, the persulfates do not show evidence of reproductive or developmental toxicity. The NOAEL is 250 mg/kg bw/day.
Acute Toxicity	The substance is irritating to the eyes, the skin and the respiratory tract. Inhalation of dust may cause asthma-like reactions. The ammonium salt gave no evidence of genotoxic activity in bacterial mutagenicity tests (including the Ames assay) or in tests for chromosomal damage with mammalian cells in culture. The acute oral LD50 for ammonium persulfate in rats is between 495 mg/kg bw to 700 mg/kg bw in females and from 600 mg/kg bw to 820 mg/kg bw in males. The acute dermal LD50s in rats and rabbits are >5,000 mg/kg. In acute inhalation studies in rats, the 4-hour LC50 was generally greater than the maximum attainable concentration (>2,950 mg/m^3 for ammonium persulfate).
Irritation	Ammonium persulfate is non-irritating to the skin in animal studies but may be slightly irritating to the eye of rabbits. There were no data available for respiratory irritation. Studies in humans indicate that aqueous solutions of 5% persulfate or higher can cause skin irritation.
Sensitisation	Results of animal skin sensitization tests (Buehler Test and Maximization Test) were negative when persulfate was applied topically, but was positive when persulfate was injected intradermally in induction and challenge phases in a non-standard Maximization Test. Ammonium persulfate at approximately 50 mg/m^3 for four hours induced airway hyper-responsiveness (AHR) (Mensing et al. 1995). Numerous dermal challenge tests indicate that all persulfates are dermal and respiratory sensitizers in humans occupationally exposed to persulfates in hairdressing salons and, in one case, in a production facility.
Health Effects Summary	Ammonium persulfate have low acute dermal and inhalation toxicity but are harmful by the oral route. The chemicals were non-irritating to slightly irritating to eyes and respiratory system and not a skin irritant in animal studies, whilst studies in humans indicate that the chemicals can cause irritation. The chemicals are capable of inducing skin and respiratory sensitisation in animals and these are also the major chronic effects observed in humans. The chemicals were not genotoxic or shown to cause tumour induction or promotion in a mouse skin model. Repeated oral exposures to ammonium persulfate provided evidence that persulfates are not reproductive or developmental toxicants. Overall, the main critical effects to human health are sensitisation and irritancy.
Key Study/Critical Effect for Screening Criteria	The most sensitive endpoint was effects on the respiratory system with a NOAEC of 10.3 mg/m^3 (equivalent to (2.1 mg/kg bw/day) in a 90-day inhalation study (FMC Corporation 1998). Local effects, including respiratory tract inflammation, increased lung weight and rales were observed in rats at the LOAEC of 25 mg/m^3.

	Drinking water guideline value = 0.0819 ppm
Ecological Toxicity [2,3,6]	
Aquatic Toxicity	Acute Aquatic - Fish -96-hr LC50 Oncorhynchus - 76.3 mg/L -48-hr EC50 Daphnia magnaL - 120 mg/L -72-hr EC10 Phaedactylum tricornutum - 320 mg/L Acute Aquatic - Invertebrate -Daphnia magna reproduction test - NOEC of 20.8 mg/L (ECHA)
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (76 mg/L), Daphnia (120 mg/L), and algae (320 mg/L). On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 76 mg/L for fish. The PNECaquatic is 0.076 mg/L.
Current Regulatory Controls [6]	
Australian Hazard Classification	Xn(Harmful); R22 (Harmful if swallowed) Xi (Irritant); R36/37/38 (Irritating to eyes, respiratory system and skin), R42/43 (May cause sensitisation by inhalation and skin contact).
Australian Occupational Exposure Standards	Time Weighted Average (TWA) of 0.01 mg/m^3.
International Occupational Exposure Standards	Time Weighted Average (TWA): 0.1 mg/m^3 (Belgium, Canada, Ireland, Italy, Portugal, Spain, US) 2 mg/m^3 (Denmark, Iceland, Norway)
Australian Food Standards	Ammonium persulfate is listed in Schedule 18–Processing Aids- S18.08 Permitted processing aids—Miscellaneous purposes (section 1.140): Yeast washing agent under GMP conditions (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	No. Not applicable, inorganic salt, ionic species ubiquitous in environment.
B/vB criteria fulfilled?	No. Not applicable, inorganic salt, ionic species ubiquitous in environment.
T criteria fulfilled?	No chronic toxicity data exist; however, the acute EC(L)50s are >0.1 mg/L in fish, invertebrates and algae. Thus does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

References

1. ECHA European Chemicals Agency, Registered Substance Database, Cellulase, http://echa.europa.eu
2. HSDB (n.d.). *Hazardous Substances Data Bank*. Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
3. IPCS *Ammonium persulphate: Summary*, 2010. International Programme on Chemical Safety and the Commission of the European Communities (IPCS and CEC).
4. OECD IUCLID Data Set for Ammonium persulfate (CAS No. 7727-54-0); Potassium persulfate (CAS No. 7727- 27-1); Sodium persulfate (CAS No. 7775-27-1), UNEP Publications, 2005.
5. OECD. Screening Information Dataset (SIDS) Initial Assessment Report for Ammonium persulfate (CAS No. 7727-54-0); Potassium persulfate (CAS No. 7727- 27-1); Sodium persulfate (CAS No. 7775-27-1), UNEP Publications, 2005.

6. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - Dicoco dimethyl quaternary ammonium chloride

Chemical and Physical Properties [2]	
CAS number	61789-77-3
Molecular formula	$C_{26}H_{56}ClN$
Molecular weight	418.18 g/mol
Solubility in water	40-5040 mg/L
Melting point	94 ˚C
Boiling point	135 ˚C
Vapour pressure	Low
Henrys law constant	No data found
Explosive potential	No data found
Flammability potential	No data found
Colour/Form	Solid
Overview	Dicoco dimethyl quaternary ammonium chloride is from a subgroup of quaternary ammonium salts that are derived from chemicals that have a biological origin. The substance represented by CAS# 61789-77-3 is expected to be a mixture of discrete chemicals with two alkyl chains of six to 18 carbons derived from coconut oil. Commercially available quaternary ammonium surfactants are often prepared indirectly from natural fats and oils. Natural fats derived from the fatty tissue of sheep or cattle, oil obtained from the kernel of the seed of *Cocos nucifera* (coconut), and seeds of *Glycine soja* (soybean) are used to prepare tallow alkyl-, coconut oil alkyl-, and soybean oil alkyl-ammonium compounds, respectively (Ash and Ash, 2004a; b). These surfactants have carbon chains with even numbers of carbon atoms, as fatty acid biosynthesis occurs mainly through addition of two carbon units in the form of acetyl-CoA (Voet and Voet, 1990). The major process for transforming fats and oils of biological origins into oleochemicals is the hydrolysis of natural triglycerides into glycerine and mixed fatty acids (Corma, et al., 2007). Reaction of these fatty acids and ammonia followed by hydrogenation produces fatty amines (Corma, et al., 2007), which are then alkylated at the nitrogen atom by reaction with chloromethane (de Oude, 1992). Alternatively, the fatty acids may be reacted with trimethylamine followed by hydrogenation to form quaternary ammonium compounds (Qadir, et al., 2014). Chemicals in this group are a source of cationic surfactants that have a wide range of industrial applications reported internationally. They are used in cleaning and washing agents as well as cosmetics, such as hair conditioners, hand soaps and deodorants. Due to their biocidal activity, they are used in agricultural and non-agricultural pesticides, disinfectants and preservatives (Nordic Council of Ministers, 2015; US EPA, 2015). There is also some indication of use as algaecides, indicating potential water treatment uses (US EPA, 2015; US NLM, 2011).
Environmental Fate [2]	
Soil/Water/Air	The chemicals in this group are all salts of quaternary ammonium surfactants and are therefore expected to have low volatility (de Oude, 1992). The water solubility values reported were determined at the critical micelle concentrations (CMCs), as is appropriate for surface-active substances. CMCs decrease with increasing alkyl chain lengths, and di-alkyl quaternary ammonium compounds have lower CMCs

	compared to mono-alkyl quaternary ammonium compounds with comparable alkyl chain lengths (Tezel, 2009). The octanol-water partition coefficient parameter (K) of the chemicals in this group is not considered to provide a reliable indicator of the partitioning behaviour of surface active substances in the environment (McWilliams and Payne, 2001; Shorts, et al., 2010), and therefore has not been reported. The quaternary ammonium cations from substances in this group partition between water and sediment, or remain in soil when released from industrial uses. The chemicals in this group are quaternary ammonium salts. If discharged into natural waters, the chemicals are expected to dissociate and release their quaternary ammonium cations. The quaternary ammonium cations can adsorb to clays and natural organic materials, such as humic substances (de Oude, 1992). They are expected to remain in soil as they are strongly adsorbed and immobile (Zhang, et al., 2015). The quaternary ammonium cations from substances in this group are biodegradable. Di-alkyl quaternary ammonium cations are also found to be rapidly biodegradable in water, undergoing 79 to 80% degradation after 2 days for those with C alkyl chains (CAS RNs 61789-80-8 and 61789-77-3) (US EPA, 2016). The quaternary ammonium cations from substances in this group have low to moderate bioaccumulation potential in aquatic organisms. The chemicals in this group are not expected to undergo long-range transport based on their low volatility and their biodegradability in the environment. Quaternary ammonium cations adsorbed to clays, sediment and soil containing organic carbon (de Oude, 1992; Ivankovic and Hrenovic, 2010) are strongly bound and immobile (Zhang, et al., 2015). Limited human health toxicity information is available for Dicocodimethylquaternaryammonium chloride, as such, information for dioctadecyldimethylammonium chloride (DODMAC) has been included below.
Human Health Toxicity Summary [1, 3]	
Chronic Repeated Dose Toxicity	Following repeated oral exposure of 500 mg/kg bw/d of DODMAC to rats degeneration of adrenal cortex was induced. No adverse effects were reported up to 100 mg/kg bw/d DODMAC (NOAEL). After repeated dermal application to rabbits, local irritation but no systemic toxic effects were observed up to 40 mg/kg bw/d (NOAEL). A systemic LOAEL was not determined. There is no information on effects after prolonged inhalation exposure to rodents.
Carcinogenicity	No data is available on carcinogenic effects of DODMAC. There are no data from mutagenicity studies which give concern regarding carcinogenicity of both substances.
Mutagenicity/ Genotoxicity	DODMAC showed negative results in bacterial mutation tests and in an *in vitro* chromosomal aberration test. There is no evidence of a genotoxic potential of the substance
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In an oral study on rats according to OECD Guideline 421 a dose of 500 mg/kg bw/d led to impaired reproductive performance in combination with clear signs of general toxicity. Based on the reduced mating, fertility and gestation indices a NOAEL for reproductive toxicity of 125 mg/kg/d can be estimated.
Acute Toxicity	In rats, the substance exhibited only low acute toxicity with oral LD50 > 2000 mg/kg bw, dermal LD50 > 200 mg/kg bw and inhalation LC50 > 180 mg/l/1 hour
Irritation	Pure DODMAC causes serious damage to the eyes but only moderate irritation to the skin of rabbits. Data on respiratory irritation is not available. Technical grade DODMAC, however, has proven to be corrosive to the skin of rabbits because of a high content of isopropanol

Sensitisation	DODMAC enhances the allergic potency of other chemical substances, but does not seem to cause skin sensitization by itself as judged on the basis of tests with relevant concentrations of DODMAC.
Health Effects Summary	
Key Study/Critical Effect for Screening Criteria	The key study chosen for the determination of a drinking water guidance value is the subacute oral rat study, where the NOAEL was 100 mg/kg/d. The oral RfD for Dicoco dimethyl quaternary ammonium chloride is thus based on the NOAEL of 100 mg/kg/day. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability); 10 (subchronic to chronic). Oral RfD: 100/1000 = 0.1 mg/kg/day Drinking water guideline value = 0.39 ppm
Ecological Toxicity [2]	
Aquatic Toxicity	The following measured median lethal concentration (LC50) and median effective concentration (EC50) values for model organisms across three trophic levels were reported in the Screening-Level Hazard Characterisation conducted by the United States Environmental Protection Agency (US EPA, 2008), the European Union Risk Assessment Report (IHCP, 2009), and the databases included in the OECD QSAR Toolbox (LMC, 2013) Fish *Lepomis macrochirus* (Bluegill) 96 h LC50 = 1.04 mg/L Invertabrate Dap*hnia magna* (Water flea) 48 h LC50 = 0.16 mg/L Algae *Pseudokirchneriella subcapitata* (Green algae) 96 h EC50 = 0.46 mg/L The following no-observed effect concentration (NOEC) values for model organisms across two trophic levels were reported in the European Union Risk Assessment Report (IHCP, 2009) and the databases included in the OECD QSAR Toolbox (LMC, 2013). Invertebrates *Daphnia magna* (Water flea) 21 d NOEC = 0.38 mg/L Algae *Pseudokirchneriella subcapitata* (Green algae) 96 h NOEC = 0.16 mg/L While the chemicals in this group can be very toxic to aquatic organisms, they are efficiently removed from wastewater in sewage treatment plants and they typically undergo rapid biodegradation in water and soil.
Determination of PNEC aquatic	The calculated PNEC for mono-alkyl quaternary ammonium compounds with C alkyl chains is 3.6 µg/L based on the 72 h NOEC of 0.0018 mg/L for algae. The laboratory endpoint value for algae was divided by an assessment factor of 10 to account for interspecies variation and the derived value was then multiplied by a factor of 20 to account for the 5% bioavailable fraction in environmental waters. The calculated PNEC for di-alkyl quaternary ammonium compounds with C alkyl chains is 2.8 µg/L based on the 96 h EC50 of 0.014 mg/L for algae. This value was calculated by a similar procedure as applied to the mono-alkyl quaternary ammonium compound, but using an assessment factor of 100 in accordance with standard methodology for deriving PNECs from acute toxicity endpoint values (EPHC, 2009).
Current Regulatory Controls[2]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available

Aquatic Toxicity Guidelines	The use of the chemicals in this group is not subject to any specific national environmental regulations.
PBT Assessment [2]	
P/vP Criteria fulfilled?	Not Persistent (Not P). Based on results obtained from biodegradation studies, all chemicals in this group are categorised as Not Persistent.
B/vB criteria fulfilled?	Not Bioaccumulative (Not B). Based on the available measured bioconcentration data, all chemicals in this group are categorised as Not Bioaccumulative.
T criteria fulfilled?	Toxic (T). Based on available acute ecotoxicity values below 1 mg/L and/or chronic ecotoxicity values below 0.1 mg/L, all chemicals in this group are categorised as Toxic.
Overall conclusion	Not P, Not B, T. The chemicals in this group are not PBT substances according to domestic environmental hazard criteria.
Revised	December 2018

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1. European Commission Joint Research Centre 2009, European Union Risk Assessment Report, Dioctadecyldimethylammonium chloride, CAS no. 107-64-2.
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Mono- and Di-Alkyl Quaternary Ammonium Surfactants: Environmental Tier II Assessment, Retrieved 2018: https://www.nicnas.gov.au
3. OECD (1996) SIDS Initial Assessment Profile for Dioctadecyldimethylammonium chloride, CAS Number 107-64-2

Poly(tetrafluoroethylene)

Chemical and Physical Properties[1,2]	
CAS number	9002-84-0
Molecular formula	(No data available.
Molecular weight	Likely >1000 MW
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	No studies are available. The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[1,2]	
Soil/Water/Air	The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate.
Human Health Toxicity Summary[1,2]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity[1,2]	
Aquatic Toxicity	Limited information is available. The polymer is expected to be a low concern for toxicity to aquatic organisms. Due to its poor solubility and high molecular weight, it is not expected to be bioavailable. It does not contain any reactive functional groups.

Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1,2]	
P/vP Criteria fulfilled?	The polymer is not readily biodegradable, hence it meets the screening criteria for persistence.
B/vB criteria fulfilled?	The polymer is expected to have a very high molecular weight and poor water solubility. It is not expected to be bioavailable, hence this polymer does not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on the polymer. It is expected to have low concern for aquatic toxicity because of its very high molecular weight and poor water solubility. As such, the polymer does not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

References

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Toxicity Summary - Propan-2-ol (Isopopranol)

Chemical and Physical Properties[1,3,4,5,6]	
CAS number	67-63-0
Molecular formula	C_3H_8O
Molecular weight	60.10 g/mol
Solubility in water	100 vol% at 20 °C (miscible)
Melting point	-88.5 °C
Boiling point	82.5 °C
Vapour pressure	45.4 mm Hg at 25ºC
Henrys law constant	7.52 x 10^{-6} atm m^3/mole
Explosive potential	Is classified as explosive. The vapours may form an explosive mixture with air.
Flammability potential	Flammable liquid and vapour.
Colour/Form	Colourless liquid with a pleasant odour.
Overview	Isopropanol (IPA) is a high production volume chemical which has wide use as an industrial solvent and as a component in numerous industrial and consumer products. It has a potential for widespread exposure to both workers and consumers. Based upon physical and chemical properties, isopropanol is not expected to persist in the environment. Aerobic biodegradation of isopropanol occurs rapidly. IPA is not expected to persist in soil due to low soil adsorption and rapid evaporation to air. In the air, isopropanol is subject to rapid oxidation by hydroxyl radical attack. IPA has a low order of toxicity to aquatic organisms and plants, and bioconcentration in aquatic organisms is not expected to occur.
Environmental Fate[1,4,5,6]	
Soil/Water/Air	Based on calculated results from a Level I fugacity model, isopropanol is expected to partition primarily to the aquatic compartment (77.7%) with the remainder to the air (22.3%) (OECD, 1977a,b). Aerobic biodegradation of isopropanol has been shown to occur rapidly under nonacclimated conditions, based on a result of 49% biodegradation from a 5-day BOD test (Bridie *et al.*, 1979). Additional biodegradation data developed using standardized test methods show that isopropanol is readily biodegradable in both freshwater and saltwater media (72 to 78% biodegradation in 20 days) (Price *et al.*, 1974). Bioconcentration of isopropanol in aquatic organisms is not expected to occur based on a measured log n-octanol/water partition coefficient (log Kow) of 0.05, a calculated bioconcentration factor of 1 for a freshwater fish, and the unlikelihood of constant, long-term exposures (OECD 1977a,b).
Human Health Toxicity Summary [1,2,3,4,5,6]	
Chronic Repeated Dose Toxicity	Considering the lowest observed adverse effect levels (LOAELs) available from a 12-week rat study (1390 mg/kg bw/day), and based on the treatment-related effects reported in various repeated dose toxicity studies, the chemical is not considered to cause serious damage to health from repeated oral exposure. Male Wistar rats were administered the chemical at concentrations of 0, 1, 2, 3, or 5 % (0, 870, 1390, 1700, or 2500 mg/kg bw/day) in drinking water for 12 weeks. The top dose was reduced to 4 % due to unpalatability after two weeks. Significantly decreased bodyweights were seen at the two highest doses and dose-related increases in relative liver and kidney weights were also significant at 1390 mg/kg bw/day and above. Relative adrenal weights were also significantly increased at the two highest doses; increased testis weight was noted only at the top dose. A dose-dependent increase of hyaline casts and hyaline droplet formation in the proximal tubules of the kidneys was also noted. The no observed adverse effect level (NOAEL) was determined to be 870 mg/kg bw/day, based on

	liver and kidney effects observed at the LOAEL of 1390 mg/kg bw/day (OECD, 2002; EFSA, 2005). In another repeated dose study, rats (strain not specified) were administered the chemical in drinking water at doses of 600 or 2300 mg/kg bw/day for males and 1000 or 3900 mg/kg bw/day for females for 27 weeks. Male rats showed decreased bodyweight gain during the first 13 weeks and increased bodyweight gain for the remainder of the treatment. Female rats showed decreased bodyweight gain throughout the dosing period. No other effects were reported. The NOAELs were 2300 and 1000 mg/kg bw/day for males and females, respectively. The LOAEL in females was 3900 mg/kg bw/day but could not be established in males (OECD, 2002). Several repeated dose inhalation studies were available in rats and mice. Considering the no observed adverse effect concentrations (NOAECs) available from these studies (500 ppm), and based on the treatment-related effects reported, the chemical is not considered to cause serious damage to health from repeated inhalation exposure. The kidney appears to be the target organ with kidney lesions and changes in urine chemistry indicative of impaired kidney function observed at doses ≥2500 ppm in animals exposed to the chemical for 78 weeks (effects not observed in 13-week studies). Transient signs of narcosis were observed for both mice and rats at doses ≥1500 ppm (OECD, 2002; REACH; US EPA, 1986). The investigation by Burleigh-Flayer et al. (1997), showed chronic kidney effects in rodents and is the only study that conducted lifetime rodent exposure to isopropanol. The kidney effects seen in this study were not reported in the 13-week studies by Burleigh-Flayer et al. (1994) which possibly indicates that longer term exposure is necessary for the development of the lesions. The increased hyaline droplets in the kidney observed in the study of Burleigh-Flayer et al. (1994) are a male rat-specific nephropathy and is not considered to be relevant to humans. The LOAEC and NOAEC established from the critical study were 2500 and 500 ppm, respectively, which are equivalent to 1275 and 255 mg/kg bw/day, respectively. Although limited information is available, it has been reported that oral intake of low doses of the chemical (2.6 or 6.4 mg/kg bw/day) by groups of eight men for six weeks had no effect on their blood cells, serum or urine and also produced no clinical symptoms (HSDB).
Carcinogenicity	Based on available data, the chemical is not considered to be carcinogenic (OECD, 2002; WHO, 1990a; EFSA, 2005; REACH). The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence for the carcinogenicity of isopropanol in laboratory animals and humans, placing the chemical in Group 3 (Not classifiable as to its carcinogenicity to humans) (IARC, 1999). Although there are no carcinogenicity studies available for the chemical by oral exposure, studies are available for inhalation exposure in rats and mice. In a carcinogenicity study (OECD TG 451), F344 rats were exposed (whole-body) through inhalation to vapours of the chemical at concentrations of 0, 500, 2500, and 5000 ppm for six hours a day, five days a week for two years. The only neoplastic lesion found was stated to be increased frequency of interstitial (Leydig) cell adenoma of the testis (77.3, 86.7 and 94.7 % at low, mid and top dose groups, respectively). The authors did not consider the tumours to be treatment related as testicular adenomas are a common finding in aged male rats and that incidence of this spontaneous tumour reported for the control group (64.9 %) of this study was lower than the historical incidence (88 %) of control F344 rats of numerous two-year National Toxicology Program (NTP) carcinogenicity studies. In a similar carcinogenicity study, CD-1 mice were also exposed (whole-body) through inhalation to vapours of the chemical at concentrations of 0, 500,

	2500, and 5000 ppm for six hours a day, five days a week for 18 months. No increased frequency of neoplastic changes was reported in any of the treated groups (OECD, 2002; EFSA, 2005; REACH).
Mutagenicity/ Genotoxicity	The chemical does not show specific reproductive or developmental toxicity. Any reproductive and developmental effects were only observed secondary to maternal toxicity.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The chemical does not show specific reproductive or developmental toxicity. Any reproductive and developmental effects were only observed secondary to maternal toxicity. Several one or two-generation reproductive toxicity studies (rats) and developmental studies (rats and rabbits) were available. Other than a statistically significant reduction in the male mating index observed in a recent two generation study (high dose, 1000 mg//kg bw/day second generation males), there were no other effects on reproductive indices, including fertility and gestational indices and histopathology of the reproductive organs. The NOAELs for reproductive toxicity were reported as ≥500 mg/kg bw/day. A benchmark dose (BMD) assessment was conducted for the study's developmental and reproductive findings (Shipp et al., 1996). For the offspring developmental effects, BMD dosages (BMDL5) of 449 and 418 mg/kg/day were estimated for the F1 and F2 generations, respectively. Based upon the decrease in male mating index observations in the P2 males, a BMDL10 of 407 mg/kg/day was estimated for reproductive effects (OECD, 2002; EFSA, 2005; REACH). Developmental effects, including a reduction in postnatal survival and decreased foetal bodyweights, occurred only at maternally toxic doses. No accompanying malformations were observed. In a developmental toxicity study (US EPA TSCA Guidelines), pregnant Sprague Dawley (SD) rats were administered the chemical by gavage at 0, 400, 800 or 1200 mg /kg bw/day on gestational days 6–15. In the same study, pregnant New Zealand white rabbits were dosed orally with the chemical at 0, 120, 240 or 480 mg/kg bw/day during gestational days 6–18. There was no evidence of developmental toxicity in rats and rabbits at any tested dose. There was mortality of two dams (8%) at 1200 mg/kg and one dam (4%) at 800 mg/kg. Reduced maternal gestational weight gain associated with significantly reduced gravid uterine weights was noted in the higher dose group. The NOAEL for maternal toxicity in rats was reported to be 400 mg/kg bw/day. The NOAEL for developmental toxicity in rats was established as 400 mg /kg bw/day, based on significantly reduced foetal litter body weights at the 800 and 1200 mg/kg dose levels. The NOAEL for maternal toxicity in rabbits was determined to be 240 mg/kg bw/day, based on decreased maternal bodyweight and profound clinical signs (peripheral vasodilatation, cyanosis, lethargy, laboured respiration) of toxicity seen at the top dose. There was no evidence of any developmental toxicity and the NOAEL for developmental toxicity was established as the highest dose: 480 mg/kg bw/day. There was no evidence of any teratogenicity in either studies in rats and rabbits (US EPA, 1995; OECD, 2002; EFSA, 2005; HSDB; REACH).
Acute Toxicity	The chemical was of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats is greater than 2000 mg/kg bw. Observed effects included irritation and respiratory arrest while under narcosis (OECD, 2002; WHO, 1990a; HSDB). The chemical was of low acute toxicity in an animal test following dermal exposure. The median lethal dose (LD50) in rats is greater than 2000/kg mg/kg bw. Observed effects were not reported (OECD, 2002; WHO, 1990a; HSDB). The chemical was of low acute toxicity in animal tests following inhalation exposure with reported median lethal concentrations (LC50) >20 mg/L in rats (OECD, 2002; HSDB). Observed effects included severe irritation of the mucous membranes and central nervous system depression as indicated by ataxia, prostration and narcosis.

	The chemical is currently classified with the risk phrase 'Vapours may cause drowsiness and dizziness (R67)' in Australia (Safe Work Australia—HSIS). In an acute inhalation toxicity study (OECD TG 403), Fischer 344 (F344) rats were exposed (whole-body exposure) to the chemical at 500, 1500, 5000, and 10000 ppm for six hours (instead of the standard four hours). Transient concentration-related narcosis and/or central nervous system sedation was noted in the study and the motor activity was decreased at 1500 ppm (males only), 5000 ppm (both sexes). Severe central nervous system depression was seen in the 10000 ppm group. After one and six hours exposure at 10000 ppm, prostration, severe ataxia, decreased arousal, slowed or laboured respiration, decreased neuromuscular tone, hypothermia, and loss of reflex function was observed (OECD, 2002; REACH). Acute intoxication incidents in humans with the chemical have been reported (WHO, 1990b; OCED, 2002; HSDB). Ingestion and inhalation are the common routes of poisoning in humans. Acute intoxication of the chemical has a rapid onset (30–60 minutes) following ingestion, and reported symptoms included drowsiness, poor coordination, abdominal pain, cramps, nausea, vomiting and diarrhea, with unconsciousness and death following massive exposure. Inhaling high concentrations of the chemical can cause nausea, headache, light headedness, drowsiness, ataxia and deep narcosis (WHO, 1990b; OECD, 2002; HSDB).
Irritation	Isopropanol applied to the intact or abraded skin of rabbits and guinea pigs produced negligible irritation (Nixon *et al.*, 1975). Liquid isopropanol is moderately irritating to the eyes of rabbits (Griffith *et al.*, 1980; WHO, 1990). Isopropanol produced little irritation when tested on the skin of six human subjects (Bevan, 2012).The chemical is classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in HSIS (Safe Work Australia). The available data support this classification (OECD, 2002; WHO, 1990a; REACH).
Sensitisation	There have been reports of isolated cases of dermal irritation and/or skin sensitization (Bevan, 2012). Except for three case reports, the positive reactions were observed on patch testing patients with contact dermatitis due to ethanol. These patients also had a positive reaction to ethanol. The chemical does not contain a structural alert for skin sensitisation (OECD Toolbox).
Health Effects Summary	The critical health effects for risk characterisation include the potential for eye irritation and intoxication symptoms following inhalation of high vapour concentrations.
Key Study/Critical Effect for Screening Criteria	The most appropriate NOAEC for risk assessment, determined from the 104-week study by Burleigh-Flayer et al. (1997), is 255 mg/kg bw/day based on kidney effects at the LOAEC of 1275 mg/kg bw/day. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability) Oral Reference Dose = 255/100 = 2.55 mg/kg/day Drinking water = 10 mg/L
Ecological Toxicity [2,4,5]	
Aquatic Toxicity	The 96-hour LC50 in *Pimephales promelas* is 9,640 mg/L (Veith *et al.*, 1983). The 24- hour EC50 in *Daphnia magna* is >10,000 mg/L (Brinkmann and Kuehn, 1977). Chronic aquatic toxicity has also been shown to be of low concern, based on 16- and 21-day NOEC values of 141 and 30 mg/L, respectively, for the freshwater invertebrate *Daphnia magna* (Hermens *et al.*, 1985); OECD, 1977a,b). Toxicity of isopropanol to plants is expected to be low, based on a 7-day toxicity threshold value of 1,800 mg/L for freshwater algae (Bringmann and Kuehn, 1980).
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (9,640 mg/L) and invertebrates (>10,000 mg/L). Results from chronic studies are available for invertebrates (16- and 21-day NOECs for Daphnia are 141 and 30 mg/L, respectively). On the basis that the data consists of a chronic study on one trophic level, an assessment factor of 100 has been applied to the lowest reported NOEC of 30 mg/L for Daphnia. The PNECaquatic is 0.3 mg/L.
Current Regulatory Controls [7]	

Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xi; R36 (Irritation) R67 (Vapours may cause drowsiness and dizziness)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 983 mg/m³ (400 ppm) time weighted average (TWA) and 1230 mg/m³ (500 ppm) short-term exposure limit (STEL).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 245–999 mg/m³ (100–400 ppm) in countries such as Canada, Denmark, Iceland, Germany, Norway, Sweden, Spain, Switzerland, UK, and USA. An exposure limit (STEL) of 600–1250 mg/m³ (250–500 ppm) in countries such as Canada, France, Spain, Sweden, Switzerland, UK, and USA.
Australian Food Standards	Isopropanol is listed in Standard 1.3.1 of the Australia New Zealand Food Standards Code and has a permitted use as a food additive at a maximum permitted level of 1000 mg/kg (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [4,5]	
P/vP Criteria fulfilled?	Isopropanol is readily biodegradable and thus it does not meet the screening criteria for persistence.
B/vB criteria fulfilled?	Based on a measured log Kow of 0.05 and a calculated BCF of 1, isopropanol does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	The chronic toxicity data on isopropanol show NOECs of >0.01 mg/L. Thus, isopropanol does not meet the screening criteria for toxicity.
Overall conclusion	Not a PBT substance (based on screening data).
Revised	December 2019

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Toxicity Summary - Potassium chloride

Chemical and Physical Properties[1,2,3,8,9,10]	
CAS number	7447-40-7
Molecular formula	KCl
Product name	--
Molecular weight	74.55 g/mol
Solubility in water	34.20 at 20 °C
Melting point	771.00 °C
Boiling point	1500 °C
Vapour pressure	White crystals or crystalline powder
Henrys law constant	No data found
Explosive potential	No data found
Flammability potential	Not explosive
Colour/Form	Not flammable
Overview	Potassium is an essential element in the body. It is the main intracellular cation with 98% of total body potassium located within the cells. It is mainly used in fertilisers, medicine, lethal injections, scientific applications, feedstock, food processing and as a sodium substitute in table salt. Potassium chloride is an essential element with homeostatic physiological processes regulating levels in the body. In cases of increased exposure to high levels of potassium significant health effects in people with kidney disease or other conditions, such as heart disease may result. Potassium chloride as an inorganic salt is not subjected to further degradation processes in the environment once it dissociates into its respective ions. In water, potassium chloride is highly water soluble, and readily undergoes dissociation. In soil, transport and leaching of potassium and chloride ions is affected by the clay minerals (type and content), pH, and organic matter. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1,3,8,9]	
Soil/Water/Air	KCl is a solid inorganic salt that is highly soluble in water (342 g/L at 20° C). Potassium chloride fully dissociates in aqueous solutions to K+ and Cl- ions. Cl, either as an inorganic salt or as K+ and Cl- ions, is ubiquitous in the environment. There is no potential for bioaccumulation or bioconcentration. Potassium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated.

Human Health Toxicity Summary [1,3,8,9]	
Chronic Repeated Dose Toxicity	Fourteen female rats were given KCl in their drinking water (approximately 5,250 mg/kg/day) for 105 days. Ten rats were sacrificed after 105 days of exposure for examination of the heart, kidneys and the adrenals; four rats (recovery group) were kept for an additional month. KCl exposure resulted in decreased heart weight, increased kidney weight, and enlargement of part of the adrenals. All changes were reversible within one month of exposure (Bacchus, 1951).F344/Slc male rats were given 0, 110, 450 or 1,820 mg/kg/day KCl in feed for two years. At the end of the study, survival rates were 48%, 64%, 58% and 84% in the controls, 110, 45 and 1,820 mg/kg/day groups. Nephritis was reported to be predominant in all groups, including the controls. The only treatment-related effect observed was gastritis(inflammation of the stomach lining). The incidence of gastritis and ulcers were 6%, 18%, 18% and 30% in the controls, 110, 450 and 1,820 mg/kg/day groups (Imai *et al.*, 1968). Male and female Wistar rats were fed diets containing 0 or 3% KCl over a total period of 30 months: Examination after 13 weeks (10 rats/sex/group), after 18 months (15 rats/sex/group) and after 30 months (50 rats/sex /group). Due to the reduction of feed intake the mean test substance intake and mean body weight decreased in time. After 30 months of treatment, there was hypertrophy of the zona glomerulosa in the adrenals (24/50 treated rats versus 4/50 in controls); and cystitis in the urinary bladder (males: 3/59; females 3/50) and single epithelial hyperplasia of the bladder (males 3/50; females 2/50) (Lina *et al.*, 1994; Lina and Kuijpers, 2004)**.**
Carcinogenicity	Potassium chloride has not been evaluated and is not listed by the IARC as a carcinogen. In a long-term study, male rats (50 per group) were fed potassium chloride in the diet at levels of 110, 450 or 1820 mg/kg bw/day for 2 years. No carcinogenic effects were observed in male rats.
Mutagenicity/ Genotoxicity	No gene mutation ns were reported in bacterial tests, with and without metabolic activation. However, high concentrations of potassium chloride showed positive results in a range of genotoxic screening assays using mammalian cells in culture. The action of potassium chloride in culture seems to be an indirect effect therefore further *in vivo* studies were not considered necessary.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A developmental study revealed no foetotoxic or teratogenic effects of potassium chloridel in doses up to 235 mg/kg/day (mice) and 310 mg/kg/day (rats). No fertility study has been located. Further human and ecological assessment was not recommended by the OECD SIDS.
Acute Toxicity	Potassium chloride is an essential element with homeostatic physiological processes regulating levels in the body. In cases of increased exposure to high levels of potassium significant health effects in people with kidney disease or other conditions, such as heart disease may result. Adverse health effects due to consumption of potassium from drinking water are unlikely to occur in healthy individuals. Acute effects are rare in humans although under particular circumstances severe effects may occur. Lethal effects were observed in a 2 month old baby fed 15,000 mg potassium chloride for 2 days and in another case report where an adult woman had ingested slow released potassium chloride tablets (35, 000 mg). The most common form of ingestion is through drinking water. It is not considered necessary to establish a health-based guideline value for potassium in drinking water due to its lack of toxicity.
Irritation	Slight skin and eye irritant. A threshold concentration for skin irritancy of 60% was seen when potassium chloride in aqueous solution was in contact with skin of human volunteers. The threshold concentration when applied to broken skin was 5%.
Sensitisation	No data found.

Key Study/Critical Effect for Screening Criteria	In a two-year rat feeding study, there was an increased incidence of gastritis and ulcers at dose levels of >110 mg/kg/day (Imai *et al.*, 1968). There was no NOAEL. Thus, the LOAEL for this study is 110 mg/kgday. Since the gastritis and ulcers are the result of a localized irritation effect of the test substance (site of contact) in the gastrointestinal tract, an uncertainty factor for interspecies variability is deemed unnecessary. For systemic effects, the NOAEL for the two-year rat feeding study is considered to be 1,820 mg/kg/day, the highest dose tested. Uncertainty factors: 10 (intraspecies variability); 10 (interspecies variability); 1 (intraspecies variability) Oral Reference Dose = 1,820/100 = 18.2 mg/kg/day Drinking water guideline: 71 ppm
Ecological Toxicity [1,3,8,9,10]	
Aquatic Toxicity	In a guideline study, the 96-hour LC50 in *Pimephales promelas* was reported to be 880 mg/L (Mount *et al.*, 1997). The 48-hour LC50 values from two studies on *Lepomis macrochirus* (Patrick *et al.*, 1968; Trama, 1954), and one study each on *Oncorhyncusmykiss* and *Ictalurus punctatus* (Waller *et al.*, 1993) ranged from 720 to 2,010 mg/L. In a guideline study, the 48-hour EC50s in *Daphnia magna* and *Ceriodaphnia dubia* were660 and 630 mg/L, respectively (Mount *et al.*, 1997; ECHA REACH database). The 48-hour EC50 in *Daphnia magna* in another study was also reported to be 177 mg/L (Biesinger and Christensen, 1972).The toxicity of KCl has been investigated in one algae species (*Nitzschia linearis*), showing 120 hour-EC50 (growth rate) of 1,337 mg/L (Patrick *et al.*, 1968). The 72-hour EC50 to *Scenedesmus subspicatus* is >100 mg/L (growth rate), with a NOEC of >100 mg/L (ECHA REACH database). In a fish early-life-stage test with the fathead minnow (*Pimephales promelas*), the 7-day NOEC is 500 mg/L (ECHA REACH database). A long term (21-day) study has been performed on *Daphnia magna* where effects on reproduction were investigated for several metals. A 16% impairment of reproduction (LOEC) was observed at a concentration of 53 mg/L of K +, equal to KCl concentration of 101 mg/L (Biesinger and Christensen, 1972). The measured NOEC for Daphnia is 373 mg/L
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 100 has been applied to the lowest reported effect concentration of 373 mg/L. The PNECaquatic is determined to be 3.73 mg/L.
Current Regulatory Controls	
Australian Food Standards	No data found
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment[1,8,9,10]	
P/vP Criteria fulfilled?	Potassium chloride is an organic salt that dissociates completely to potassium and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both potassium and chloride ions are also ubiquitous and are present in most water, soil and sediment. For the purposes of this PBT assessment, the persistent criteria is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Potassium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, potassium chloride is not expected to bioaccumulate.
T criteria fulfilled?	The measured chronic toxicity data for potassium chloride was 373 mg/L for Daphnia. Thus, potassium chloride does not meet the screening criteria for toxicity
Overall conclusion	Not PBT

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10. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - Talc

Chemical and Physical Properties [1,4]	
CAS number	14807-96-6
Molecular formula	H2-O3-Si 3/4Mg or Mg3Si4O10(OH)2
Molecular weight	78.10 (estimate)
Solubility in water	Insoluble in water, cold acids or in alkalis
pH	9.0 to 9.5
Melting point	800-900°C (disintegration; WHO 2005)
Boiling point	549.7°C (estimate)
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	NA
Flammability potential	Not flammable
Colour/Form	white to gray-white, fine crystalline powder.
Overview	Talc finely powdered hydrous magnesium silicate mineral sometimes found in association with asbestos. After being mined, it is processed to remove impurities and powdered. Talc is a useful commercial product due to its fragrance retention, luster, purity, softness, and whiteness as well as its chemical inertness and oil and grease adsorption. Talc is a mineral composed of hydrated magnesium silicate. Talc refers to both mineral talc and industrial mineral products that are marketed under the name talc and contain proportions of mineral talc that range from about 35% to almost 100%. Industrial talc generally refers to products that contain abundant minerals other than talc; cosmetic talc now normally contains >98% talc but the content may have been lower in the past. Pharmaceutical talc contains >99% talc. Talcum powder is cosmetic-grade talc. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment. Further assessment of the environmental risks from the use of this chemical is also not required.
Environmental Fate [2,3]	
Soil/Water/Air	As a mineral, talc does not biodegrade

Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity Carcinogenicity	Talc-based body powder, when used perineally, is classified by IARC as group 2B as possibly carcinogenic to humans. However, talc for general use not containing asbestos or asbestiform fibres is classified as group 3 as not classifiable to its carcinogenicity to humans. Talc containing asbestiform fibres is classified by IARC as group 1 for carcinogenic to humans. Talc alone failed to induce respiratory tumors, granulomas or mesothelial proliferation in a hamster study but produced tumours of the larynx, trachea and lungs when tested in association with benzo(a)pyrene. In a rat study of aerosol talc there was some evidence of carcinogenic activity of talc in male F344/N rats and clear evidence of carcinogenic activity in female F344/N rats. No evidence of carcinogenicity was evident in intraperitoneal or inhalation studies in hamsters. Male and female Wistar rats were given in their diet 0 or 50 mg/kg of commercial talc [characteristics unspecified] for the life of the animals (average survival was 702 and 649 days, respectively). There was no significant difference in the talc-fed animals compared with control animals (Gibel *et al.*, 1976). In humans and experimental animals, the effects of talc are dependent on the route of exposure, and the dose and properties of the talc. Talc pneumoconiosis was somewhat more prevalent and severe among miners exposed to talc containing asbestiform minerals and/or asbestos than among those exposed to talc without such contaminants. However, the role of quartz and asbestos in the observed pneumoconiosis could not be ruled out. Among drug users, intravenous injection of talc present as a filler in the drugs resulted in microembolization in a variety of organs and alterations in pulmonary function. In animal studies, talc has been shown to cause granulomas and mild inflammation when inhaled. Observations of the effects that occurred in the lungs of rats exposed by inhalation to talc suggested that the operative mechanisms may be similar to those identified for carbon black, and talc is known to cause the release of cytokines, chemokines and growth factors from pleural mesothelial cells. IARC: There is *inadequate evidence* in humans for the carcinogenicity of inhaled talc not containing asbestos or asbestiform fibres. There is *limited evidence* in experimental animals for the carcinogenicity of talc not containing asbestos or asbestiform fibres. Inhaled talc not containing asbestos or asbestiform fibres is *not classifiable as to its carcinogenicity (Group 3)*.
Mutagenicity/ Genotoxicity	Talc was not mutagenic in host-mediated assays in mice. It did not produce chromosomal aberrations or dominant lethal mutations in rats. The IARC (1987) review of talc included unpublished results from a 1974 study conducted by Litton Bionetics that showed no mutagenic activity for talc *in vitro* or *in vivo.* Talc did not induce mutations in *Salmonella typhimurium* strains TA1530 or HisG46, or in the yeast, *Saccharomyces cerevisiae***.** No chromosomal aberrations were observed in human fibroblasts treated with talc *in vitro. In vivo* tests conducted in rats gave negative results for induction of chromosomal aberrations in bone marrow cells and dominant lethal mutations in germinal cells
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No teratological effects were observed in hamsters, rats, mice, or rabbits after oral administration of 900-1600 mg/kg. No teratologic effects were observed in hamsters, rats, mice, or rabbits after oral administration of talc. The doses used were 1,600 mg/kg for rats and mice on days *6* through 15 of gestation; 1,200 mg/kg for hamsters on day 6 through 10 of gestation; and 900 mg/kg for rabbits on days 6 through 18 of gestation
Acute Toxicity	Acute inhalation exposure to talc causes symptoms such as cough, dyspnea, sneezing, vomiting, and cyanosis. Other inhalation exposure symptoms include diffuse pleural thickening and fibrous adhesions of pleural surfaces. Respiratory distress syndrome has been reported in children after massive accidental inhalation of talcum powder. Animal (rat, dog, rabbit) studies showed internal accumulation of talc after short- and long-term inhalation exposure as well as numerous lung afflictions such as fibrosis and inflammation.
Irritation	In monkey eyes, talc in the anterior chamber has induced persistent glaucoma. Talc can induce severe granulomatous reactions when introduced into wounds. It has induced granulomas in and about the human eye when as a dusting powder for surgeons' gloves.

Sensitisation	Talc particles are smaller than 1 um and these particles are respirable and produce an intense inflammatory response characterized by cough, rhinitis, dyspnea, and vomiting.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health, and it is listed by the US Food and Drug Administration (FDA) as a Generally Recognised as Safe (GRAS) substance.
Key Study/Critical Effect for Screening Criteria	There are no adequate studies for which to derive am oral reference dose. Talc is poorly absorbed from the gastrointestinal tract, if at all, and the limited data available by the oral route indicate that talc is essentially non-toxic by the oral route of exposure
Ecological Toxicity [2,3,4]	
Aquatic Toxicity	No data were found. Talc is expected to have low toxicity to the environmental based on its ubiquity in the environment, its low bioavailability, and its widespread use in consumer products (Zazenski et al. 1995).
Determination of PNEC aquatic	PNEC values for talc cannot be calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	TWA: 2.5 mg/m^3
International Occupational Exposure Standards	NIOSH: TWA 2 mg/m^3
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [4]	
P/vP Criteria fulfilled?	Talc does not biodegrade in the environment. It is a naturally-occurring mineral and is persistent in the environment. However, for the purposes of this PBT assessment, it does not meet the criteria for persistence.
B/vB criteria fulfilled?	Talc is not expected to be bioavailable to aquatic organisms; thus, it is does not meet the criteria for bioaccumulation
T criteria fulfilled?	Talc is not expected to be bioavailable to aquatic organisms; thus, it is does not meet the criteria for toxicity.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment (UNECE 2007; US EPA 2007).
Revised	April 2018

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2. IARC (2010) Carbon Black, Titanium Oxide and Talc. Volume 93. International Agency for Research on Cancer Monographs on the Evaluation of Carcinogenic Risks to Humans. Available at http://monographs.iarc.fr/ENG/Monographs/vol93/mono93.pdf.

3. Pfizer (2006) Material Safety Data Sheet for Gemfibrozil Tablets, 90mg. Available at http://www.pfizer.com/files/products/material_safety_data/CI-719.pdf.

4. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - Fatty acids, tall-oil, ethoxylated

Chemical and Physical Properties[1]	
CAS number	61791-00-2
Molecular formula	C(18-50)H(34-98)O(3-8)
Molecular weight	UVCB
Solubility in water	No data available.
Melting point	-85 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified
Colour/Form	Liquid
Overview	This substance is used by consumers, in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
Environmental Fate[1]	
Soil/Water/Air	One study investigating the adsorption/desorption behaviour of Fatty acids, tall-oil, ethoxylated (CAS 61791-00-2) is available. The study was performed according to GLP and OECD guideline 121 (BASF 2017). 6 different peaks were observed with log Koc values ranging from < 1.8 to > 5.63. The two main components (> 85%) show log Koc values > 4. Thus, adsorption of Fatty acids, tall-oil, ethoxylated to solid soil is expected. The test with the source substance was conducted according to OECD Guideline 301B, under GLP conditions (BASF 2005). Domestic, non-adapted activated sludge was exposed to the test substance for 28 days at 22°C, and biodegradation was measured by CO2 consumption. After 28 days, the test substance reached a biodegradation of 90 - 100 %. Based on the results for the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable. The test substance consists of components with log Kow values in the range of 5 to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological mebranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be bioaccumulative.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	The test substance is not mutagenic in bacteria, as determined in an OECD 471 study. The test substance is not chromosome damaging, as determined in an OECD 487 study.

	The test substance is not mutagenic in mammalian cells, as determined in an OECD 476 study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of the test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats. The NOAEL for reproductive performance and fertility was set to 1000 mg/kg bw/d for male and female Wistar rats.
Acute Toxicity	In an acute oral toxicity study performed similar to OECD guideline 401 (BASF 1971), three groups of rats consisting of 10 animals/sex/dose were treated by single gavage application with an aqueous solution of the test substance (10000, 8000, 6400 mg/kg bw). The animals were observed for mortality and for clinical symptoms of toxicity over a period of 7 days. At the end of the observation period, the surviving animals were sacrificed for the purpose of necropsy. No mortality occurred at the tested concentrations. At all doses mastication, irregular breathing, redness of the eyes and closed eyes were seen immediately after dosing. The next morning mastication and irregular breathing was observed. On the following days, no clinical sings were observed. Pathological examination revealed hydrometra in 3 animals exposed to 10000 mg/kg bw, 2 animals exposed to 8000 mg/kg bw, and 3 animals exposed to 6400 mg/kg bw. Based on the results obtained under the test conditions of this study, the acute oral LD50 was determined to be > 10000 mg/kg bw. To evaluate the potential acute inhalation toxicity of the test substance an Inhalation Risk Test conducted according to a BASF internal testing method (BASF 1971). The test demonstrates the toxicity of an atmosphere saturated with vapours of the volatile components of a test substance at the temperature chosen for vapour generation (20 °C). Rats were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. The animals were exposed for 8 hour. The exposure concentration was estimated to be 0.28 mg/L based on evaporated substance. In addition to mortality, clinical signs were recorded and necropsy on surviving animals performed. No mortality occurred and no clinical sign were noted during exposure and observation period. In one animal exposed for 8 hours hydrometra was observed after necropsy. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. In another Inhalation Risk Test of similar design, Rats (12 animals) were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. This time vapours were generated at 20 °C as well as 50 °C. The exposure concentrations were 0.04 mg/L and 0.34 mg/L. Rats were exposed for 8 hour. As in the previous study, no mortality occurred after exposure up to 8 hours. Clinical sings observed in the animals exposed to the vapour generated at 20°C included mild escape attempts when exposure began and at the end of the exposure period slight eye irritation was observed. The next day, the animals were without symptoms. In the animals exposed to the vapour generated at 50 °C escape attempts were noted in the first 60 minutes of exposure. Exposure to the saturated atmosphere caused slight eye irritation. At the end of the exposure period, all clinical signs were resolved. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. Based on the inhalation studies, no conclusion on LC50 can be drawn, because the tested concentrations are too low in relation to the classification criteria.
Irritation	The test substance was not irritant or corrosive to the skin in a GLP-compliant OECD 431 and 439 study. The test substance was not irritant to the eyes in a GLP-compliant OECD 492 study. Based on the available information, classification for skin and eye irritation is not warranted, in accordance with EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation No. (EC) 1272/2008.

Sensitisation	The test substance did not show an indication of skin sensitising potential in an OECD 429 (LLNA) study. However, an earlier Buehler test (OECD 406) did indicate skin sensitising potential of the substance.
Health Effects Summary	Possible sensitiser.
Key Study/Critical Effect for Screening Criteria	The oral repeated dose toxicity in rats was considered the most sensitive endpoint with a NOAEL of 1000 mg/kg bw/day.
Ecological Toxicity [1]	
Aquatic Toxicity	Short-term toxicity tests with the target substance for all trophic levels (fish, daphnia, algae) are available. The test substance did not indicate to be harmful to freshwater fish (96h-LL50 > 100 mg/L), but showed to be toxic to aquatic invertebrates (48h-EL50 = 12.41 mg/L) and harmful to algae (72h-EL50 = 39.7 mg/L). Hence, aquatic invertebrates were most susceptible to the test substance and this effect value was used for the PNEC derivation. Long-term toxicity data with the source substance are only available for algae. The algal test revealed the substance to be of low toxicity to algae (72h-EL10 = 7.08 mg/L). In addition, data are available for toxicity to microorganisms. A test on respiration inhibition with activated sludge resulted in an 3h-EC10 of > 10000 mg/L indicating that detrimental effects in STPs are not to be expected.
Determination of PNEC aquatic	A PNECaqua = 0.012 mg/L can be calculated based on the lowest acute toxicity value (EL50 = 12.41 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 1000.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Based on the results from the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable.
B/vB criteria fulfilled?	No. The test substance consists of components with log Kow values in the range of xx to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological membranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be B or vB.
T criteria fulfilled?	No. Available short-term and long-term toxicity tests with aquatic organisms resulted in effect values > 1 mg/L. Thus, this substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

Revised	January 2019

References

1. ECHA REACH, Fatty acids, tall-oil, ethoxylated, Retrieved 2019: https://echa.europa.eu/

Toxicity Summary - Hexadec-1-ene

Chemical and Physical Properties[1,2,3]	
CAS number	629-73-2
Molecular formula	C16H32
Molecular weight	224.42
Solubility in water	0.00144 at 25°C
Melting point	4.1
Boiling point	284.9 at 1013 hPa
Vapour pressure	0.00352 hPa at 25°C
Henrys law constant	0.541 – 16.9 atm-m^3/mole
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Hexadec-1-ene are liquids at room temperature.
Overview	Hexadec-1-ene also known as 1-hexadecene are mono-olefins. It is an alkene in the C6-C18 range. These products are produced commercially in closed systems and are used primarily as intermediates in the production of other chemicals. No non-intermediate applications have been identified. Any occupational exposures that do occur are most likely by the inhalation and dermal routes.
Environmental Fate[1]	
Soil/Water/Air	Members of this category do not contain any hydrolysable functional groups, so will not undergo hydrolysis. Category members with carbon numbers from C6 to C24 have been shown to be readily biodegradable in biodegradation screening tests. The estimated half-life of 1-hexene in air is 10.2 hours. The soil adsorption coefficients (Koc) range from 149 for C6 to 230,800 for C18, indicating increasing partitioning to soil/sediment with increasing carbon number. It is expected that C16-C18 olefins would partition primarily to soil. Volatilization from water is predicted to occur rapidly (hours to days).
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	Repeated-dose studies, using the inhalation (C6 alpha), dermal (C12-C16), or oral (C6 alpha and internal linear/branched; C8 and C14 alpha; and C16, C18 and C20-C24 internal linear/branched) routes of exposure, have shown comparable levels of low toxicity in rats. In females, alterations in body and organ weights, changes in certain clinical chemistry/hematology values, and liver effects were noted (NOELs of ≥ 100 mg/kg oral or ≥ 3.44 mg/L (1000 ppm) inhalation). In males, alterations in organ weights, changes in certain clinical chemistry/hematology values, liver effects, and male rat-specific kidney damage that is likely associated with the alpha 2- globulin protein were noted (LOELs ≥ 100 mg/kg oral only). The male rat kidney damage was seen in oral studies with C6, C8 and C14 linear alpha olefins and C6 internal branched olefins, but was not seen in studies with C16/C18 or C20 - C24 internal linear/branched olefins. The noted liver effects were seen in oral studies with C14 alpha olefins (minimal-to-mild hepatocyte cytoplasmic vacuolation with increased liver weight in males and females) and with C20-C24 internal olefins (minimal centrilobular hepatocyte hypertrophy with increased liver weight in females only). No effects were present in the study with C20-C24 internal olefins following a 4-week recovery period, indicating reversibility of the observed effects. These liver effects seen only with the larger molecules may be indirect effects of an intensified liver burden, rather than a direct toxic effect of the olefin. Based on evidence from neurotoxicity screens included in repeated dose studies with C6 and C14 alpha olefins and with C6, C16/C18 and C20-C24 internal linear/branched olefins, the category members are not neurotoxic.

Carcinogenicity	No carcinogenicity tests have been conducted on C6 – C18 alpha or internal olefins; however, there are no structural alerts indicating a potential for carcinogenicity in humans.
Mutagenicity/ Genotoxicity	Based on the weight of evidence from studies with alpha and internal olefins, category members are not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on evidence from reproductive/developmental toxicity screens in rats with C6 and C14 alpha olefins and C6 and C18 linear/branched internal olefins, along with the findings of no biologically significant effects on male or female reproductive organs in repeated dose toxicity studies, the category members are not expected to cause reproductive or developmental toxicity.
Acute Toxicity	Olefins (alkenes) ranging in carbon number from C6 to C24, alpha (linear) and internal (linear and branched) demonstrate low acute toxicity by the oral, inhalation and dermal routes of exposure: Rat oral LD50 >5 g/kg; rat 4-hr inhalation LC50 range = 110 mg/L (32,000 ppm) to 6.4 mg/L (693 ppm) for C6 to C16; and rat/rabbit dermal LD50 > highest doses tested (1.43 - 10 g/kg).
Irritation	These materials are not eye irritants. Prolonged exposure of the skin for many hours may cause skin irritation.
Sensitisation	These materials are not skin sensitizers.
Health Effects Summary	Olefins (alkenes) ranging in carbon number from C6 to C24, alpha (linear) and internal (linear and branched) demonstrate low acute and chronic toxicity by the oral, inhalation and dermal routes of exposure.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity in rats was considered the most sensitive endpoint with a NOEL of 100 mg/kg.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Short term toxicity 96-hr LC50 > solubility Actual concentration negligible. Fish 96-hr LL0 = 1000 mg/L (nominal) Long term toxicity: NOEC (21 days) 19.4 µg/L (invertebrates)
Determination of PNEC aquatic	An assessment factor of 1000 is applied to the lowest NOEC of 19.4 µg/L (invertebrates). A PNECaqua of 0.0019 µg/L was derived.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1,2]	
P/vP Criteria fulfilled?	No. Readily biodegradable. The C6-C18 olefins have been shown to degrade to an extent of approximately 8 to 81% in standard 28-day biodegradation tests.
B/vB criteria fulfilled?	No. Based on calculated bioconcentration factors, hexadec-1-ene are not expected to bioaccumulate (BCF = 71).

T criteria fulfilled?	No. Chronic toxicity data >0.01 mg/L in fish, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

References

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4. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
5. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
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7. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Poly(vinylidene chloride-co-methyl acrylate)

Chemical and Physical Properties [1,2, 3,4,5]	
CAS number	25038-72-6
Molecular formula	$(CH_2CCl_2)_x[CH_2CH(CO_2CH_3)]_y$
Molecular weight	Assumed to be greater than 1,000 Da
Solubility in water	Not soluble in water
pH	No data found
Melting point	No data found
Boiling point	80.2 °C
Vapour pressure	86.3 mm/Hg at 25C
Henrys law constant	No data found
Explosive potential	Stable under recommended storage and use conditions. Fine dusts of these resins are capable of forming.
Flammability potential	No data found
Colour/Form	White odourless granules
Overview	Poly(Vinylidene Chloride-Co-Methyl Acrylates) are polyvinylidene chloride (PVDC) copolymer made from polymerizing vinylidene chloride with comonomers like vinyl chloride and alkyl acrylates. This polymer is used extensively in packaging applications for food, pharmaceuticals, hygiene products, and sterilized medical products. It offers excellent barrier performance to moisture, oxygen, and doors. The resins are essentially non-irritating to the eyes and skin. Dust may cause temporary mechanical irritation to the skin and eyes under extreme conditions. However, it is considered to present no significant health hazard. The polymers are expected to be inert in the environment. They are unlikely to accumulate in the food chain, and are practically nontoxic to aquatic organisms on an acute basis. There is a significant lack of toxicological data related to this polymer and suitable surrogates are not readily available. The polymers are relatively stable and inert and unlikely to present health concerns based on chemical considerations. As this product is a granular substance, dusting potential and particulate inhalation (physical hazard) may warrant further investigation for occupational concerns and large-scale environmental release of the powder in close proximity to residential areas. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment. Further assessment of the environmental risks from the use of this chemical is also not required.

Environmental Fate [1,2,3]	
Soil/Water/Air	Poly(Vinylidene Chloride-Co-Methyl Acrylates) are inert polymers that are not soluble in water and will sink into sediment or float depending on product density. No appreciable biodegradation is expected, but surface photodegradation with exposure to sunlight and degradation due to mechanical action would be expected. Poly(Vinylidene Chloride-Co-Methyl Acrylates) are not expected to accumulate in the food chain due to their relatively high molecular weight (bioconcentration potential is low). They are practically nontoxic to fish and aquatic organisms on an acute basis.
Human Health Toxicity Summary [1,3,4]	
Chronic Repeated Dose Toxicity	Repeated exposures to dusts are not anticipated to result in systemic toxicity or permanent lung injury, however, excessive exposures may cause less severe respiratory effects.
Carcinogenicity	No data found.
Mutagenicity/ Genotoxicity	No data found.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data found.
Acute Toxicity	No data found.
Irritation	Contact with solids or dusts may cause irritation or corneal injury due to mechanical action. Thermal degradation of the polymer may generate hydrogen chloride gas at concentrations that may cause eye irritation. Dust may cause irritation to upper respiratory tract (nose and throat). Thermal degradation of the resin may generate hydrogen chloride gas at concentrations that may cause respiratory irritation. Material has very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts.
Sensitisation	Brief contact is essentially non-irritating. Prolonged contact may cause slight irritation with local redness.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	No data found.
Ecological Toxicity [2,3,5]	
Aquatic Toxicity	This polymer has no readily dissociable function groups and thus expected to be non-ionic species in the environment. The methylacrylate-vinylidene chloride copolymer is not expected to be highly soluble in water based on its predominantly hydrophobic structure. If discharged to the aquatic environment, this polymer is expected to partition to soil or sediment. It is not expected to be highly mobile if released to the soil compartment (Beothling and Nabholz 1997). As such, this polymer is expected to have low bioavailability and their adverse effects results from physical effects such as occlusion of respiratory organs (e.g. the gills of fish). These adverse effects occur only at very high loading levels in water (Beothling and Nabholz, 1997). Therefore, this polymer is expected to have low toxicity to aquatic life.
Determination of PNEC aquatic	This chemical has been identified by NICNAS to be of low concern to the environment and has not been assessed further.
Current Regulatory Controls[2]	
Australian Hazard Classification	No data found
Australian Occupational Exposure Standards	No data found

International Occupational Exposure Standards	No data found
Australian Food Standards	No data found
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment [1,3,4,6]	
P/vP Criteria fulfilled?	The polymers are synthetic addition polymers with stable carbon-chain backbones. If released to the environment, the polymers in this group are not expected to undergo rapid degradation, and are considered to be Persistent according to domestic hazard criteria (EPHC 2009).
B/vB criteria fulfilled?	Polymers with a NAMW greater than 1,000 Da cannot cross biological membranes (Nabholz 1997). Therefore, this polymer is considered to be not bioaccumulative according to domestic hazard criteria (EPHC 2009).
T criteria fulfilled?	No relevant toxicity data are available. This polymer is not expected to be toxic according to domestic environmental hazard criteria (EPHC 2009).
Overall conclusion	Not PBT

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5. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - 2-Propenoic acid, polymer with sodium phosphinate and 2-Propenoic acid, sodium salt, polymer with 2-propenamide

Chemical and Physical Properties[1,2,3]	
CAS number	129898-01-7 25085-02-3
Molecular formula	(C3H4O2.H3O2P.Na)x.xNa (C3H5NO.C3H4O2.Na)x
Molecular weight	Likely >1000 MW
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	No studies are available. The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[2]	
Soil/Water/Air	The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate.
Human Health Toxicity Summary	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity[2]	

Aquatic Toxicity	Limited information is available. The polymer is expected to be a low concern for toxicity to aquatic organisms. Due to its poor solubility and high molecular weight, it is not expected to be bioavailable. It does not contain any reactive functional groups.
Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	The polymer is not readily biodegradable, hence it meets the screening criteria for persistence.
B/vB criteria fulfilled?	The polymer is expected to have a very high molecular weight and poor water solubility. It is not expected to be bioavailable, hence this polymer does not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on the polymer. It is expected to have low concern for aquatic toxicity because of its very high molecular weight and poor water solubility. As such, the polymer does not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved: https://www.nicnas.gov.au
2. Categorization Results from the Canadian Domestic Substance List, 2-Propenoic acid, polymer with sodium phosphinate
3. U.S National Library of Medicine, Toxicology Data Network, ChemIDplus, CAS#38193-60-1. Accessed https://chem.nlm.nih.gov/chemidplus/rn/38193-60-1

Toxicity Summary - Aliphatic Alcohols, ethoxylated

Chemical and Physical Properties[1]	
CAS number	68951-67-7
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	Soluble in water
Melting point	-3 °C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Yellow liquid, mild odour
Overview	Principle Route of Exposure: Eye or skin contact, inhalation Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed. Limited data is available for CAS #68951-67-7, as such read across data from CAS #69227-22-1 has been utilised.
Environmental Fate[1]	
Soil/Water/Air	This substance is expected to be readily biodegradable (84% @ 28d) (similar substances). Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative. Mobility in soil: KOC = >4
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	No data available to indicate product or components present at greater than 0.1% are chronic health hazards.
Carcinogenicity	Did not show carcinogenic effects in animal experiments (similar substances)
Mutagenicity/ Genotoxicity	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Animal testing did not show any effects on fertility.
Acute Toxicity	LD50 Oral: 600 mg/kg (Rat) (similar substance) LD50 Dermal: > 5200 mg/kg (Rabbit) (similar substance) LD50 Inhalation: > 0.22 mg/L (saturated concentration) (Rat) (similar substance)
Irritation	May cause mild respiratory irritation. Causes severe eye irritation which may damage tissue. Causes skin irritation.
Sensitisation	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Health Effects Summary	Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Key Study/Critical Effect for Screening Criteria	

Ecological Toxicity [1]	
Aquatic Toxicity	Acute Toxicity to fish: NOEC 2.19 mg/L (fathead minnow) NOEC 0.740 mg/L (fathead minnow) Chronic Toxicity to fish: NOEC 0.280 mg/L (fathead minnow) NOEC 0.160 mg/L (fathead minnow) Acute Toxicity to invertebrates: EC50 0.510 mg/L (Daphnia magna) EC50 0.247 mg/L (Daphnia magna) Acute Toxicity to algae: EC50 1.90 mg/L (duckweed)
Determination of PNEC aquatic	On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 0.14 mg/L for Daphnia. The PNEC aquatic is 0.14 µg/L.
Current Regulatory Controls [1]	
Australian Hazard Classification	H302 - Harmful if swallowed H315 - Causes skin irritation H318 - Causes serious eye damage
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable.
B/vB criteria fulfilled?	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2022

References

1. Halliburton Safety data sheet Date / Revised: 07.02.2018 Version: 19 Product: DCA-32002
2. USEPA CompTox Chemicals Dashboard, retrieved April 2022: https://comptox.epa.gov/dashboard/chemical/hazard/DTXSID5041936

Toxicity Summary - Diutan/Duitan Gum

Chemical and Physical Properties [1]	
CAS number	595585-15-2 and 125005-87-0
Molecular formula	(C6H12O6. C6H12O5. C6H10O7)x.xC2H4O2. xCa.xK.xMg.xNa
Molecular weight	> 1,000,000 g/mol
Solubility in water	6.3 g/L at pH 1 @ 200C > 40 g/L at pH range 7 and 10 @ 200C
pH	No data found.
Melting point	Duitan decomposed from approximately 175 ± 0.5C without melting.
Boiling point	No data found.
Vapour pressure	≈ 0.1 kPa at 25 C
Henrys law constant	NA
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	White to tan powder
Overview	The polymer Diutan is suitable for a wide variety of thickening and suspending applications. Diutan is likely to be used in the following categories of application: cementitious packaged products, viscosifier for spacer fluids, and viscosifier for oil field drilling fluid, oil field cementing, firefighting foams, concrete, tyre /pneumatic application sealants, cleaners and coatings. There is limited toxicological data available for Diutan. The following information below is obtained from the National Industrial Chemicals Notification and Assessment Scheme (NICNAS).
Environmental Fate [1]	
Soil/Water/Air	The polymer, Duitan is expected to be highly mobile in solids and was found to be readily biodegradable via biotic and abiotic processes under the OECD TG 301 B Ready Biodegradability: CO2 Evolution Test. Based on the molecular weight, water solubility and Kow value (log Kow -2.76) the polymer is not expected to bioaccumulate.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	In a 28-day oral repeat dose study in rats, a No Observed Effect Level (NOEL) was established as 1000 mg/kg bw/day, based on the absence of treatment related effects.
Carcinogenicity	Diutan not listed as an IARC carcinogen
Mutagenicity/ Genotoxicity	The polymer was not mutagenic to bacteria and not clastogenic to human lymphocyte treated in vitro.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data found.
Acute Toxicity	The polymer is of low acute toxicity via the oral route. Dermal toxicity was not tested. An acute inhalation study in rats showed effects that were seen in both the test and control animals to a similar extent, and therefore cannot be attributed to the notified polymer. However the level of airborne dust achieved in this study (0.316 mg/L) was well below the cutoff of 5 mg/L for determining hazard classification for this endpoint. The U.S. Environmental Protection Agency (USEPA) identified concerns for lung effects from inhalation exposure to the notified polymer when it was assessed as a new chemical in the USA, based on structural analogues and submitted test data. The concern is that fine respirable particles of a high molecular weight substance, when inhaled deep into the lungs, would absorb water and cause congestion (communication from notifier). While the USEPA does not expect water-soluble polymers to exhibit lung toxicity because they are expected to rapidly clear the respiratory tract and therefore not cause an overloading effect, they require testing on new chemicals of this type under their exposure –based authority (USEPA, 2006). In this case the USEPA considered that significant inhalation exposure would not occur under the use conditions described for the USA, but that significant human exposure could occur under other scenarios. They have therefore recommended that a 90-day inhalation study with 60-day holding period be performed if additional applications for the chemical commence.
Irritation	Based on a study in rabbits the polymer is considered to be slightly irritating to the eyes, but not classifiable. A dermal irritation study was carried out on an analogue chemical containing the same monosaccharide units, but with a different molecular weight and branching structure. The protocol for this study was more severe than the OECD test method, as it used a 24 h rather than 4 h exposure time, abraded skin and occlusive covering. The test substance was not washed from the skin after the exposure period. Under the conditions of this test the analogue polymer was moderately irritating, with mild erythema and slight to moderate oedema. Additional information on the irritation potential of the polymer is available from the irritation effects of a 50% solution of the notified polymer in the guinea pig sensitisation study (24 h exposure time). In this study there was mild to moderate erythema, but oedema was absent. Based on the results of these two studies, it is considered that the notified chemical would not be classified as a skin irritant
Sensitisation	There was no evidence of sensitisation potential to the polymer in the guinea pig maximisation test. Therefore the notified polymer is considered not to be a potential skin sensitiser.
Health Effects Summary	Available data on the polymer indicates that it is of low toxicity, however there are concerns about possible adverse effects on lungs after inhalation exposure. The hydrophilic nature of the notified polymer in powder form can contribute to mechanical irritation and collection in the eyes, on the skin or in the airways when dust is generated.

Key Study/Critical Effect for Screening Criteria	The NOEL of 1000 mg/kg bw/day, derived from a 28-day rat oral study will be used to derive a drinking water guidance value. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability), 10 (subacute to chronic). Oral RfD = 1000/1000 = 1 mg/kg/day Drinking water guideline = 3.9 ppm
Ecological Toxicity [1]	
Aquatic Toxicity	The results of the aquatic toxicity tests conducted by NICNAS are listed below. *Organism* — *Duration* — *End Point* — *mg/L* Freshwater Fish — 96 h — LC_{50} — > 100 Freshwater Daphnia — 48 h — LC_{50} — > 100 Marine water Copepod — 48 h — LC_{50} — 250 Freshwater Algae — 0-72 h — E_bC_{50} — > 100 E_rC_{50} — > 100 Marine water Algae — 0-72 h — E_bC_{50} — > 1000 E_rC_{50} — > 1000
Determination of PNEC aquatic	Using the lowest value of > 100 mg/L for freshwater organism and a safety factor of 100 (based on 3 experimental results) for fish/Daphnia/algal acute toxicity endpoints, a Predicted No Effect Concentration (PNEC) for freshwater is > 1 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	Based on the available data, the Diutan is not classified as a hazardous substance in accordance with the NOHSC Approved Criteria for Classifying Hazardous Substances (NOHSC 2004).
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	Diutan expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence
B/vB criteria fulfilled?	Based on the molecular weight, water solubility and Kow value (log Kow -2.76) Diutan is not expected to bioaccumulate.
T criteria fulfilled?	The acute aquatic toxicity of guar gum is >0.1 mg/L. Thus, Diutan is not expected to meet the screening criteria for toxicity
Overall conclusion	Not a PBT substance.
Revised	April 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS), Full Public Report, Diutan Gum, 2006.

Toxicity Summary - Non Crystalline Silica

Chemical and Physical Properties [1]	
CAS number	7631-86-9
Molecular formula	SiO_2
Molecular weight	60.1 g/mol
Solubility in water	Insoluble
Melting point	1710 °C
Boiling point	2230 °C
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	NA
Flammability potential	NA
Colour/Form	Amorphous powder
Overview	Non crystalline silica (silica gel/amorphous silica) is silicon dioxide, an inorganic compound which is ubiquitous in the environment. Amorphous silica is incorporated in a variety of food products as anti-caking agent and as an excipient in pharmaceuticals.
Environmental Fate [2,3]	
Soil/Water/Air	Silicon oxides are the most abundant compounds in the earth's crust mass. Synthetic amorphous silica and silicates are released into the environment are expected to be distributed mainly into soils and sediments, weakly into water and probably not at all in the air due to their physico-chemical properties, particularly low water solubility and very low vapour pressure. Synthetic amorphous silica and silicates released into the environment are expected to combine indistinguishably with the soil or sediment due to their similarity with inorganic soil/sediment matter and will be subjected to natural processes under environmental conditions (cation exchange, dissolution, sedimentation). Biodegradation is not applicable to these inorganic substances. The bioavailable form of synthetic amorphous silica and silicates is the dissolved form which exists exclusively as monosilicic [Si(OH)4] acid under environmental pH. In analogy to the general chemical reaction of weak acids and salts of weak acids with water, the water-soluble fraction of silica acts as a weak acid and, therefore, will tend to lower the pH value, while that of a silicate acts as a base tending to bind protons and, thus, raise the pH value by forming hydroxyl ions. But pH shifts which are measurable at high loadings under laboratory conditions are not expected to occur from the anthropogenic deposition in the aquatic environment of synthetic amorphous silicas due to low aquatic releases and sufficient natural buffer capacities. Finally, these materials are supposed to combine indistinguishably with the soil layer or sediment due to their chemical similarity with inorganic soil matter. Dissolved silica can be actively assimilated by some marine and terrestrial organisms as normal natural processes mainly related to structural function.
Human Health Toxicity Summary [4]	
Chronic Repeated Dose Toxicity	Inhalation: Based on the available data in animals and humans, the chemicals are considered to have repeated dose inhalation toxicity, warranting hazard classification. The reported lowest observed adverse effect concentration

	(LOAEC) for adverse pulmonary effects in various rat and mice studies ranged between 1–5 mg/m^3 (US EPA, 1996). Non-neoplastic adverse effects specific to the lungs of rodents included granulomatous lesions in the walls of the large bronchi, pulmonary fibrosis, hyperplasia of the alveolar compartment and increases in lung collagen content. A No Observed Adverse Effect Concentration (NOAEC) of 50 mg/m^3 was established in an 8-month rat inhalation study based on no adverse effects at 50 mg/m^3 (Johnston et al. 2000). It is noted that the transient pulmonary inflammatory response which returned to control levels after exposure stopped. <u>Dermal (in humans):</u> Long-term (3–34 years) occupational dermal exposure to silica dusts are reported to be associated with connective tissue diseases with a potential to produce progressive systemic scleroderma. While there is debate about a true cause and effect relationship, there is evidence to show a link between scleroderma and lung silicosis in occupational settings (Thomas et al., 2000). <u>Inhalation (in humans):</u> In humans, inhaled particles of crystalline silica can be transported to other parts of the body through the lymphatic system (US EPA, 1996; Thomas et al., 2000). Two forms of silicosis—accelerated (develops 5–10 years after initial exposure) and chronic (develops 10 years after initial exposure)—have been reported after repeated occupational exposure to crystalline silica dust, mainly that from quartz (US EPA, 1996; WHO, 2000). In a study of 67 gold mine workers in Canada, there was a significant linear relationship between lung quartz concentration and the severity of silicosis. While there were other particles detected in the lung tissue, quartz was the only significant indicator of silicosis severity (WHO, 2000).
Carcinogenicity	The International Agency for Research on Cancer (IARC) has classified the chemical as 'Carcinogenic to humans' (Group 1), based on sufficient evidence for carcinogenicity in humans and experimental animals.
Mutagenicity/ Genotoxicity	In vitro studies with chemicals in this group gave both positive and negative results. The majority of positive genotoxicity assay results can be explained by the generation of reactive oxygen species (OECD, 2011) resulting in DNA damage. Since DNA damage is secondary to crystalline silica-induced oxidative damage, a direct genotoxic effect is not expected. Based on this information, it is not expected that chemicals in this group directly induce heritable mutations in human germ cells. Therefore, the available data do not warrant hazard classification.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	An early limited one-generation study on rats gave no evidence of adverse effects on reproduction performance at 500 mg/kg/day, the highest dose tested (NOAEL). But the reliability is poor due to the small group size of animals. SAS was examined for embryotoxic and developmental effects during the gestation phase in various animals' species, rat, mouse, rabbit and hamster, at oral doses up to 1,600 mg/kg/day. There were no significant signs of maternal or embryotoxic/developmental toxic effects in any species tested. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not differ from the frequencies occurring spontaneously in the control animals.
Acute Toxicity	No guideline studies have been conducted to assess the acute inhalation exposure to crystalline silica. Studies conducted using a single intratracheal instillation of crystalline silica in rodents have shown significant lung pathology such as the formation of silicotic nodules and lung fibrosis (WHO, 2000). However, these studies are not directly relevant for human exposure. A single intratracheal instillation of quartz (50 mg, particle size <5 mm in diameter) in male rats (strain unspecified) resulted in a three-fold increase in water, protein and phospholipid content in lungs within 28 days of administration (WHO, 2000). In another study, 12 mg of quartz (particle size <5 mm in diameter) was administered to male and female rats (strain unspecified) using a single

	intratracheal instillation. Discrete silicotic granulomas in the lungs of both sexes were observed 21–30 days after instillation (WHO, 2000).
Irritation	Synthetic amorphous silicas are not irritating to the skin of rabbits exposed to 0.19 g (one case) or 0.5 g of dry or moistened test item under occlusive conditions for 4 or 24 hours. All products tested as a powder (0.1 g) have shown no or only weak and transient irritating effects on the conjunctivae of the eyes of rabbits with the iris and cornea not affected at all.
Sensitisation	No experimental data are available on the synthetic amorphous silicas. Medical surveillance records on workers gave no evidence of skin sensitization over decades of practical experience.
Health Effects Summary	The critical health effects for risk characterisation include local long-term effects (carcinogenicity) and harmful effects following repeated exposure through inhalation (silicosis). According to NICNAS, A Tier III assessment might be necessary to provide further information whether the current exposure controls are appropriate to offer adequate protection to workers. All other risks are considered to have been sufficiently assessed at the Tier II level, subject to implementing any risk management recommendations, and provided that all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.
Key Study/Critical Effect for Screening Criteria	The NOAEC of 50 mg/m^3 based on an 8-month rat inhalation study will be carried forward for the risk assessment. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability)
Ecological Toxicity [2,3]	
Aquatic Toxicity	Studies on fish, Daphnia and algae using excess loadings of SAS or NAS showed no acute toxicity, although physical effects on Daphnia were observed in tests using unfiltered test medium. Test results, based on loading rates, are as follows: 96hr-LL0 *(Brachydanio rerio)* is 10,000 mg/L for SAS and NAS; 24hr-EL50 *(Daphnia magna)* >10,000 mg/L for SAS; 72hr-NOEL *(Scenedesmus subspicatus)* is 10,000 mg/L for NAS. There are no chronic aquatic toxicity data, but due to the known inherent physico-chemical properties, absence of acute toxic effects as well as the ubiquitous presence of silica/silicates in the environment, there is no evidence of harmful long-term effects arising from exposure to synthetic amorphous silica/silicates.
Determination of PNEC aquatic	Not applicable
Current Regulatory Controls [4,5]	
Australian Hazard Classification	Not specifically listed on the HSIS (Safe Work Australia)
Australian Occupational Exposure Standards	Silica (CAS No. 7631-86-9) is listed as 'Fumed silica (respirable dust)' with an exposure standard of 2 mg/m3 TWA – although the CAS No. used for this entry is the same as the crystalline form, it refers to the amorphous form of the chemical.
International Occupational Exposure Standards	No data available
Australian Food Standards	Silica is regarded as GRAS (generally recognised as safe) for food use (FDA, 2013)
Australian Drinking Water Guidelines	To minimise an undesirable scale build up on surfaces, silica (SiO2) within drinking waters should not exceed 80 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.

T criteria fulfilled?	No. Chronic toxicity data not available. Acute data >0.1 mg/L in fish, invertebrates and algae, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2018

References

1. HSDB. Hazardous Substances Data Bank. Retrieved 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. IUCLID (2004) IUCLID Data Set for Synthetic Amorphous Silica and Silicates: Silicon Dioxide (CAS No. 7631-86-9, 112945-52-5, 112926-00-8; Silicic Acid, Aluminum Sodium Salt (CAS No. 1344-00-9); Silicic Acid, Calcium Salt (CAS No. 1344-95-2), UNEP Publications.
3. OECD-SIDS (2004) Screening Information Dataset (SIDS) Initial Assessment Report for Synthetic Amorphous Silica and Silicates: Silicon Dioxide (CAS No. 7631-86-9, 112945-52-5, 112926-00-8; Silicic Acid, Aluminum Sodium Salt (CAS No. 1344-00-9); Silicic Acid, Calcium Salt (CAS No. 1344-95-2), UNEP Publications.
4. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Crystalline silica: Human health tier II assessment, Retrieved 2018: https://www.nicnas.gov.au
5. NHMRC, 2011. Australian Drinking Water Guidelines 6. Volume 1. National Water Quality Management Strategy. National Health and Medical Research Council.

Polyethylene glycol monohexyl ether

Chemical and Physical Properties [1,2]	
CAS number	31726-34-8
Molecular formula	(C2-H4-O)mult-C6-H14-O
Molecular weight	146.228 g/mol
Solubility in water	Soluble in water.
Melting point	5C
Boiling point	High boiling points
Vapour pressure	Low vapour pressure
Henrys law constant	Low henrys law constant
Explosive potential	No data available.
Flammability potential	Thermal decomposition can lead to release of irritating gases and vapours
Colour/Form	Clear yellow liquid with alcohol odour
Overview	Polyethylene glycol monohexyl ether (also known as poly(oxy-1,2-ethanediyl), α-hexyl-ω-hydroxy, hexan-1-ol, ethoxylated; and hexyl poly[oxyethylene] ether). The chemical is an Ethoxylated Alcohol (EA), a major class of non-ionic surfactants, used in oilfield applications, as solvents in cleaning fluids; in the manufacture of paper products; in adhesives and binding agents; in paints, lacquers, and varnishes; in surface treatments; in cosmetics; in nonagricultural pesticides and preservatives; in construction materials; in pharmaceuticals; as corrosion inhibitors; as antifreezing agents; in aerosol propellants; and in lubricants. Limited data is available for Polyethylene glycol monohexyl ether. Information on Alcohol Ethoxylates from the HERA report (2009) and ethylene glycol monobutyl ether (EGBE) CAS 111-76-2 has been included in this toxicity profile.
Environmental Fate[1,2]	
Soil/Water/Air	EAs undergo rapid primary and biodegradation under both laboratory and field conditions. In surface water, sediment, and soil aerobic and anaerobic biodegradation will occur. In addition, EA may be taken up by plants or animals living in the surface water or soil The proposed half-lives in river water at 12C range from 4 to 24 hours (based on experimental data). EAs are not bioaccumulative, based on a log Kow value greater than 3, and a maximum BCF value of under 800. EAs are rather water soluble and the vapour pressures of EAs are relatively low, the Henry's law constants of EAs can be expected to be very low. As a result, volatilisation of surfactants can be expected to be negligible. Further work reported by Environment Canada and Health Canada (2006) has established that the degree of bioaccumulation expected from EA is well below the Canadian bioconcentration criterion of 5000. The sixteen measured BCF values for 15 EA homologues showed the lack of a linear relationship between alkyl or ethoxylate chain length and BCF, with the highest measured BCF value being under 800. Environment Canada (2006) concluded that it is evident that the EA metabolism rates prevent any significant accumulation. The data indicated that there may be an optimal structural combination of ethoxylate and alkyl chain lengths, at or around C14EO7, where BCF is maximized, but even the measured BCF for this chemical is well below the criterion of 5000. Thus Environment

	Canada (2006) concluded that ethoxylated aliphatic alcohols are not bioaccumulative.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In two chronic long-term toxicity studies which also investigated the carcinogenic potential of EAs, no adverse effects were observed up to a dose level of 50 mg/kg/day. In several dermal and oral subchronic studies over 90 days the range of NOELs/NOAELs was 50 to 700 mg/kg/day. Most of the 90-day oral feeding studies were in many respects similar to OECD test method 407. Two studies, one dermal and one oral repeated dose studies were conducted in compliance with GLP regulations. In the oral GLP-compliant study with C14-15AE7, the NOEL was established at the 50 mg/kg bw/d exposure level. However, the same product was tested in a non-GLP 90-day oral feeding study and the NOAEL was determined to be at the highest exposure level of 700 mg/kg bw/d. C14-15AE7 was also examined in two 2-year feeding studies. Dose related body weight depressions in females in the upper two treatment levels were seen. At termination, elevated organ-to-body weight ratios were noted in the liver, kidney and heart. No effects have been observed on the organs of the reproductive system. Moreover, no treatment-related histopathology and no increase in tumour incidence were reported. It was concluded that the NOAEL should be established at the 0.5% level which converts to a dose of about 190 mg/kg bw/d for female rats. In the other long term study dose related body-weight depression were observed in females in the upper two treatment levels (*i.e.*, 100 and 250 mg/kg bw/d). Based on these findings, the NOAEL was established at the 50 mg/kg/d exposure level. In a 2-year feeding study with C12-14AE6.5 the NOAEL was established to be 50 mg/kg bw/d. At the higher dose levels (*i.e.*, 250 and 500 mg/kg bw/d) reduced food consumption and body weight gain was observed. At study termination, elevated organ-to-body weight ratios were noted for the liver, kidney and brain in females at the 250 and 500 mg/kg bw/d dose levels. These differences were not accompanied by histological changes in the organs examined. This study was not indicated to be GLP or OECD compliant but should be regarded as suitable as the study was conducted following the principles and procedures of the OECD guideline. A number of different alcohol ethoxylates with different structural characteristics were evaluated (*e.g.*, carbon chains raging in length from C9 to C14-16 and ethoxy unit length from 3 to 20). Despite differences in protocols and study periods the overall toxicological response was qualitatively and quantitatively similar and a contribution of structural characteristics to toxicity could not be established. No clear trends in the toxicity after repeated exposure with structural components of the test material could therefore be determined. Dermal treatment of 10 rats per sex per group for 90-days with 1%, 10% and 25% C9- 11AE6 did not result in any significant compound related effects (Gingell and Lu, 1991). In-life observations included clinical observations for e.g., skin irritation, body weights, urine and blood collection and analysis. At necropsy organs and tissues collected were preserved in buffered formalin and histopathologically examined. Scores for signs of irritation at the application site throughout the study were zero but at 10% and 25% dry and flaky skin was noted. Relative kidney weights were increased in both sexes at the 25% treatment level, but no histological lesions could be determined. As a result of the observation of the increases in relative kidney weight, the NOAEL was established at the 10% level. This exposure level reflects a dose of about 80 mg/kg bw/d. This study followed the principles of the OECD procedure 411 and was GLP compliant. When given by gavage the most prominent finding was local irritation in the gastrointestinal tract. In repeated dose feeding studies the liver was the most prominent target organ. EAs induced increased relative liver weights and in some cases liver hypertrophy. This effect could however be related to an induction of liver metabolism and would normally considered an adaptive rather than an adverse effect. The NOAEL in the chronic toxicity studies is based on reduced body weight gain and increased relative organ weights only. The NOAEL of 50 mg/kg bw/d that is taken forward to the risk characterisation is based on the lowest

	NOAEL in a chronic oral feeding study in rats which was equal to the lowest NOAELs in subchronic feeding studies in rats.
Carcinogenicity	The carcinogenic potential of C14-15AE7 in rats has been evaluated in a one- to two-year oral feeding study (Procter and Gamble Ltd., 1979). C14-15AE7 was administered at dietary levels of 0, 0.1, 0.5 and 1% to four groups of Charles River rats (*i.e.*, 65 of each sex) for a period of one or two years. Fifteen males and females from the control and the 0.5% dose group, 15 males and 14 females from the 0.1% dose group, and 14 males and 15 females from the 1% dose group were sacrificed after an interim of 1 year exposure. The remaining animals were treated for the full 2-year period. Administration of C14-15AE7 for a period of 1 or 2 years did not produce any compound related changes in general behaviour and appearance. The survival rate of the test animals was comparable if not better than the controls. Body weights of females fed with 0.5% C14-15AE7 and males and females fed with 1% C14-15AE7 had significantly lower weight gains than the control. At necropsy, no compound related effects were observed in organ to body weight determinations. In conclusion, there was no evidence to indicate that treatment related changes of a carcinogenic nature were produced in rats by repeated ingestion of 0.1, 0.5 and 1% C14-15AE7. No carcinogenic effects were observed in a two-year study in which 100 Sprague-Dawley rats were fed with C12-13AE6.5 containing diet at doses up to 1% (*i.e.*, 500 mg/kg bw/d) (Exxon; Talmage, 1994). Reduced food consumption was noted at the higher dose levels (*i.e.*, 0.5 and 1% for females and 1% for males), resulting in a lower body weight gain compared to the control group. No treatment-related histopathology was found and no increase in tumour incidence was observed. Thus, on the basis of this study, C12-13AE6.5 is not considered to be carcinogenic No treatment-related lesions were observed when C12-13AE6.5 was applied to the backs of ICR Swiss mice three times a week at 0, 0.2, 1.0 or 5.0% for 18 month (Shell Chemicals Ltd., 2002; Talmage, 1994). On the basis of the information presented it can be concluded that alcohol ethoxylates are not carcinogenic.
Mutagenicity/ Genotoxicity	In all available *in vitro* and *in vivo* genotoxicity assays, there was no indication of genetic toxicity of broad range of structurally different alcohol ethoxylates.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a two-generation study conducted in Charles River CD rats, the reproductive toxicity and developmental effects of C14-15AE7 were evaluated at dietary levels of 0.05%, 0.1% and 0.5% (*i.e.*, about 25, 50 and 250 mg/kg bw/d). No compound related differences were seen between control and treated rates with restpect to fertility, gestation or viablilty indices. No treatment-related changes in behaviour or appearance were observed in the parental rats or pups throughout the study. The reproductive toxicity and developmental effects of C12AE6 was evaluated in a feeding study using a similar experimental design as described above (Little, 1977; Shell Chemicals Ltd., 2002; Talmage, 1994). Rats were exposed in a two-generation study to the compound at dose levels of 25, 50 or 250 mg/kg bw/d. No treatment related effects in the parents or pups on general behaviour, appearance or survival were observed. Fertility of treated groups was comparable with the controls. The presented information indicates that the investigated EAs did not cause reproductive toxicity when applied orally or dermally.
Acute Toxicity	EAs are of low oral, dermal and inhalation toxicity. Alcohol ethoxylates have been shown to have a low to moderate order of acute oral toxicity in the rat with LD50 values ranging between 0.6 to more than 10 g/kg. The structure of the test compound influenced acute toxicity determined by the relative number of ethoxy units, whereas, carbon chain length was not correlated with the acute oral toxicity. The degree of ethoxylation of the EA appeared to be the only factor found to be of relevance in acute oral toxicity with the compounds with ethoxylate chains between 5 and 14 being more toxic by oral consumption than those with less than 4 or more than 21 ethoxy units. Clinical findings observed

	in the test animals after treatment were indicative of gastrointestinal irritation such as ulcerations of the stomach, pilo-erection, diarrhoea and lethargy and may be linked with administration of a bolus dose, in particular in cases where the test item was administered undiluted. There is further an apparent sex difference for a group ethoxylates with LD50 values below 2,000 mg/kg, with females being more susceptible to the acute oral toxicity than males. It should be noted that there is unpublished information suggesting that this is not a sex specific phenomenon, but an effect related to body weight; lighter animals being more susceptible than heavier animals. Alcohol ethoxylates are considered to be of low acute inhalation toxicity to rats with LC50 values exceeding the saturated vapour concentration in air. Acute toxic thresholds were reached only when animals were exposed to the undiluted test chemical in form of a respirable mist or aerosol. Alcohol ethoxylates were shown to have a low order of acute dermal toxicity in the rat and rabbit with LD50 values typically greater than the maximum applied dose, ranging from greater than 0.8 to greater than 5 g/kg in rats. LD50 values in rabbits were greater than 2 g/kg but less than 5 g/kg. There was no relationship between compound structure and dermal toxicity.
Irritation	High quality studies investigating the skin and eye irritation potential of alcohol ethoxylates have shown that the use of these compounds in household cleaning products is of low concern. When tested undiluted EAs were found to be slightly too severely irritating to skin in rabbits and rats and mildly to severely irritating to the rabbit eye. However, if the skin or eye irritation potential was investigated at in-use concentrations, EAs were only mildly irritating to skin and eyes.
Sensitisation	EAs are not considered to be skin sensitizers.
Health Effects Summary	The critical human health effects of the AEs for risk characterisation are acute oral toxicity and skin and eye irritation. The severity of irritation appears to increase directly with the chemical concentration. Skin irritation, but not eye irritation, generally decreases with an increasing degrees of ethoxylation.
Key Study/Critical Effect for Screening Criteria	EAs of different structures with regard to the length of the alkyl chain and the degree of ethoxylation were evaluated in oral and dermal repeated dose toxicity studies. The lowest NOAEL of the EAs for systemic toxicity was 50mg/kg/day in a 2-year oral feeding study in rats. Effects observed at the LOAEL were related to significantly elevated organ-to-body weight ratios for liver, kidney and heart. No adverse histopathological changes were observed at the LOAEL. Uncertainty factors: 10 (interspecicies variability); 10 (intraspecies variability) Oral RfD = 50/100 = 0.5 mg/kg/day Drinking water guidance value = 1.95 ppm
Ecological Toxicity [3]	
Aquatic Toxicity	Acute Aquatic - Fish -96-hr LC50 Oncorhynchus mykiss - 1,464 mg/L -96-hr LC50 Pimephales promelas - range from 1,580 mg/L - 2,137 mg/L -96 hr LC50 - Lepomis machrochirus - 1,490 mg/L Acute Aquatic - Invertebrate -48-hr EC50 Daphnia magna - range from - 881 mg/L - 2,650 mg/L Acute Aquatic - Algae and other aquatic plants -72-hr EC50 Pseudokirchneriella subcapitata - 911 mg/L -72-hr EC50 Selenastrum capricornutum - 720 mg/L Chronic Aquatic - Fish -21-day NOEC Brachydanio rerio - > 100 mg/L Chronic Aquatic - Invertebrate - 21-day NOEC Daphnia magna - >100 mg/L
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish, algae and invertebrates. Results from chronic studies are available for invertebrates and fish. As such, an assessment factor of 100 has been applied to the lowest reported NOEC of 100 mg/L for Daphnia. The PNECaquatic is 1 mg/L.

Current Regulatory Controls [1,2]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [2]	
P/vP Criteria fulfilled?	EAs are readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on a log Kow value greater than 3, and a maximum BCF value of under 800. EAs are not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of EAs are > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not PBT
Revised	April 2022

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Toxicity Summary - Fumaric acid and monosodium fumarate

Chemical and Physical Properties [2,3,5,8]	
CAS number	Fumaric Acid: 110-17-8 Monosodium Fumarate: 7704-73-6
Molecular formula	Fumaric Acid: C4H4O4 Monosodium Fumarate: C4H3NaO4
Molecular weight	Fumaric Acid: 116.07 g/mol Monosodium Fumarate: 138.06 g/mol
Solubility in water	Fumaric Acid: 7000 mg/L @ 25C Monosodium Fumarate: Soluble in water
pH	No data found
Melting point	287 C
Boiling point	522 C
Vapour pressure	1.54X10-4 mm Hg at 25 deg C
Henrys law constant	No data found
Explosive potential	Dust presents explosion hazard
Flammability potential	Non flammable
Colour/Form	Fumaric Acid: Colourless odourless crystals or powder Monosodium Fumarate: Odourless, white crystalline powder
Overview	Fumaric acid is an organic dicarboxylic acid naturally present in all organisms. It predominantly originates from the oxidation of succinate and is further converted to malic acid in the tricarboxylic acid cycle. Exogenous fumaric acid will be rapidly metabolised by well-recognised pathways, and neither fumarate nor its metabolites would be expected to accumulate in human or animal tissues. Fumaric acid is used primarily in liquid pharmaceutical preparations as an acidulant and flavoring agent. Fumaric acid is approved for use as a food additive in Australia, and use as a therapeutic agent in the treatment of psoriasis and other skin disorders, as wells as a feed additive for all animals without a maximum level. A Tier 1 human health risk assessment has been performed by the Australian Government Department of Health, National Industrial Chemicals Notification and Assessment Scheme (NICNAS), indicating the chemical is not considered to pose an unreasonable risk to the health of workers and public health. The highest category use is listed as Cosmetic and the data available on the function of the chemical indicate that it may be used in cosmetics but only at low concentrations. Monosodium fumarate is the sodium salt of fumaric acid, and is a food additive, used as a flavour enhancer and acidity regulator. The WHO JECFA has listed a group ADI of “not specified” for fumaric acid and its salts in 1999. Limited information is available for monosodium fumarate, and as such Fumaric acid has been used as its surrogate.

Environmental Fate [5]	
Soil/Water/Air	If released to soil, fumaric acid is expected to have very high mobility based upon an estimated Koc of 7. The pKa values of fumaric acid are 3.03 and 4.54, indicating that this compound will exist almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil is not expected because the acid exists as an anion and anions do not volatilize. Using a Warburg respirometer and a sewage inoculum, 5-day Theoretical BODs of 57-70% were reported, suggesting that biodegradation may be an important environmental fate process in soil. If released into water, fumaric acid is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. The half-life of fumaric acid in various natural waters ranged from 1-15 days using river die-away studies, indicating that biodegradation is an important environmental fate process in water. Fumaric acid's pKa values indicate it will exist almost entirely in the anion form at pH values of 5 to 9 and therefore volatilization from water surfaces is not expected to be an important fate process. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. Fumaric acid will be degraded in brightly sunlit natural waters by reaction with photochemically produced hydroxyl radicals with a half-life of 45 days.
Human Health Toxicity Summary [5,6]	
Chronic Repeated Dose Toxicity	Eight groups of 14 weanling rats were kept on diets containing 0, 0.1 and 1.0% fumaric acid and 1.38% sodium fumarate for one year (half the groups) or two years. No adverse effect was noted on rate of weight gain, haemoglobin, blood picture, calcium balance as shown by bone histology, or on the histology of liver, kidney, spleen and stomach (Levey et al., 1946). In another experiment five groups of 12 male and 12 female rats were fed diets containing 0, 0.1, 0.5, 0.8 and 1.2% of fumaric acid for two years without toxic effects on growth or food consumption. A further four groups of 12 male rats were kept for two years on diets containing 0, 0.5, 1.0 and 1.5% fumaric acid. Only at the 1.5% level was there a very slight increase in mortality rate and some testicular atrophy. Gross and microscopic examination of major organs revealed no abnormalities and tumour incidence was not significantly different between the groups (Fitzhugh & Nelson, 1947). Seventy-five chronically disabled subjects ranging in age from 29-91 years received 500 mg fumaric acid daily for one year without any toxic manifestations in haemoglobin level, RBC and WBC, nonprotein nitrogen level, creatinine level, bromosulfonphthalein excretion and phenolsulfonphthalein excretion (Levey et al., 1946).
Carcinogenicity	Based on the available data, fumaric acid is not considered to be a carcinogen. Fumaric acid has not been classified by International Agency for Research on Cancer (IARC) or the United States Environment Protection Agency (USEPA).
Mutagenicity/ Genotoxicity	Fumaric acid is not considered to be a mutagen.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data found

	Eight groups of 14 weanling rats were kept on diets containing 0, 0.1 and 1.0% fumaric acid and 1.38% sodium fumarate for one year (half the groups) or two years. No adverse effect was noted on rate of weight gain, haemoglobin, blood picture, calcium balance as shown by bone histology, or on the histology of liver, kidney, spleen and stomach (Levey et al., 1946). In another experiment five groups of 12 male and 12 female rats were fed diets containing 0, 0.1, 0.5, 0.8 and 1.2% of fumaric acid for two years without toxic effects on growth or food consumption. A further four groups of 12 male rats were kept for two years on diets containing 0, 0.5, 1.0 and 1.5% fumaric acid. Only at the 1.5% level was there a very slight increase in mortality rate and some testicular atrophy. Gross and microscopic examination of major organs revealed no abnormalities and tumour incidence was not significantly different between the groups (Fitzhugh & Nelson, 1947). Seventy-five chronically disabled subjects ranging in age from 29-91 years received 500 mg fumaric acid daily for one year without any toxic manifestations in haemoglobin level, RBC and WBC, nonprotein nitrogen level, creatinine level, bromosulfonphthalein excretion and phenolsulfonphthalein excretion (Levey et al., 1946).
Acute Toxicity	Fumaric acid has low acute toxicity via oral, inhalation, or dermal exposure. The LD50s for the oral administration of fumaric acid in rats range from 8,000 to 10,700 mg/kg bw and 3,600 to 4,800 mg/kg bw for rabbits. Inhalation LD50s for rats is reported to be 1,306 mg/L and a dermal LD50 of 20,000 mg/kg bw has been reported for rabbits.
Irritation	The available data show that fumaric acid is a mild irritant of the skin and may cause respiratory tract irritation. Furmaric acid is considered to cause serious eye irritation. Ingestion of fumaric acid may cause abdominal cramps, diarrhoea and nausea.
Sensitisation	The chemical is considered to be not sensitising.
Health Effects Summary	Fumaric acid occurs naturally in the metabolism, and is approved for use as a food additive in Australia as well as a feed additive for all animals without a maximum level. A Tier 1 human health risk assessment has been performed by the NICNAS, indicating the chemical is not considered to pose an unreasonable risk to the health of workers and public health. It is considered to have low acute and chronic health effects.
Key Study/Critical Effect for Screening Criteria	WHO JECFA in 1975 derived an acceptable daily intake of 6 mg/kg bw for adults and children for use as a food additive. The key study chosen was the two-year rat feeding study by Fitzhugh & Nelson, (1947). No adverse chronic effects from fumaric acid dosing were seen in animals exposed below 1.2% (600 mg/kg bw). However it is to be noted that in 1989, the ADI was changed to 'not specified' when Fumaric Acid was evaluated as a flavouring agent by the JECFA. Drinking water guideline value = 23 ppm
Ecological Toxicity [3,5]	
Aquatic Toxicity	Acute Aquatic -96-h LC50 Danio rerio - >100 mg/L -48-h EC50 daphnia magna - >100 mg/L -72-h EC50 Pseudokirchneriella subcapitata - >100 mg/L -48-hr EC50 Daphnia magna - 62,630 mg/L
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (245 mg/L), Daphnia (212 mg/L), and algae (41 mg/L). On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 41 mg/L for algae. The $PNEC_{aquatic}$ was calculated to be 0.041 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data found.

Australian Occupational Exposure Standards	No data found.
International Occupational Exposure Standards	No data found.
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	No data found.
Aquatic Toxicity Guidelines	No data found
PBT Assessment[3,5]	
P/vP Criteria fulfilled?	Fumaric acid is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on the measured log Kow of <3 Fumaric acid is not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of Fumaric acid is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).

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Toxicity Summary - Boric acid / sodium tetraborate / boronatrocalcite / borax

Chemical and Physical Properties[1,3,5,8,9]	
CAS number	Boric Acid: 10043-35-3 Sodium Tetraborate: 1330-43-4 Boronatrocalcite: 1319-33-1 Borax: 1303-96-4
Molecular formula	Boric acid: H_3BO_3 Sodium Tetraborate: $Na_2B_4O_7$ Boronatrocalcite: $CaNaH_{12}(BO_3)5.2H_2O$ Borax: (Na2(B4O7).10H2O)
Molecular weight	Boric acid: 61.833 g/mol Sodium Tetraborate: 201.220 g/mol Boronatrocalcite: 405.23 g/mol Borax: 381.37
Solubility in water	Boric acid: 50 g/l at 25 °C Sodium Tetraborate: 3.1% at 25 °C Boronatrocalcite: no data found Borax: 59.3 g/L at 25 °C
pH	Boric acid: 6.1 in a 0.1% (wt) solution Sodium Tetraborate: 9.3 at 20 °C (3% solution) Boronatrocalcite: no data found Borax: no data found
Melting point	Boric Acid: 170.9 °C Sodium Tetraborate: 743 °C Boronatrocalcite: no data found Borax: 75 °C (decomposes)
Boiling point	Boric Acid: 300 °C Sodium Tetraborate: 1,575 °C (decomposes) Boronatrocalcite: no data found Borax: no data found
Vapour pressure	Boric acid: 9.9 x 10^{-6} Pa @ 25 °C Sodium Tetraborate: Negligible at 20 °C Boronatrocalcite: no data found Borax: Negligible
Henrys law constant	No data found
Explosive potential	Not explosive
Flammability potential	Not flammable

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Toxicity Summary - 2-hydroxy-N,N,N-trimethylethanaminium (Choline Chloride)

Chemical and Physical Properties[1,2,3,4]	
CAS number	67-48-1
Molecular formula	$C_5H_{14}NOCl$
Molecular weight	139.63 g/mole
Solubility in water	Very soluble in water and alcohol
Melting point	247°C
Boiling point	Decomposition upon heating
Vapour pressure	6.57 x 10^{-8} Pa at 25°C
Henrys law constant	2.06*10E-11 Pa*m³/mole at 25°C
Explosive potential	Not explosive
Flammability potential	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.
Colour/Form	white crystalline solid
Overview	Choline chloride is a quaternary amine salt, it dissociates in water into the corresponding positively charged quaternary hydroxyl alkylammonium ion and the negatively charged chloride ion. Choline chloride has neither explosive nor oxidizing properties due to its molecular structure Choline is a dietary component and found in foods as free choline and as esterified forms such as phosphocholine, glycerophosphocholine, sphingomyeline, and phosphatidylcholine. It functions as a precursor for acetylcholine, phospholipids, and the methyl donor betaine and is important for the structural integrity of cell membranes, methyl metabolism, cholinergic neurotransmission, transmembrane signalling, and lipid and cholesterol transport and metabolism. Evidence from animal studies and from human exposure indicates that choline chloride has low toxicity, is not mutagenic and has no developmental toxicity. This is not unexpected in view of its presence in the diet and its production in metabolic processes in the body; it fulfils key roles in nerve transmission, cell membrane integrity, and lipid metabolism. Only limited animal data are available on effects on fertility, but the normal exposure of humans to appreciable amounts of choline chloride both from the diet and formed from normal metabolic processes, would argue against it having any significant adverse effects on fertility. This is supported by the fact that it has been widely used as an animal feed additive for decades with no apparent adverse effects being noted on fertility. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health.
Environmental Fate[1,3,4]	
Soil/Water/Air	Distribution modelling using Mackay Level I indicates water (100 %) to be the main target compartment. The amount in the other compartments is with < 0.0001 % negligible. Choline chloride is readily biodegradable according to OECD-criteria (MITI-I Test; BOD measurements) reaching 93 % degradation within 14 days. Due to the chemical structure hydrolysis can be excluded. In the atmosphere choline chloride will be rapidly degraded according to a half-life time (t½) of about 6.9 hours for hydroxyl-radicals based on a 12 hours day. Due to the measured and calculated logKow of –3.77 and –5.16 both at 25°C, respectively, and a calculated logKoc of 0.37 a bio- or geoaccumulation is not to be expected.

Human Health Toxicity Summary [1,3,4,5]	
Chronic Repeated Dose Toxicity	A 72-week feeding study was conducted to investigate the impact of choline chloride on the liver tumour promoting activity of phenobarbital and DDT in diethylnitroamineinitiated Fischer 344 rats (Shivapurkar *et al.*, 1986). Animals received approximately 500 mg/kg-day choline chloride. Following the end of the exposure period, the animals were kept on the same untreated diet as the control group until study termination at week 103. Histopathology was limited to the liver and organs that developed gross abnormalities. There were no significant differences between treated and control animals on survival rates, body weights, and relative liver weights. Neither was there any increased number of neoplastic liver nodules, hepatocellular carcinomas, lung tumours, leukaemia nor other tumours between treated and control animals. The NOAEL for choline chloride in this study is 500 mg/kg/day In humans, oral administration of 10,000 mg/day choline chloride in a pilot study treating a small number of patients with Alzheimer's disease, resulted in a slight hypotensive effect (Boyd *et al.*, 1977). This dose was regarded as a LOAEL by the Standing Committee on the Scientific Evaluation of Dietary Reference Intake (2000).
Carcinogenicity	No studies were located.
Mutagenicity/ Genotoxicity	Choline chloride was not mutagenic to bacteria in reverse mutation assays (Haworth *et al.*, 1984; JETOC, 1997; Litton Bionetics, 1977). A small, but statistically significant, and dose-related increase in sister chromatid exchanges (SCEs) in Chinese Hamster Ovary (CHO) cells was reported at 50 and 500 µg/ml choline chloride in the absence of S9 only (Bloom *et al.*, 1982). No higher concentrations were examined. These results could not be confirmed in another study using CHO cells at concentrations of choline chloride up to 5,000 µg/ml. (Galloway *et al.*, 1985). In a gene conversion assay with *Saccharomyces cerevisiae* strain D4, choline chloride was negative in the presence and absence of metabolic activation (Litton Bionetics, 1977). No *in vivo* genotoxicity studies were available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Pregnant female mice were given in their feed 1,250 to 20,000 mg/kg choline chloride during gestational days 1 to 18 (BASF AG, 1966). Maternal body weight gain was reduced in all treated groups except for the 1,250 mg/kg group. Determination of maternal weight gain of dams with embryonic/foetal absorptions showed that there was no All foetuses were resorbed in the 20,000 mg/kg group. Embryonic/foetal lethality of 35% and 69% were seen in the 4,160 and 10,800 mg/kg groups, respectively. No resorptions occurred in the 1,250 mg/kg group. Developmental toxicity was seen in all but the 1,250 mg/kg group. No statistically significant increases in malformations were observed in any dose group. The NOAELs for maternal and developmental toxicity is 1,250 mg/kg/day.
Acute Toxicity	The oral LD50 in rats was reported to be between 3,150 and 5,000 mg/kg (BASF AG, 1963a, 1969).
Irritation	Application of a 70% aqueous solution to the skin of rabbits for 20 hours under occlusive conditions resulted in only minor skin irritation (BASF AG, 1963b). Slight eye irritation was seen in the eyes of rabbits after instillation of a 70% aqueous solution of choline chloride; no effects were seen one day after exposure (BASF AG, 1963c).
Sensitisation	No data are available in animals. In a Human Repeated Insult Patch Test, there was no evidence of dermal sensitization in two hundred subjects given 0.5% (w/v) aqueous solution of choline chloride during the induction phase and 0.2% (w/v) aqueous solution during the challenge phase (Colgate-Palmolive, 2003).
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.

Key Study/Critical Effect for Screening Criteria	The Standing Committee on the Scientific Evaluation of Dietary Reference Intakes selected hypotension as the critical effect from the study by Boyd *et al.* (1977) when deriving a Tolerable Upper Intake Level. Boyd *et al.* (1977) reported a LOAEL of 10,000 mg/day choline chloride (7,500 mg/day choline). An uncertainty factor of 2 was chosen because of the limited data regarding hypotension and the inter-individual variation in response to cholinergic effects. Thus, the value for the Tolerable Upper Intake Value for repeated exposure of adults to choline is 3,500 mg/day choline. The oral RfD for choline chloride is derived by using the LOAEL of 10,000 mg/day from the Boyd *et al.* (1977) study, which is divided by an uncertainty factor of 2, to obtain a value of 5,000 mg/day or 71 mg/kg/day for a 70 kg person. Oral RfD = 71 mg/kg/day Drinking water guideline value = 248 ppm
Ecological Toxicity [4]	
Aquatic Toxicity	The 96-hour fish LC50 value is >100 mg/L (nominal and measured) in *Oryzias latipes* (MOE Japan, 1999a), and the 48-hour in vertebrate EC50 is 349 mg/L (nominal and measured) in *Daphnia magna* (MOE Japan, 1999b). The 72-hour EC50 to *Pseudokirchneriella subcapitata* is >1,000 mg/L (nominal and measured) based on growth rate; the 72-hour NOEC is 32 mg/L (MOE Japan, 1999c). In a 21-day *Daphnia magna* reproduction test, the nominal and measured NOEC was reported to be 30.2 mg/L (MOE Japan, 1999d).
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (>100 mg/L), invertebrates (349 mg/L), and algae (>1,000 mg/L). Results from chronic studies are available for invertebrates (21-day NOEC = 30.2 mg/L) and algae (72-hour NOEC = 32 mg/L). On the basis that the data consists of chronic studies on two trophic levels, an assessment factor of 10 has been applied to the lowest reported NOEC of 30 mg/L for Daphnia. The PNECaquatic is 3.02 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [3]	
P/vP Criteria fulfilled?	Choline chloride is readily biodegradable and thus it does not meet the screening criteria for persistence.
B/vB criteria fulfilled?	Based on a measured log Kow of -3.77 and a calculated BCF of 0.59, choline chloride does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	The chronic toxicity data on choline chloride show NOECs of >0.01 mg/L. Thus, choline chloride does not meet the screening criteria for toxicity.
Overall conclusion	Not a PBT substance (based on screening data).
Revised	December 2018

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Toxicity Summary - Acetic acid

Chemical and Physical Properties[1,6]	
CAS number	64-19-7
Molecular formula	$C_2H_4O_2$
Product name	Acetic Acid 60%
Molecular weight	60 g/mol
Solubility in water	1000 g/L at 25°C
pH	1.38
Melting point	16.6 °C
Boiling point	117.9 °C
Vapour pressure	1.5 kPa at 20°C
Henrys law constant	0.0101 Pa m^3/mol
Explosive potential	Above 39°C explosive vapour mixtures may be formed. Risk of fire and explosion on contact with strong oxidants.
Flammability potential	Flammable. Flashpoint = 39°C
Colour/Form	Clear colourless liquid with a pungent vinegar smell
Overview	Acetic acid is naturally occurring as the acid in apple cider vinegar and other fruit derived products. Acetic acid is recognised by Food Standards Australia New Zealand (FSANZ) and the US Food and Drug Administration (FDA) as safe as a food additives (e.g. flavouring agent, preservative).
Environmental Fate[1]	
Soil/Water/Air	When released into the environment, acetic acid is not expected to adsorb onto suspended solids or sediments. Acetic acid dissociates in aqueous media to H+ and the acetate anion ($CH_3CO_2^-$). The compound is expected to be present in the dissociated form, where volatilisation is not an important process. Based on the range of expected Koc values, acetic acide is expected to have a very high to moderate mobility in soil. In air acetic acid will exist soley in the vapour phase where it is degraded with photochemically produced hydroxyl radicals with a half-life for this reaction in air of approximately 22 days. Acetic acid is readily biodegradable, and biodegrades rapidly under aerobic and anaerobic conditions. Based on an estimated bioconcentration factor of 3.2, the potential for bioaccumulation is low.

Human Health Toxicity Summary [1,2,5,6]	
Chronic Repeated Dose Toxicity	In a six-month repeat dose oral toxicity study (Lamb and Evard 1919), pigs were initially fed acetic acid at 155 mg/kg bw/day with the dose was raised every 10 to 30 days until a final dose of 380 to 450 mg/kg bw/day was reached after 60 days. There was no mortality and no effects on body weight or acid-base balance noted in this study (REACH 2013). A NOAEL was not established in this study. Repeated intra-gastric administration of the chemical at 3% concentration in animals (unspecified) for six months resulted in chronic inflammation of the oesophageal mucosa (HSDB 2013). Similarly, intra-gastric administration to rats of 3 mL of a 10% solution for 90 days produced a drop in haemoglobin concentration and erythrocyte count (HSDB 2013). In another similar study, pigs were fed daily diets containing the chemical at 0, 240, 720, 960 and 1200 mg/kg bw/day for successive 30-day periods for a total of 150 days (HSDB 2013).There were no significant differences in growth rate, weight gain, early morning urinary ammonia and terminal blood pH between controls and test groups. A NOEL or NOAEL was not indicated by the authors. Based on the available information and taking a conservative approach, the NOAEL in the study is considered to be 1200 mg/kg bw/day, the highest tested dose with no adverse effects. This NOAEL will be used for human health risk assessment. In the only available dermal repeat dose toxicity study (Slaga et al. 1975), acetic acid was applied dermally to mice at doses of 1 to 40 mg/animal, one to three times/week for 32 weeks. Single dermal applications of acetic acid at doses of up to 40 mg/animal did not induce mortality. However, more than one application per week of 10 mg acetic acid or more caused excessive mortality. 33% of mice died when 10 mg acetic acid/animal was applied dermally three times/week and approximately 50% of mice died when 20 mg was applied twice a week. No biochemical or histopathological effects were reported. A LOAEL of 10 mg/animal was suggested by the authors, however it was expressed in terms of ‘mg/animal’ rather than ‘mg/kg bw/day’ and it therefore cannot be adopted. Dermal NOAEL or LOAEL for acetic acid are not available. Repeated oral, inhalation and dermal exposure of humans to pure acetic acid has been reported to have effects on the gastrointestinal tract and to cause digestive disorders including heartburn and constipation, chronic inflammation of the respiratory tract, pharyngitis, catarrhal bronchitis, darkening of skin, skin dermatitis and erosion of the exposed front teeth enamel. In addition, skin on the palms of hands can become dry, cracked and hyperkeratotic. These observed effects were not associated with any systemic findings, suggesting the effects observed could be due to its corrosive action (EC 2012; HSDB 2013).
Carcinogenicity	In a carcinogenicity study (Slaga et al. 1975), acetic acid was tested as the promoter for tumour development in mice. Acetic acid was applied dermally to mice initiated with a carcinogenic agent, dimethylbenz(a)anthracene (DMBA) at doses of 1 to 40 mg/animal, one to three times/week for 32 weeks. Control animals received acetic acid dermally once per week. No further details were provided about the exposure duration. Single dermal application of acetic acid at doses of up to 40 mg/animal did not induce mortality. However, more than one application per week of 10 to 40 mg acetic acid caused excessive mortality. Thirty three per cent of mice died when 10 mg acetic acid/animal was applied dermally three times/week and approximately 50% of mice died when 20 mg was applied twice a week. No biochemical or histopathological effects were reported. Acetic acid did not produce any carcinogenic effects in mice (REACH 2013). In another study, oral administration of the chemical as a 3% solution in rats, three times/week for eight months did not induce tumours in the oesophagus and fore-stomach, although epithelial hyperplasia was observed. When dosed in combination with the known carcinogen, N-nitrososarcosine ethyl ester (positive control), there was an increase in oesophageal/stomach tumour formation (REACH 2013). Based on the limited available data, acetic acid is not likely to be a carcinogen.

Mutagenicity/ Genotoxicity	Acetic acid was not mutagenic in bacterial reverse mutation assays using Salmonella typhimurium strains TA100, TA1535, TA97 and TA98 with and without metabolic activation (Ishidate et al. 1984). Acetic acid was negative in the chromosome aberration assay using Chinese hamster lung fibroblasts at concentrations of up to 1 mg/mL with or without metabolic activation. In one study using Chinese hamster ovary KI cells, acetic acid induced chromosomal aberrations at the initial pH of 6.0 or below (about 10 to 14 mM of acid) both with and without S9 mix (REACH 2013). However, when the culture medium was neutralised to pH 7.2 with sodium hydroxide, no clastogenic activity was observed. Moreover, pH lower than 6.0 (pH 5.7 or below) were also found to be cytotoxic. Chromosomal aberrations induced at these high concentrations were therefore considered to be artefacts due to acidification of the culture medium. Acetic acid was concluded not to be clastogenic when tested in cultured Chinese hamster K1 cells (REACH 2013; HSDB 2013). It was concluded that acetic acid is not mutagenic.
Reproductive Toxicity	No data available
Developmental Toxicity/Teratogenicity	In two developmental toxicity studies conducted according to the EU Method B.31 (prenatal developmental toxicity study), acetic acid was administered by gavage to pregnant female Wistar rats and CD-1 mice at 16, 74.3, 345, and 1600 mg/kg bw/day during gestation days 6 to 15 (10 consecutive doses) (REACH 2013). In a similar study, the chemical was administered by gavage to female Dutch rabbits at 16, 74.3, 345, and 1600 mg/kg bw/day during gestation days 6 to 18 (13 consecutive doses) (REACH 2013). There were no clearly discernible effects on implantation, maternal survival or foetal survival in any species at any of the doses. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not differ significantly from those occurring spontaneously in the controls. No NOAEL could be established for maternal toxicity or foetal developmental effects. Based on the available data, the chemical does not show developmental toxicity.
Acute Toxicity	Acetic acid was of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) observed in two rat studies is greater than 2000 mg/kg bw (REACH2013). In one study, groups of unfasted rats were fed 2239, 2512, 2859, 3100, 3500, 4000, 4467 mg/kg bw sodium acetate and observed for six days (REACH 2013). The acute oral median lethal dose (LD50) of the sodium salt of acetic acid was found to be 3310 mg/kg bw for rats. Acetic acid was of moderate acute toxicity in rabbits following dermal exposure. The LD50 in rabbits was 1060 mg/kg bw (HSDB 2013). Details regarding the concentration of the administered test substance were not provided. The moderate acute dermal toxicity is believed to be due to its local corrosive effects rather than any systemic toxicity. Acetic acid was of low acute toxicity in animal tests following inhalation exposure. In an acute inhalation study, mice were exposed to various concentrations of acetic acid (experimental details and concentration range not provided) (HSDB 2013). Clinical signs of respiratory irritation were evident at concentrations of 2.46 mg/L and higher. Animals exposed to concentrations higher than 11.07 mg/L died within 27 hours of exposure. Surviving mice recovered quickly and showed no abnormalities three days after exposure. The median lethal concentration (LC50) was determined by the Weil's method and was estimated to be 13.8 mg/L in the mouse. Severe health effects have been reported in humans following accidental exposure to acetic acid by different routes, mainly due to the local corrosive effects of the chemical leading to systemic effects (HSDB 2013).

Irritation	Pure acetic acid is corrosive to skin. In animal studies, severe skin burns were reported in guinea pigs following application to intact or abraded skin of patches of 80% solution of the chemical, moderate to severe burns at 50 to 80% solution, mild injury at 50% solution, and no effect at 10% solution (HSDB 2013). In a study with rabbits, the chemical was considered to be slightly irritating at concentrations of 3.3% and 10% (REACH 2013). In another study with rabbits, a concentration of 2.5% of the chemical was not irritating while concentrations of 10 to 25% caused moderate to severe erythema, slight to severe oedema, skin lesions over the application site and eschar formation (REACH 2013). A 10% solution was therefore considered a skin irritant. As part of a study to select the optimum testing conditions for predicting hazard to the human eye, 3%and 10% aqueous acetic acid were tested in rabbit eyes (REACH 2013). Materials were applied directly to the central corneal surface. Irritation was followed for up to 21 days and scored according to the Draize scale. The 3% acetic acid gave moderate irritation and 10% acetic acid was severely irritating or corrosive. In other studies, instillation of 0.5 mL of a 1% acetic acid solution in the eyes of rabbits caused a severe burn (Smyth et al. 1951). Solutions of 5% induced injury in eyes of rabbits which healed by 14 days, while a 10% solution resulted in severe permanent damage (Henschler 1973). Based on the results of the studies pure acetic acid is considered to be corrosive to eyes. In an acute inhalation study in mice, clinical signs of respiratory irritation were evident at concentrations of 2.46 mg/L and higher (see Section A28.5.2.3). Acetic acid vapours were reported to cause damage to nose, throat and lungs in humans (SCOEL 2012). Acetic acid is considered to be a respiratory tract irritant. Chemical burns and eye and nasal irritation have been reported in humans following exposure
Sensitisation	No experimental data were available, however the US National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards mentions skin sensitisation as one of the symptoms of acetic acid exposure (NIOSH 2010). A 1994 report (Kivity et al. 1994) describes a late asthmatic response to inhaled glacial acetic acid by an asthma patient. Based on reports of patients with bronchial asthma reacting to acetic acid challenge, it is believed that acetic acid may cause allergic reactions in humans (HSDB 2013). Some researchers consider acetic acid capable of causing a syndrome known as ‘reactive airways dysfunction’, which resembles bronchial asthma. Symptoms include dyspnoea, wheezing, and cough.
Health Effects Summary	Acetic acid has low acute oral and inhalation toxicity but moderate dermal toxicity. LD50 for oral, dermal and inhalation routes were >3100 mg/kg bw, 1060 mg/kg bw and 13.8 mg/L, respectively in laboratory animals. It is corrosive to skin, eyes and respiratory tract. Acetic acid has low repeat dose toxicity by oral and dermal routes. Information on toxicity by the inhalation route is not available. It is not genotoxic or carcinogenic and does not have any developmental effects in animals. Information on effects on fertility is not available. The critical health effect of acetic acid for risk characterisation is its corrosivity.
Key Study/Critical Effect for Screening Criteria	A NOEL or NOAEL was not established in any of the repeat dose studies. Based on the available information and taking a conservative approach, the highest tested dose with no adverse effects in the repeat dose oral study (1200 mg/kg bw/day) was taken as the NOAEL for human health risk assessment.
Ecological Toxicity [2]	
Aquatic Toxicity	Acute endpoints: Fish = 75 mg/L (measured), Daphnia EC50 = 32 mg/L (Dept. Env. (2013a) in LMC, 2012 Chronic endpoints: Daphnia = 150 mg/L (measured)
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 10 has been applied to the lowest reported effect concentration of 150 mg/L. The PNECaquatic is determined to be 15 mg/L.

Current Regulatory Controls	
Australian Hazard Classification	Acetic acid is classified as hazardous, with the following risk phrase for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013): C; R35 (Corrosive, causes severe burns). Mixtures containing the chemical are classified as hazardous with the following risk phrases based on the concentration (Conc) of the chemical in the mixtures: Conc >=90%: C; R35 (Corrosive, causes severe burns) ≥25% Conc <90%: C; R34 (Corrosive, causes burns) ≥10% Conc <25%: Xi; R36/38 (Irritant, Irritating to eyes and skin).
Australian Occupational Exposure Standards	The chemical has an exposure standard of 25 mg/m³ (10 ppm) Time Weighted Average (TWA) and 37 mg/m³ (15 ppm) Short-Term Exposure Limit (STEL) (Safe Work Australia 2013).
International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013). Occupational Exposure limit (TWA): 10 to 25 mg/m^3 [China, Canada, Denmark, Germany, Ireland, South Africa, Spain, Sweden, Switzerland, and the US]. An exposure limit (STEL): 15 to 50 mg/m^3 [China, Canada, France, Ireland, Singapore, South Africa, Spain, Sweden, Switzerland, and the US].
Australian Food Standards	Acetic acid is allotted the following International Numbering System of food additives number: INS 260 (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	No. The acetate ion of acetic acid is readily biodegradable and thus it does not meet the screening criteria for persistence.
B/vB criteria fulfilled?	The log Kow for acetic acid is reported to be -0.136. Acetate is also found in the body and is metabolized as part of the body's biochemical pathways. Thus, acetic acid (specifically, the acetate ion) does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The NOECs from the chronic aquatic toxicity data on acetic acid are >1 mg/L, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

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Toxicity Summary - Acrylamide polymers: Acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, sodium salt polymer and Polymer of 2-acrylamido-2- ethylpropanesulfonic acid sodium salt and methyl acrylate

Chemical and Physical Properties [2, 3, 4]	
CAS number	38193-60-1, 136793-29-8, 9003-06-9, 25987-30-8
Molecular formula	38193-60-1: $(C_7H_{13}NO_4S.C_3H_5NO.Na)_x$ 136793-29-8: $C_{11}H_{18}NNaO_6S$
Molecular weight	Likely >1000 MW
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	No studies are available for the Acrylamide polymers. Information for 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt will be referenced in the following sections. 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salts are generally incorporated into polymers. As such, the fate of the monomer is tied to the polymer and no hydrolysis, movement, biodegradation or bioaccumulation of the polymer is expected. A Tier 1 Human Health Assessment for Acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, sodium salt polymer has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health.
Environmental Fate [2]	
Soil/Water/Air	The polymers are not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weights and the low water solubilities of the polymers. Due to their high molecular weight, the polymers are not expected to bioaccumulate.
Human Health Toxicity Summary [2]	
Chronic Repeated Dose Toxicity	A repeat dose 28 day oral toxicity study carried out in rats with a 50% aqueous solution of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt indicated no treatment related toxic effects.
Carcinogenicity	No information available.
Mutagenicity/ Genotoxicity	2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt did not induce a mutagenic response in bacteria and no clastogenicity was observed when a 50% solution of the notified chemical was tested in albino mice cells in vitro.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.

Acute Toxicity	Aqueous solutions containing 50% of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt exhibited low acute oral and dermal toxicity in rats (LD50 > 5 000 mg/kg, and 2 000 mg/kg respectively).
Irritation	2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt was non-irritant to rabbit skin and a slight eye irritant in rabbits.
Sensitisation	A 50% aqueous solution of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt showed minimal sensitisation potential when tested in guinea pigs.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	No data available
Ecological Toxicity [2]	
Aquatic Toxicity	Limited information is available. The polymers are expected to be a low concern for toxicity to aquatic organisms. Due to their poor solubility and high molecular weights, they are not expected to be bioavailable. The polymers do not contain any reactive functional groups. Ecotoxicity data for 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt indicate that it is practically non-toxic to fish, water fleas and algae.
Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls [5]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	Based on health considerations, the concentration of acrylamide in drinking water should not exceed 0.0002 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1, 2]	
P/vP Criteria fulfilled?	The polymers are not readily biodegradable, hence they meet the screening criteria for persistence.
B/vB criteria fulfilled?	The polymers are expected to have very high molecular weights and poor water solubility. They are not expected to be bioavailable, hence the polymers do not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on the polymers. They are expected to have low aquatic toxicity because of their very high molecular weights and poor water solubility. As such, the polymers do not meet the criteria for toxicity.
Overall conclusion	Not PBT substances
Revised	December 2018

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Toxicity Summary - Acrylonitrile

Chemical and Physical Properties [1,2,3,4]	
CAS number	107-13-1
Molecular formula	C3H3N
Molecular weight	53.06
Solubility in water	73 g/L at 20 °C
Melting point	– 88.55 °C
Boiling point	77.3 °C
Vapour pressure	12.4 kPa at 20 °C
Henrys law constant	9.0 Pa ·m^3/mole at 20 °C
Explosive potential	Sax (1989) presents that acetonitrile forms explosive mixtures with air. The lower explosive limit is 3.05% in volume and the upper explosive limit 17% in volume.
Flammability potential	Acetonitrile is highly flammable, with a lower flammability limit of 4.4% in volume and an upper flammability limit of 16% in volume.
Colour/Form	Volatile, colourless liquid with a sweet ether-like odour
Overview	Acrylonitrile was first prepared in 1893 but had no significant technical or commercial applications until the late 1930s when a synthetic rubber based on a co-polymer of butadiene and acrylonitrile was introduced in Germany (Langvardt, 1984). In USA, projects relating to nitrile rubber received special support during World War II because of their strategic importance and acrylonitrile became established as a monomer of commercial importance. Demand for acrylonitrile began to soar following the introduction of acrylic fibres in 1950. Today, acrylonitrile is an industrial intermediate used predominantly in the production of polymeric materials, with acrylic fibres accounting for 60% and plastics for 25% of world consumption (SRI, 1995). Other uses include the production of adiponitrile and acrylamide monomers and the co-polymerisation with other monomers to produce polymer emulsions, elastomers and nitrile rubber. From the early 1940s to the mid-1960s, acrylonitrile was mainly manufactured by the dehydration of ethylene cyanohydrin produced from ethylene oxide and aqueous hydrocyanic acid. Nowadays, all acrylonitrile is produced by direct catalytic conversion of propene, oxygen (as air) and ammonia (SRI, 1995). Processes based on propane or ethylene have been developed and may become commercially viable in the future where propane or ethylene feedstock is readily available. In 1995, global acrylonitrile capacity amounted to 4.5 million metric tonnes (t) (SRI, 1995).
Environmental Fate[1]	
Soil/Water/Air	Acrylonitrile is readily to fairly degradable in water, soil and in the troposphere. Its toxicity to aquatic vertebrates and invertebrates, algae and aquatic plants is slight to moderate. Bioaccumulation is expected to be slight to negligible. As there are no readily hydrolysable groups on the acrylonitrile molecule, hydrolysis is not expected to be an environmentally significant process. The vapour pressure of acrylonitrile puts it in the category of highly volatile chemicals (Mensink et al., 1995). However, the water solubility is also high. The Henry's Law constant can provide an indication of the volatility characteristics of compounds (Lyman et al., 1982). The characteristics of acrylonitrile indicate that although the volatilisation from aquatic systems is not rapid, it may be a significant removal process in the environment. Therefore, the high vapour pressure is mediated by the high water solubility. The volatilisation half-life of acrylonitrile in a typical pond, river and lake has been estimated at 6, 1.2 and 4.8 days respectively (Howard, 1989). The US EPA has previously suggested that although acrylonitrile is quite volatile, large spillages of the substance could lead to groundwater contamination (DoE, 1993).
Human Health Toxicity Summary [1,2,3]	

Chronic Repeated Dose Toxicity	Repeated-dose toxicity studies involving inhalation, ingestion or subcutaneous or intraperitoneal injection of acrylonitrile for 1-12 months in rats, mice, guinea pigs, rabbits, cats, dogs and monkeys showed a narrow range between lethal and no observed adverse effect levels. The most consistently observed effects were decreased body weight gain, irritation of the respiratory tract, kidney damage and reversible ataxia or paralysis. Retching and vomiting, adrenal hyperplasia, increased liver weight, hyperplasia of the gastric mucosa and biochemical effects such as small reductions in haemoglobin, haematocrit and erythrocyte counts and small increases in alkaline phosphatase were observed in some studies.
Carcinogenicity	The carcinogenic potential of acrylonitrile has been investigated in three strains of rats exposed to 5-80 ppm in air (2 studies), 1-500 ppm in drinking water (5 studies), or 0.1-10 mg/kg by gavage (2 studies). Exposure-related tumours were found in all studies. The most common forms were astrocytomas of the CNS and carcinomas of the zymbal gland, both of which rarely occur spontaneously in experimental animals. Tumours of the mammary gland, tongue, small intestine and forestomach (oral exposure only) were less consistent across studies. A 2-year bioassay in mice, where metabolism via CNEO plays a greater role than in rats, is currently underway within the US National Toxicology Program. Acrylonitrile has also been evaluated by the International Agency for Research on Cancer (IARC). In 1979 and 1987, IARC concluded that there was limited evidence of carcinogenicity of acrylonitrile in humans and sufficient evidence of carcinogenicity in animals and therefore assigned the chemical to group 2A: agents that are probably carcinogenic to humans (IARC, 1979, 1987). In February 1998, all published literature on acrylonitrile was re-evaluated by an IARC working group comprising 30 experts from 12 countries. The group concluded that although additional studies confirmed that acrylonitrile is a potent multi-site carcinogen in rats, the combined epidemiological evidence did not support a credible association between acrylonitrile exposure and cancer. As such, IARC determined that there was inadequate evidence in humans but sufficient evidence in experimental animals for the carcinogenicity of acrylonitrile and re-classified the chemical in group 2B: agents that are possibly carcinogenic to humans (IARC, 1999).
Mutagenicity/ Genotoxicity	The genetic toxicity of acrylonitrile has been investigated in numerous in vitro and in vivo test systems. In vitro, it was weakly positive in several bacterial, fungal and mammalian mutagenicity assays and mammalian and fungal cytogenetic tests, particularly in the presence of metabolic activation. Where CNEO was tested in parallel assays, it was mutagenic in the absence of metabolic activation. In vivo, acrylonitrile tested negative in several dominant lethal, micronucleus and chromosome aberration assays. Studies in Drosophila using various genetic markers gave positive results. In vitro and in vivo assays for DNA binding and unscheduled DNA synthesis yielded negative results in tests using the most reliable techniques. On balance, it appears that acrylonitrile has little affinity for DNA, whereas the metabolite CNEO is a direct-acting mutagen in vitro. It is conceivable that the lack of genotoxicity of acrylonitrile in several in vivo tests is due to limited formation and/or rapid degradation of CNEO in intact mammals.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a 3-generation rat study, up to 35 mg/kg/day had no effect on fertility. In sub-acute studies in rats and mice, there was evidence of defective spermatogenesis at oral doses approaching acutely toxic levels, whereas several long-term studies found no abnormalities in male reproductive organs. In developmental toxicity studies in rats, hamsters, and rat embryos exposed in vitro, acrylonitrile showed some potential to cause foetal toxicity, but developmental effects in vivo occurred only at exposure levels associated with marked maternal toxicity.
Acute Toxicity	Acrylonitrile is acutely toxic by all routes of administration. In the rat, the LD50 is 72-186 mg/kg from oral and 148-282 mg/kg from skin exposure, and the 4 h LC50 from inhalation is 138-558 ppm (0.47-1.2 mg/L). The acute toxicity is roughly similar in other species, including mice, guinea pigs, rabbits, cats and dogs. Irrespective of route or test species, a lethal dose causes central nervous system (CNS) excitation followed by paralysis and respiratory arrest. The target organs are the gastrointestinal tract (bleeding), adrenals (haemorrhagic necrosis), brain (oedema) and lungs (oedema).
Irritation	Acrylonitrile is irritating to the skin and eyes. Repeated airborne exposure induces inflammatory and hyperplastic changes in the nasal mucosa, indicating a potential for irritation of the respiratory system.

Sensitisation	A guinea pig maximisation test for skin sensitisation was strongly positive. There are no data on respiratory sensitisation.
Health Effects Summary	Acrylonitrile is acutely toxic to humans by inhalation, in contact with skin and if swallowed. It is also a severe eye irritant and may cause sensitization by skin contact. Repeat dose toxicity studies in animals have shown treatment related changes in the gastrointestinal tract, central nervous system and adrenal gland. There are occasional reports of liver and kidney damage. It is a rodent carcinogen, tumours being observed in the brain, Zymbal gland, gastrointestinal tract and mammary gland. Detailed, recent epidemiological studies do not however provide evidence of human carcinogenicity. Acrylonitrile is an in vitro mutagen, indicating that the mechanism of carcinogenicity may be genotoxic. This is not however supported by the results of in vivo mutagenicity studies. It is concluded that there is a need for active management of the identified risk and further consideration of the risk management measures currently being applied in relation to workers, consumers and the population exposed via the environment.
Key Study/Critical Effect for Screening Criteria	In animals repeated exposure to acrylonitrile results in damage to the gastrointestinal tract, central nervous system and adrenal gland. There are occasional reports of liver and kidney damage. The respiratory tract is also affected following inhalation exposure, based on histopathological changes in the nasal turbinates of rats in the Quast et al.,(1980) two year study. A LO(A)EL of 20 ppm was established in the study, treatment-related nasal changes being evident at this exposure level, and this was used as a starting point in the risk assessment in relation to inhalation exposure. A No Adverse Effect Level (NAEL) of 4 ppm for the inhalation route was been derived from the LO(A)EL of 20 ppm, by application of a safety factor of 5. In relation to oral administration of acrylonitrile, the N(A)OEL is estimated to be 3 ppm (0.25 mg/kg/day) in drinking water, based on the information from the Biodynamics study (1980) study in rats which showed systemic toxicity, probably attributable to metabolic release of cyanide.
Ecological Toxicity [6]	
Aquatic Toxicity	The data set for acrylonitrile includes a wide range of information on short and long term toxicity in fish, Daphnia and other aquatic invertebrates. Acrylonitrile is moderately toxic to fish, with 96-hour LC50 for fresh water fish generally lying in the range of 10 - 20 mg/l (nominal). A recent short term study in the saltwater species Cyprinodon variegatus, carried out in full compliance with current protocols, reported a 96-hour LC50 of 8.6 mg/l. The lowest 48 hour EC50 for Daphnia was 7.6 mg/l. The fish early life stage toxicity test in Pimephales promelas, using flow-through conditions, provided a LOEC/NOEC of 0.34 mg/l, while a 30 day flow through test in mature fish of the same species provided a long-term LC50 of 2.6 mg/l. If the value of 0.34 mg/l is taken as a LOEC, a NOEC may be derived by application of safety factor of 2, giving a NOEC of 0.17 mg/l.
Determination of PNEC aquatic	Applying an assessment factor of 10 to the NOEC (0.17 mg/l) derived from the fish early life stage toxicity test gives a PNEC of 17 µg/l.
Current Regulatory Controls [1,7]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Chemical Information System (HCIS) (Safe Work Australia): H225 (Highly flammable liquid and vapour) H350 (May cause cancer) H331 (Toxic if inhaled) H311 (Toxic in contact with skin) H301 (Toxic if swallowed) H335 (May cause respiratory irritation) H315 (Causes skin irritation) H318 (Causes serious eye damage) H317 (May cause an allergic skin reaction) H411 (Toxic to aquatic life with long-lasting effects)
Australian Occupational Exposure Standards	The current national occupational exposure standard for acrylonitrile in Australia is 2 ppm (4.3 mg/m3) expressed as an 8 h TWA airborne concentration, Carcinogen Category 2, with a ‘skin’ notation (NOHSC, 1995a).

International Occupational Exposure Standards	The following exposure standards are identified: 8h TWA: Austria 2 ppm (4.5 mg/m^3) Belgium 2 ppm (4.3 mg/m^3) Denmark 2 ppm (4.0 mg/m^3) Finland 2 ppm (4.3 mg/m^3) France 2 ppm (4.0 mg/m^3) Germany 3 ppm (7.0 mg/m^3) Hungary 0.23 ppm (0.5 mg/m^3) India 2 ppm (4.3 mg/m^3) Ireland 2 ppm (4.5 mg/m^3) Japan 2 ppm (4.3 mg/m^3) Netherlands 4 ppm (9 mg/m^3) Philippines 20 ppm (43 mg/m^3) Poland 5 ppm (10 mg/m^3) Russia 0.23 ppm (0.5 mg/m^3) Spain 2 ppm (4.5 mg/m^3) Sweden 2 ppm (4.5 mg/m^3) Turkey 20 ppm (43 mg/m^3) United Kingdom 2 ppm (4 mg/m^3) USA (NIOSH) 1 ppm (2.2 mg/m^3) USA (OSHA) 2 ppm (4.3 mg/m^3) Short-term exposure limits (STEL): Finland 4 ppm (9 mg/m^3) France 15 ppm (32.5 mg/m^3) Netherlands 10 ppm (22 mg/m^3) Sweden 6 ppm (14 mg/m^3) USA (NIOSH) 10 ppm (22 mg/m^3) USA (OSHA) 10 ppm (22 mg/m^3)
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	A freshwater low reliability trigger value of 160 µg/L was calculated for acetonitrile using an AF of 1000. In the absence of marine data, this was adopted as a marine low reliability trigger value.
PBT Assessment	
P/vP Criteria fulfilled?	No. Acrylonitrile is readily to fairly degradable in water, soil and in the troposphere
B/vB criteria fulfilled?	No. The low log Pow (0.00-0.30) measures for acrylonitrile suggest bioaccumulation will not occur.
T criteria fulfilled?	Yes. Chronic toxicity data <1 mg/L in fish, thus acrylonitrile meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - Alcohols, C10-16, ethoxylated propoxylated

Chemical and Physical Properties[1]	
CAS number	69227-22-1
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	Soluble in water
Melting point	-3 °C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Yellow liquid, mild odour
Overview	Principle Route of Exposure: Eye or skin contact, inhalation Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Environmental Fate[1]	
Soil/Water/Air	This substance is expected to be readily biodegradable (84% @ 28d) (similar substances). Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative. Mobility in soil: KOC = >4
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	No data available to indicate product or components present at greater than 0.1% are chronic health hazards.
Carcinogenicity	Did not show carcinogenic effects in animal experiments (similar substances)
Mutagenicity/ Genotoxicity	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Animal testing did not show any effects on fertility.
Acute Toxicity	LD50 Oral: 600 mg/kg (Rat) (similar substance) LD50 Dermal: > 5200 mg/kg (Rabbit) (similar substance) LD50 Inhalation: > 0.22 mg/L (saturated concentration) (Rat) (similar substance)
Irritation	May cause mild respiratory irritation. Causes severe eye irritation which may damage tissue. Causes skin irritation.
Sensitisation	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Health Effects Summary	Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [1]	

Aquatic Toxicity	Toxicity to fish: LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96h) 1.6 mg/L (Pimephales promelas) (similar substace) LC50 (96h) 3 mg/L (Brachydanio rerio) (similar substance) Toxicity to invertebrates: EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 2 mg/L (Daphnia magna) (similar substance) Toxicity to algae: EC50 (72h) 0.75 mg/L (Pseudokirchnerella subcapitata) (similar substance) ErC50 (48h) 0.7 mg/L (Skeletonema costatum) EC10 9.79 mg/L (Selenastrum capricornutum) (similar substance) ErC50 1.1 mg/L (Scenedesmus subspicatus) (similar substance) Toxicity to microorganisms: ErC50 (16.9h) > 10 g/L (Pseudomonas putida) (similar substance)
Determination of PNEC aquatic	On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 0.14 mg/L for Daphnia. The PNEC aquatic is 0.14 µg/L.
Current Regulatory Controls [1]	
Australian Hazard Classification	H302 - Harmful if swallowed H315 - Causes skin irritation H318 - Causes serious eye damage
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable based on similar substances.
B/vB criteria fulfilled?	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. Redacted

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Toxicity Summary - Alcohols, C6-12, ethoxylated propoxylated

Chemical and Physical Properties[1]	
CAS number	68937-66-6
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	Soluble in water
Melting point	-3 °C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Yellow liquid, mild odour
Overview	Principle Route of Exposure: Eye or skin contact, inhalation Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Environmental Fate[1]	
Soil/Water/Air	This substance is expected to be readily biodegradable (60% @ 28d) (similar substances). Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative. Mobility in soil: KOC = >4
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	No data available to indicate product or components present at greater than 0.1% are chronic health hazards.
Carcinogenicity	Did not show carcinogenic effects in animal experiments (similar substances)
Mutagenicity/ Genotoxicity	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Animal testing did not show any effects on fertility.
Acute Toxicity	LD50 Oral: 600 mg/kg (Rat) (similar substance) LD50 Dermal: > 5200 mg/kg (Rabbit) (similar substance) LD50 Inhalation: > 0.22 mg/L (saturated concentration) (Rat) (similar substance)
Irritation	May cause mild respiratory irritation. Causes severe eye irritation which may damage tissue. Causes skin irritation.
Sensitisation	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Health Effects Summary	Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [1]	

Aquatic Toxicity	Toxicity to fish: LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96) 1.4 mg/L (Pimephales promelas) (similar substance) NOEC 4.4 mg/L (Pimephales promelas, juvenile) Toxicity to invertebrates: EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance) Toxicity to algae: EC50 (72h) 0.75 mg/L (Pseudokirchnerella subcapitata) (similar substance) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) (similar substance) CD10 8 mg/L (Pseudokirchneriella subapitata) EC10 2 mg/L (Brachionus calyciflorus) Toxicity to microorganisms: EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance)
Determination of PNEC aquatic	On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 0.14 mg/L for Daphnia. The PNEC aquatic is 0.14 µg/L.
Current Regulatory Controls [1]	
Australian Hazard Classification	H302 - Harmful if swallowed H315 - Causes skin irritation H318 - Causes serious eye damage
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable based on similar substances.
B/vB criteria fulfilled?	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. Redacted

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Toxicity Summary - Ethoxylated of aliphatic alcohols (>C6)

Chemical and Physical Properties [1,2,3]	
CAS number	112-59-4, 3055-93-4, 3055-94-5, 3055-95-6, 3055-97-8, 4536-30-5, 5274-68-0, 25190-05-0, 9002-92-0, 9004-95-9, 9004-98-2, 9005-00-9, 9043-30-5, 31726-34-8, 24938-91-8, 26183-52-8, 26468-86-0, 27252-75-1, 27306-79-2, 31943-12-1, 32128-65-7, 37281-47-3, 37702-39-9, 39587-22-9, 52292-17-8, 61723-78-2, 68439-45-2, 68439-46-3, 68439-49-6, 68439-50-9, 68439-54-3, 61791-13-7, 61791-28-4, 61827-42-7, 64425-86-1, 66455-14-9, 66455-15-0, 69227-20-9, 67254-71-1, 68002-97-1, 68131-39-5, 68131-40-8, 68155-01-1, 68213-23-0, 68526-94-3, 68551-12-2, 97953-22-5, 68920-66-1, 68991-48-0, 78330-21-9
Molecular formula	Unspecified
Molecular weight	Unspecified
Solubility in water	0.1876 - 13.18 mg/L at 25 °C (C12-14 ethoxylated, 1-2.5 EO) (CAS 68131-39-5) 1.69 - 246.7 mg/L at 25 °C (C9-11, ethoxylated (EO < 2.5) (CAS 68439-46-3)
Melting point	7.2 °C at 101.3 kPa (CAS 68131-39-5) -20 °C at 101.3 kPa (CAS 68439-46-3)
Boiling point	271.11 - 516.11 °C (CAS 68131-39-5) 260 °C (CAS 68439-46-3)
Vapour pressure	< 1 Pa at 25 °C (CAS 68131-39-5) 0.004 - 117 Pa at 20 °C (CAS 68439-46-3)
Henrys law constant	No data available.
Explosive potential	Non explosives
Flammability potential	Non flammable
Colour/Form	Organic liquid, colourless to light yellow
Overview	The chemicals in this group are structurally related alcohol ethoxylates (AEs), ethoxylated ethers of aliphatic alcohols, where the alky chain length is six carbons or higher. Ethoxylates of shorter chain alcohols (C<6) do not show the same degree of surfactancy compared to the chemicals in this group. Commercially available AEs generally consist of a mixture of various AE homologues of varying carbon chain lengths and degree of ethoxylation. The chemicals contain a hydrophobic alkyl chain attached via an ether linkage to a hydrophilic ethylene oxide (EO) chain that gives them their characteristic surfactant properties. The hydrophobic alkyl and the hydrophilic EO chains can vary in length depending on method of production and source of the precursor chemicals (HERA, 2009). Although most of chemicals of this group are polymers according to the definition in the Industrial Chemicals (Notification and Assessment) Act (1989), the individually named members do not necessarily meet the polymer of low concern (PLC) criteria as the number-average molecular weight (NAMW) >1000 Da. Lower molecular weight forms of these chemicals (MW <500) are expected to be used in commercial, domestic and cosmetic products. The chemicals are used extensively as non-ionic surfactants in a wide range of cosmetic and domestic products. The chemicals in this group are expected to have similar physicochemical and toxicological properties, which depend on the alkyl chain length and the number of EO units.
Environmental Fate [2,3]	
Soil/Water/Air	Alcohol ethoxylates are readily biodegradable under aerobic conditions and also anaerobically biodegradable (HERA, 2009). The main mechanism of primary biodegradation for the linear and essentially linear AE is the central cleavage of the molecule, leading to the formation of long chain alcohol and polyethylene glycol (HERA, 2009; Marcomini et al., 2000a; Marcomini et al., 2000b). Long chain alcohols themselves are readily biodegradable up to C18 (SIDS, 2006). Abiotic degradation in water, soil, sediment and air is not expected to occur because of the chemical structures of AE homologues. Neither hydrolysis under normal

	environmental conditions (pH range from 4 to 9) nor photolysis in the atmosphere, in water, or when absorbed to soil and sediment surfaces, is to be considered (HERA, 2009). Experimentally determined BCF-values given for pure homologues and summarized in the publication of Tolls et al. (2000) are used as read-across data for the endpoint bioaccumulation in water. It can be stated that bioaccumulation of alcohol ethoxylates is regarded to be negligible as the surfactants will be rapidly metabolised. For more detail see endpoint summary for bioaccumulation. Concerning transport and distribution of the alcohol ethoxylate mixtures a high adsorption of the substances is determined by using QSAR-models. Adsorption onto surfaces is an intrinsic property of alcohol ethoxylates and thus a high Koc-value is expected.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	The chemicals in this group are not expected to cause serious damage to health fr In several 90-day oral feeding studies in rats (similar to OECD TG 407), the NOAEL was established between 50 and 700 mg/kg bw/day (calculated from dietary levels) for group members (CAS Nos. 68439-50-9 and 68131-39-5, ranging from C12–15 with EO7). Effects observed at higher concentrations included reduction in mean body weights, and increases in relative liver and kidney weights. These changes were considered to be adaptive and related to the poor palatability of the test chemicals. No treatment related histopathological changes were reported (SCCS, 2007; HERA 2009; CIR, 2012). Similar effects were seen in longer-term studies. Alcohols, C12-13, ethoxylated (CAS No. 66455-14-9; EO6.5) and alcohols, C14-15, ethoxylated (CAS No. 68951-67-7, EO7, not listed on AICS) were given to rats in one- and two-year chronic feeding studies at levels between 0.1 and 1 %. The NOAEL was established between 50 and 192 mg/kg bw/day (calculated from dietary level). Effects observed at higher levels included reduction in mean body weights, and increase in relative liver and kidney weights. These changes were considered to be adaptive and may be due to poor palatability of the test chemicals. No treatment related lesions were observed (SCCS, 2007; HERA, 2009; CIR, 2012).om repeated oral and dermal exposure. In a 90-day study (OECD TG 411), Fischer rats were exposed to the chemical (C9–11 with 6 EO units, CAS No. 68439-46-3) at 1, 10 or 25 % concentration, 3 days/week. The application site was shaved but not covered. There were no significant treatment related effects at any concentration. Dry and flaky skin was observed in the 10 and 25 % dose groups. Increased relative kidney weights were observed in the 25 % dose groups. However, no histological lesions were observed. The NOAEL was established at 10 %, equivalent to 80 mg/kg bw/day (HERA, 2009).
Carcinogenicity	Based on the data available, the chemicals in this group are not considered to be carcinogenic. Two chemicals, alcohols, C12-13, ethoxylated (CAS No. 66455-14-9; EO6.5) and alcohols, C14-15, ethoxylated (CAS No. 68951-67-7, EO7, not listed on AICS) were administered at up to 1 % in the diet to rats for one and two years, respectively. No treatment related histopathological effects or increased tumour incidences were observed in either study (HERA, 2009; CIR, 2012). The chemicals are synthesised through processes which may result in 1,4-dioxane as an impurity. This impurity is classified as a Carcinogen—Category 3 (R40—Limited evidence of a carcinogenic effect). However, it is reported that cosmetic industry uses additional purification steps to remove the 1,4-dioxane residual in PEG before blending into cosmetic formulations (CIR, 2012).

Mutagenicity/ Genotoxicity	Based on the data available, the chemicals in this group are not considered to be genotoxic. The group members (CAS Nos. 68439-50-9, 68131-39-5 and 64425-86-1) and several analogue chemicals (ranging from C12–18 and EO3–21) produced negative results in several in vitro and in vivo tests for gene mutation and clastogenicity. Negative results were reported in bacterial reverse mutation tests for mutagenicity against Salmonella typhimurium (strains TA98, TA100, TA102, TA104, TA1535, TA1537 and TA1538) and Escherichia coli (strains WP2 and WP2uvrA pKM101), with or without metabolic activation. Negative results were also reported in chromosomal aberration tests in Chinese hamster V79, Chinese hamster ovary, mouse lymphoma and rat liver cell lines (SCCP, 2007; HERA, 2009; CIR, 2012). These chemicals did not induce chromosomal damage in Chinese hamster or Tunstall Wistar rat bone marrow cells after acute oral doses ranged between 250 and 3400 mg/kg bw (HERA, 2009).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the data available, the chemicals of this group are not considered to cause reproductive or developmental toxicity. In a two-generation reproductive and developmental toxicity study, the chemical (C14-15EO7) was administered in the diet of Charles River CD rats (n=25/sex/group, at doses of 0, 25, 50 or 250 mg/kg bw/day). The NOAEL for reproductive toxicity was established as 250 mg/kg bw/day (or 0.5 % of the diet). No treatment related effects were reported with respect to fertility, gestation, or viability indices or other histopathological parameters. The NOAEL for developmental toxicity was established as 50 mg/kg bw/day based on reduced pup body weights in the second generation at 250 mg/kg bw/day (HERA 2009; CIR, 2012). In a two-generation reproductive and developmental toxicity study, the chemical (C9-11EO6) was applied dermally to Fischer 344 rats (n=30/sex/group, at doses of 0,10, 100 or 250 mg/kg bw/day, 3 times a week except mating periods). No treatment related effects were reported with respect to mating, fertility, gestation, or viability indices and mean gestational length in both generations. No effects on testicular weights or sperm counts were observed in the male rats. The NOAEL for reproductive toxicity was established as 250 mg/kg bw/day. The NOAEL for developmental toxicity was >250 mg/kg bw/day, based on no effects seen in growth and development in the offspring up to the highest dose tested (HERA 2009; CIR, 2012). In a two generation study, the chemical (C12EO6) was administered in the diet of female rabbits at doses of 0, 50, 100 or 200 mg/kg bw/day from gestation days 2 to 16. Ataxia and a slight decrease in body weight were observed at 100 and 200 mg/kg bw/day, indicating maternal toxicity. Nine rabbits in the control group and 31 in the treatment groups died during the study (details not available). There were no treatment related effects on implantations, number of live foetuses and spontaneous abortions. The NOAEL for maternal toxicity was reported as >50 mg/kg bw/day (HERA, 2009). Although certain short chain monoethylene glycol ethers such as 2-ethoxyethanol (CAS No. 110-80-5) are known reproductive toxicants, the ability of the glycol ethers to cause testicular toxicity decreases with increasing chain length, with effects not observed with chain lengths greater than C2 (OECD, 2004).

Acute Toxicity	Based on the available animal (rats, mice and guinea pigs) studies, the chemicals in this group are expected to have low to moderate acute oral toxicity (REACHa-h; OECD, 2005; HERA, 2009; CIR, 2012). The LD50 in rats ranged from 600 mg/kg bw to greater than 20 g/kg bw. Observed sublethal effects for the chemical with the highest toxicity (C15–16 and EO10) included diarrhoea, pilo-erection, ataxia, abnormal posture, difficult laboured breathing, salivation, lacrimation, bloody noses and lethargy. Data from HERA assessment studies show that the chemicals with ethoxylate chains (EO) between 5 and 15 units were more toxic by the oral route than those with less than 4 or greater than 21 units. No relationship between the alcohol chain length and toxicity was observed (HERA, 2009). The chemicals of this group exhibit low acute dermal and inhalation toxicity. The chemicals (C9 to C15 with 3–13 EO units) were of low acute toxicity in rats and rabbits following dermal exposure. The LD50 ranged from 2000 to 5000 mg/kg bw. Sub-clinical effects included wet appearance of the fur, little or no urine, laboured breathing, lethargy, diarrhoea, ataxia, muscle tremours and decreased activity. There was no relationship between the alcohol chain length or number of ethoxylate groups and toxicity. Very high dermal doses of the chemicals (>16000 mg/kg bw) applied dermally for 24 hours in rabbits led to severe skin irritation, ataxia and lung lesions (HERA, 2009; CIR, 2012). In a guideline study (Test Guideline (TG) 403), a single static inhalation exposure to substantially saturated vapour (equivalent to 131.58 ppm - calculated) of C6EO1-2.5 (CAS No. 112-59-4), resulted in no mortality or other signs of inhalation toxicity in Sprague- Dawley (SD) rats (REACHa).
Irritation	The chemicals in this group are reported to be moderate to severe skin irritants in animal studies. The degree of irritation was reported to be dependent on the type of patch (occluded vs semi-occluded), exposure time (ranging from 4 hours up to 4 weeks) and the concentration used. Undiluted chemicals were moderately to severely irritating, 1–10 % was mildly irritating and 0.1 % and 0.5 % were non-irritating. There was also a general trend between the severity of irritation and the degree of ethoxylation. Chemicals with three and less ethoxylate units appeared to be more irritating than chemicals with higher degree of ethoxylation. No trend in irritation potential with respect to the length of carbon chain could be established. Available data indicates that undiluted AEs can produce varying degrees of eye irritation ranging from moderate to severe irritancy. The severity of irritation was found to be concentration dependent, with up to 1 % minimally irritating and concentrations in the range of 1 to 10 % slightly to moderately irritating. In most cases, following exposure, the eyes of the treated animals recovered a few days after exposure. Further tests showed that rinsing the eye 30 seconds after application with tap water may reduce the severity of the effects. No clear relationship could be established between the number of EO units or carbon chain length and eye irritation potency.
Sensitisation	Based on available data, the chemicals in this group are not skin sensitisers.
Health Effects Summary	The chemicals in this group are synthesised from linear alcohols (primary or secondary) or branched alcohols. The commercial AEs may also contain un-reacted alcohol as reaction by-products at about 5 % but with variations between different commercial products (HERA, 2009). Available data on linear and branched chain alcohols show that they have low acute and systemic toxicity and exhibit similar patterns of absorption, metabolism, and excretion to alcohol ethoxylates. They are also shown to have no skin sensitisation potential. A potential for skin and eye irritation exists with alcohols >11 carbon chain length (OECD, 2006; OECD, 2006a).
Key Study/Critical Effect for Screening Criteria	The critical human health effects for risk characterisation are acute oral toxicity and skin and eye irritation. The irritant effects are similar to those produced by other surfactants, and the severity of irritation appears to increase directly with concentration and generally decrease with an increasing number of ethoxylate units.

Ecological Toxicity [2,3]	
Aquatic Toxicity	The 96 h LC50 value for Alcohols, C9-11, ethoxylated with Oncorhynchus mykiss was 5 - 7 mg/L based on nominal concentrations. In the long term toxicity test to Lepomis macrochirus, the NOEC (30 days) was 0.11 – 0.33 mg/L. In the short–term toxicity test to Daphnia magna, the EC50 (48 h) was 2.5 mg/L. In the long term toxicity test to Daphnia magna, the NOEC (21 days) was 0.77 – 1.75 mg/L. In the short–term toxicity test to Pseudokirchneriella subcapitata (green algae), the EC50 (96 h) was 1.4 mg/L. The EC50 (3 h) for microorganisms was 140 mg/L. In a study conducted with two different fish species (bluegill sunfish and fathead minnow) the effects of C14 -15 alcohol ethoxylates (7EO) were determined (Dorn et al., 1995, Shell). In two experiments fish were exposed for 10 d in a laboratory assay and for 30 d in an outdoor stream mesocosm. Effect parameters determined were survival and growth of juvenile bluegills and survival and reproduction of fathead minnows. In the laboratory experiment the NOEC for survival and swimming performance of bluegills and for survival of fathead minnows was 0.16 mg/L. In the stream mesocosm the NOEC for bluegill survival and growth was >0.33 mg/L and for fathead minnow survival 0.28 mg/L. There was an indication of decreased egg laying by fathead minnow in the streams at concentrations of 0.33 mg/L or greater. On the basis of the reported results a worst-case NOEC of 0.16 mg/L is assumed. One publication is available for an alcohol ethoxylate mixture with a chain length of C12 - C13 and approximately 6.5 ethoxy groups (Gillespie et al. 1999). The 21 days flow-through chronic experiment on daphnids is conducted according to the guidelines USEPA-TSCA (U.S. EPA, 1992) and ASTM (1988) and is well documented in the paper. Nevertheless the degree of ethoxylation of the tested mixture described in the paper (6.5 EO) is higher than the degree of ethoxylation described for CAS 68131-39-5 (2.5 EO). The NOEC of 0.77 mg/L for reproduction can be used for read-across.
Determination of PNEC aquatic	A PNECaquatic of 11 µg/L was calculated using the lowest chronic endpoint of NOEC of 0.11 mg/L for Daphnia magna. An assessment factor of 10 was used.
Current Regulatory Controls [1]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	No specific exposure standards are available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Trigger values for freshwater (95% species) (ANZECC 2000): Alcohol ethoxyolated sulfate (AES) = 650 μgL^{-1} Alcohol ethoxylated surfactants (AE) = 140 μgL^{-1}
PBT Assessment	
P/vP Criteria fulfilled?	No. These chemicals were found to be readily biodegradable. Thus, it does not meet the screening criteria for persistence.
B/vB criteria fulfilled?	No. Bioaccumulation in organisms is expected to be negligible, due to biotransformation and excretion of alcohol ethoxylates.
T criteria fulfilled?	No. The NOECs from the chronic aquatic toxicity data are >0.01 mg/L, hence does not meet the screening criteria for toxicity.

Overall conclusion	Not PBT
Revised	January 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier II Assessment for Ethoxylates of aliphatic alcohols (>C6):, Retrieved 2019: https://www.nicnas.gov.au
2. ECHA REACH, Alcohols, C9-11 ethoxylated, < 2.5 EO, Retrieved 2017: https://echa.europa.eu/information-on-chemicals/registered-substances
3. ECHA REACH, Alcohols, C12-15 ethoxylated, Retrieved 2017: https://echa.europa.eu/information-on-chemicals/registered-substances

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Toxicity Summary - Alcohols, C6-12, ethoxylated propoxylated

Chemical and Physical Properties[1]	
CAS number	68937-66-6
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	Soluble in water
Melting point	-3 °C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Yellow liquid, mild odour
Overview	Principle Route of Exposure: Eye or skin contact, inhalation Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Environmental Fate[1]	
Soil/Water/Air	This substance is expected to be readily biodegradable (60% @ 28d) (similar substances). Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative. Mobility in soil: KOC = >4
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	No data available to indicate product or components present at greater than 0.1% are chronic health hazards.
Carcinogenicity	Did not show carcinogenic effects in animal experiments (similar substances)
Mutagenicity/ Genotoxicity	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Animal testing did not show any effects on fertility.
Acute Toxicity	LD50 Oral: 600 mg/kg (Rat) (similar substance) LD50 Dermal: > 5200 mg/kg (Rabbit) (similar substance) LD50 Inhalation: > 0.22 mg/L (saturated concentration) (Rat) (similar substance)
Irritation	May cause mild respiratory irritation. Causes severe eye irritation which may damage tissue. Causes skin irritation.
Sensitisation	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Health Effects Summary	Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [1]	

Aquatic Toxicity	Toxicity to fish: LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96) 1.4 mg/L (Pimephales promelas) (similar substance) NOEC 4.4 mg/L (Pimephales promelas, juvenile) Toxicity to invertebrates: EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance) Toxicity to algae: EC50 (72h) 0.75 mg/L (Pseudokirchnerella subcapitata) (similar substance) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) (similar substance) CD10 8 mg/L (Pseudokirchneriella subapitata) EC10 2 mg/L (Brachionus calyciflorus) Toxicity to microorganisms: EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance)
Determination of PNEC aquatic	On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 0.14 mg/L for Daphnia. The PNEC aquatic is 0.14 µg/L.
Current Regulatory Controls [1]	
Australian Hazard Classification	H302 - Harmful if swallowed H315 - Causes skin irritation H318 - Causes serious eye damage
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable based on similar substances.
B/vB criteria fulfilled?	No. Based on an estimated log Kow value of 4.3 – 5.36, and BCF value of 1.1 – 1.8, it is not expected to be bioaccumulative.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. Redacted

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Toxicity Summary - Amides, tall-oil fatty, N,N-bis(hydroxyethyl)

Chemical and Physical Properties [1,2]	
CAS number	68155-20-4
Molecular formula	UVCB
Molecular weight	370 (typical C18 monounsaturated)
Solubility in water	Dispersible
Melting point	<25 °C (liquid)
Boiling point	>300 °C (estimated)
Vapour pressure	$<1.0\times10^{-10}$ (estimated)
Henrys law constant	$<1.0\times10^{-10}$ (estimated)
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Liquid
Overview	Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include other basic organic chemical manufacturing as surface active agents and intermediates; pesticide and other agricultural chemical manufacturing as surface active agents; soap and cleaning compound manufacturing as surface active agents; support activities for mining as surface active agents; and petrochemical manufacturing as surface active agents. Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives.
Environmental Fate [1,2]	
Soil/Water/Air	The members of the fatty nitrogen derived amides category are long-chain alkyl substituted amides used in commercial product mixtures. The category consists of three subcategories: Subcategory I, fatty acid amides; Subcategory II, fatty alkanolamides; and Subcategory III, fatty acid reaction products with amines. For the purpose of this discussion only, a one-member Subcategory, Subcategory IV, which contains CASRN, 61790-63-4, has been considered as part of Subcategory II. The components of Subcategory I are solids possessing low vapor pressure and low water solubility. The substances in Subcategory II contain solids and liquids with negligible to low vapor pressure and tend to be dispersible in water. The substances in Subcategory III also contain solids and liquids possessing negligible to low vapor pressure that tend to be dispersible in water. The fatty acid amides (Subcategory I) and the fatty acid reaction products with amines (Subcategory III) are expected to possess low mobility in soil. The fatty alkanolamides (Subcategory II) are expected to possess moderate to high mobility in soil. Volatilization is low to moderate for the fatty acid amides and low for the fatty alkanolamides and the fatty acid reaction products with amines. The rate of hydrolysis is considered negligible for all category members. The rate of atmospheric photooxidation is considered moderate to rapid for members of each subcategory; however, this is not expected to be an important environmental fate process since these substances are not expected to exist in the vapor phase in the atmosphere. The overall weight of evidence suggests that the members of the fatty nitrogen derived amides category should possess low persistence (P1) and low bioaccumulation potential (B1) with the exception of two members of subcategory III. Fatty acids, tall-oil, reaction products with tetraethylenepentamine and fatty acids, tall-oil, reaction products with polyethylenepolyamines are expected to possess low persistence (P1), but moderate bioaccumulation potential (B2).
Human Health Toxicity Summary [1,2, 3]	

Chronic Repeated Dose Toxicity	Based on read-across from CAS 120-40-1, an oral repeated dose toxicity study reported NOEL = 0.1% which corresponds to 50 mg/kg/day. No rats died as a result of being treated with the test substance. Two males treated with diet containing 1.0% test substance were euthanized on Days 23 and 58 because of weight loss and respiratory distress. Extensive lung abscess formation was seen at autopsy and bronchopneumonia was confirmed histologically. Growth was inhibited significantly in males and females at and above the 0.5% dietary concentration. Food intake was reduced at all dietary levels except 0.1%, and was attributed to an effect of the test substance on palatability of the diet. The rats in the palatability study showed exclusive preference to the control feed than the treated feed, virtually no test diet was consumed at any dietary levels incorporated. Hematological examination revealed statistically significant reductions in hemoglobin levels and red cell counts in females at the 2.0 and 1.0% dietary concentration and in hemoglobin levels in males at the 2.0% level. Examination of the femoral bone marrow smears showed not deviation from normality. Serum chemistry revealed significantly high serum levels of glutamic-oxaloacetic transaminase in females at the 0.5% level and higher, but only at the 0.5% level in males. Urinalysis was comparable across all groups for males and females. Gross examinations were unremarkable. Statistically significant increases in relative kidney weight in all test groups except at 0.1% in females and at 2.0 and 1.0% in males; and increases in relative liver weight in females at 2.0 and 1.0% were seen. These were attributed to the decreases in body weight. Types and incidence of pathological lesions seen histologically were comparable in control and test groups. Gonads were examined histologically, thus this study meets SIDS requirements for a reproductive screen.
Carcinogenicity	Not regarded as carcinogenic.
Mutagenicity/ Genotoxicity	Based on read-across from CAS 120-40-1, the test substance did not induce reverse mutations in the tested strains of Salmonella typhimurium in the presence or absence of S-9 activation.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on read-across from CAS 68603-42-9, the results from a developmental toxicity study showed that repeated oral administration of COMPERLAN KD to pregnant rats on day 6 through 15 of gestation, caused no symptoms of cumulative toxicity up to a dose level of 1000 mg/kg/day. With the exception of salivation and propulsion of the head during the dose administration, there were no treatment-related effects. Also, COMPERLAN KD does not reveal any embryotoxic or teratogenic potential at dose levels up to 1000 mg/kg/day (author of the report).
Acute Toxicity	Acute oral and dermal toxicities of CASRN 68140-00-1 in rat and rabbit, respectively, are low. Based on read-across from CAS 68140-00-1, an oral acute toxicity test on rats reported LD50 > 5 g/kg. All animals survived the 8-day observation period and no adverse effects were observed. With respect to the determined LD50 value, it is assumed that the LD50 value for female rats also exceeds the limit dose of > 2000 mg/kg body weight. In a dermal acute toxicity test on rabbits, LD50 > 2 g/kg was reported. All animals survived. All animals appeared normal through day 14. Two females that had abraded skin lost weight (0.01 and 0.25 kg) over the 14-day post-exposure period. All remaining rabbits gained weight through day 14. Swiss-Webster mice (4 males/dose) were administered “Alkanolamide #1”, identified in the robust summary as CASRN 68144-20-4, via whole body exposure for 3 hours. Doses were 86- 219 mg/m3 (0.086 – 0.219 mg/L). Animals were observed for several days. No mortality was observed. LC50 > 0.219 mg/L
Irritation	The test article produced sensory irritation later in the exposure at low concentrations. Pulmonary irritation also occurred later in these exposures.
Sensitisation	Did not cause sensitization on laboratory animals (similar substances)

Health Effects Summary	Acute oral and dermal toxicities of CASRN 68140-00-1 in rat and rabbit, respectively, are low. CASRNs 142-78-9 and 68140-00-1 were negative for gene mutations in bacteria in vitro. No data are available for the repeated-dose/reproductive/developmental toxicity and genetic toxicity (chromosomal aberrations) endpoints. The repeated-dose/reproductive/developmental toxicity and genetic toxicity (chromosomal aberrations) endpoints are identified as data gaps
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [1, 3]	
Aquatic Toxicity	Based on read-across for CAS No: 68603-42-9 Daphnia: EC50 (24-hour): 3.3 mg active matter/l Daphnia: 48-hour LC50 = 2.15 and 2.64 mg/l Based on read-across for CAS No: 112-84-5 The experiment measured the survival and reproduction of Daphnia magna over a 21-day exposure to the test and control substances. Daphnids were cultured in the laboratory using Elendt M7 medium and a daily feeding regiment of green algal cells (Chlorella vulgaris). Four experimental groups: control (Elendt M7 medium), solvent control (0.1 ml methanol/l), 33 µg/l, and 100 µg/l (nominal concentrations) were used in a static-renewal exposure system. All test solutions were prepared with Elendt M7 medium. Replicate test vessels consisted of 4 oz glass bottles containing 100 ml of test solution. There were 10 replicates per experimental group. On the day of test initiation, neonate daphnids were removed from cultures and placed in a crystallizing dish containing Elendt M7 medium. One daphnid was placed in each replicate test vessel, and each vessel was randomly placed in the testing area. Light intensity was not measured, but ambient laboratory lighting was provided with a photoperiod of 16 hours light/8 hours dark. Each day, test solutions were renewed, and the daphnids were fed 1.7 x 10(5) cells/ml of Chlorella vulgaris. Adult survival and reproduction was assessed each day and neonates were removed daily. The pH, dissolved oxygen (DO) and total hardness (as mg/l CaCO(3)) were measured on test days 0, 1, every Tuesday and Friday and on day 21. Means and ranges for temperature, water pH, DO and total hardness were 19.7 °C (14.5 - 25.0 °C), 7.6 (7.2 - 8.1), 8.2 mg/l (4.5 - 9.3 mg/l) and 245 mg/l (234 - 256 mg/l) as CaCO(3), respectively. Concentrations of the test substance in exposure solutions were measured on test days 0, 1, 5, 9, 12, 16 and 19 in both the old and the new solutions. Effect concentrations were based on mean measured concentrations. 21 d NOEC = 0.08 mg/L
Determination of PNEC aquatic	Applying an assessment factor of 1000 to the NOEC (0.08 mg/l) gives a PNEC of 0.08 µg/l.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable based on similar substances.

B/vB criteria fulfilled?	No. Based on BAF = 108 and log Kow of 3 (estimated)
T criteria fulfilled?	No. Acute toxicity data was >1 mg/L.
Overall conclusion	Not PBT
Revised	January 2019

References

1. OECD, Amides, tall-oil fatty, N,N-bis(hydroxyethyl), Retrieved 2019: http://www.echemportal.org
2. USEPA Hazard Characterization Document, Fatty Nitrogen Derived (FND) Amides Category, September 2010
3. Redacted

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Toxicity Summary - Amine oxides, cocoalkyldimethyl

Chemical and Physical Properties	
CAS number	61788-90-7
Molecular formula	CH3.(CH2)R.N(CH3)2:O, where R is 9-17
Molecular weight	237 (70% C12: 30% C14) (molecular weight will vary depending on structure)
Solubility in water	409.5 g/L
Melting point	Average: 130.5
Boiling point	Decomposes before boiling
Vapour pressure	Predicted vapour pressure values are < 4.6E-7 hPa
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Surfactants known as amine oxides (AO) contain even numbered linear alkyl chains ranging from C8 to C20. Also known as fatty alkyl dimethyl AOs, they are usually produced by reacting alkyl dimethyl amines with hydrogen peroxide in water. The AOs are produced, transported and used in water solutions, typically at a 25-35% activity level. The AOs are produced and used either as single chain length substances (e.g., C12) or as a mixture of different chain lengths (e.g., C12 to C18). All of the substances in this category are surfactants, consisting of a polar “head” (the amine oxide) and a relatively inert, hydrophobic “tail” (the long alkyl substituent). AOs are used in cleaning and personal care products as foam stabilizers, thickeners, emollients, emulsifying and conditioning agents. Primary uses are in liquid hard surface cleaners, laundry and dishwashing detergents, shampoos and hair conditioning products.
Environmental Fate[1]	
Soil/Water/Air	AOs are highly water soluble (C10-16 AO = 409.5g/L). AO is fully biodegradable under both aerobic and anaerobic conditions and is effectively removed during wastewater sewer transport (“pipe loss” >90%) and in biological wastewater treatment (~98%). It has low potential for bioaccumulation (BCF <87 L/kg). These characteristics help to minimize the potential for environmental exposure, and for indirect human exposures via drinking water and/or fish consumption.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	In four repeated-dose studies with rats and mice exposed to AO via oral and dermal routes (all with CAS No 70592-80-2), three dermal studies were designed to assess the effect of repeated exposure on skin at maximum doses of 1.5 mg AO/kg-bw/day. Higher doses were tested in a 90-day dietary study with rabbits. No treatment-related clinical chemistry, hematology and histopathological changes were observed. In these studies, LOAELs ranged from 87 to 150 mg AO/kg bw/day with the highest oral NOAEL below the lowest LOAEL as 80 mg AO/kg bw/day. Signs of toxicity observed in the oral study included suppressed mean body weight gain, lenticular opacities and diarrhoea; in the dermal studies, local dermal irritation was evident.
Carcinogenicity	The carcinogenic potential of amine oxides has been thoroughly investigated in three carcinogenicity studies in rats or mice by dermal, dietary, or drinking water routes. In all cases the substances demonstrated no evidence of a carcinogenic response.

Mutagenicity/ Genotoxicity	In five in vitro bacterial (Salmonella) mutagenicity studies, AO shows no evidence of mutagenicity either with or without S9 metabolic activation at concentrations up to 250 ug/plate (higher concentrations caused cytotoxicity). Three in vivo studies investigated clastogenic effects on a close structural analog of the category, 1-(methyldodecyl)dimethylamine-N-oxide including: a mouse micronucleus, a Chinese hamster micronucleus and a Chinese hamster cytogenetics study. These studies were all negative showing no increase in micronuclei or chromosome aberrations. An in vivo mouse dominant lethal assay showed no evidence of heritable effects. Two AOs (CAS No 1643-20-5 and CAS No 3332-27-2) were negative in an in vitro cell transformation assay tested at concentrations up to 20 ug/ml.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No evidence of reproductive toxicity or fertility effects was observed in a study in which rats were given dietary doses of AO in the diet over two generations (CAS No 1643-20-5). No macroscopic or histopathological changes were attributable to treatment with the test substance. The maternal NOAEL from this reproductive study was >40 mg AO/kg bw/day, which was the highest dose tested. At all treatment levels, the rate of bodyweight gain for the F1 and F2 offspring was reduced during the lactation period, however, this reduction was not greater than 10%. This effect appeared to be dose-related, but was not statistically significant until after weaning in the mid and high dose levels. This was not considered an adverse effect since the body weight change only reached statistical significance when the rat pups were getting the majority of their calories from solid food (Developmental NOAEL >40 mg/kg bw/day). In three developmental toxicity studies via gavage in rats and rabbits (with CAS No 1643-20-5 & 70592-80-2), effects such as decreased fetal weight or delayed ossification, were most often observed only at maternally toxic doses and were associated with the irritation effects of AO on the gastrointestinal tract. No decreases in litter size, no changes in litter parameters, no malformations or significant differences in skeletal defects were observed at oral doses up to 25 mg/kg bw/day in rats (based on decreased fetal weight at 100 mg/kg bw/day) and >160 mg/kg bw/day in rabbits (the highest dose tested).
Acute Toxicity	In rat oral acute toxicity limit tests, no deaths occurred at single doses of 600 mg C10-16 AO/kg bw or less (for CAS No 70592-80-2). In multi-dose studies, acute oral LD50 values for rats ranged from 846 mg AO/kg bw to 3873 mg AO/kg bw (both values for CAS No 61788-90-7), with several other AO's having rat oral LD50's falling within this range. In single dose acute dermal toxicity limit tests, no deaths occurred at a dose of 520 mg AO/kg bw (CAS No 70592-80-2). This dose was equivalent to 2 mL/kg of a 30% formulation. There were no deaths observed in a rat acute inhalation study to aerosol droplets of a consumer product providing a dose of 0.016 mg AO/L.
Irritation	In a series of studies on rabbits, AO's of varying chain length showed consistent results and all 1) were not irritating to the skin or eyes at low concentrations (1%), 2) were moderately irritating at 5%, and 3) more severely irritating when tested as produced (e.g., ~30% aqueous solutions). In studies that included rinsing, eye irritation effects diminished with rinsing after 30 seconds of exposure and were slight with rinsing after 4 seconds of exposure. In Draize rabbit eye irritation tests using ~30% AO solutions, rabbits experienced severe to moderate irritation. (The maximum concentration of AO is 10% active in consumer products.) Accidental eye exposure in manufacturing employee incidents and consumer incidents established that eye irritation effects of exposure during manufacturing and use of products containing AO and other surfactants are moderate, transient and reversible
Sensitisation	There is no indication of skin sensitization for the AO category based on the available animal and human data.
Health Effects Summary	The chemicals in this category present properties indicating a hazard for human health (skin and eye irritation). However, these hazards do not warrant further work as they are related to reversible, transient and non-lasting effects. Nevertheless, these hazards should be noted by chemical safety professionals and users.
Key Study/Critical Effect for Screening Criteria	Skin and eye irritation.

Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Extensive aquatic toxicity data are available for commercially representative amine oxides (C10 to C18) that are single chain length as well as mixtures. Based on hazard data, freshwater green algae are considered the most sensitive species, for acute and chronic endpoints. Acute toxicity is affected by chain length for fish and invertebrates. Chain length affects hydrophobicity, wherein longer chain-lengths increase the rate of uptake and decrease depuration. All but four supporting AO's have been tested for acute toxicity in fish, daphnia, and algae. The range of acute LC50/EC50/ErC50 values based on a review of the aquatic toxicity data on AO were 0.60-32 mg/L for fish, 0.50-10.8 mg/L for Daphnia magna and 0.010-5.30 mg/L for algae. Chronic toxicity data were normalized to a chain length of 12.9 carbon atoms, as this average chain length represents the largest volume product for North America (CAS No 70952-80-2). Chronic toxicity (NOEC, EC20) for an amine oxide of average chain length of C12.9 ranged as follows for the different trophic levels: 0.010-1.72 mg/L for algae, 0.28 mg/L for Daphnia (flow through) and 0.31 mg/L for fish (flow through). These are based on geometric mean values, and a dataset of 21 chronic toxicity studies. Based on a chronic periphyton microcosm bioassay that included 110 taxa of algae (most sensitive species), a NOEC value of 0.050 mg/L was derived when normalized for a C12.9 amine oxide.
Determination of PNEC aquatic	Chronic toxicity values are reported for fish, aquatic invertebrates, and freshwater algae. Since there is valid chronic toxicity data for three trophic levels, an assessment factor of 10 is used (in accordance with EU guidance). Based on the NOEC for freshwater algae (the most sensitive species), the aquatic PNEC is 0.01 µg/L.
Current Regulatory Controls [4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. AOs are highly removed by conventional sewage treatment systems and biodegrade rapidly and completely under aerobic and anaerobic conditions.
B/vB criteria fulfilled?	No. BCFWIN predictions using the calculated logKow value of < 2.7 as input parameters (derived for C10-16 AO), calculated bioconcentration factor < 87 for C12-14 AO (The Procter & Gamble Company, 2002C). Thus the potential for bioaccumulation of AOs in aquatic organisms is considered to be low.
T criteria fulfilled?	Yes. Chronic toxicity data < 1 mg/L fish, aquatic invertebrate and/or algae, thus AO does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. OECD (2001) SIDS Initial Assessment Profile for Amine Oxides (AO)

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Toxicity Summary - Benzaldehyde

Chemical and Physical Properties[1,2,3]	
CAS number	100-52-7
Molecular formula	C7H6O
Molecular weight	106.12
Solubility in water	6.55 g/L at 25°C
Melting point	-26°C
Boiling point	179.2°C
Vapour pressure	0.130 kPa (0.97 mmHg) at 20°C
Henrys law constant	2.85 Pa.m³.mol-1 @ 25 °C
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Colourless or yellow liquid with an almond-like odour.
Overview	Benzaldehyde is a colourless liquid that becomes yellowish with age. It smells a little like almond and has a burning, aromatic taste. Benzaldehyde is very soluble in water. Benzaldehyde occurs naturally in plants. It can be formed in the atmosphere from the reaction of some chemicals with sunlight. It has been detected in air associated with volcanoes. Benzaldehyde is an important commercial chemical that is used to make other chemicals. It is also used as a preservative in cosmetics, personal care products, food and select car detailing products. It is used as a solvent for oils, flavouring, and in synthetic perfumes. It may be a tobacco additive. It was formerly used as an insecticide.
Environmental Fate [2,3]	
Soil/Water/Air	The test substance is readily biodegradable. The test substance was shown to degrade under influence of light with a DT50 of 9.4 hours. In addition under anaerobic conditions complete biodegradation is expected. As the logKow is 1.4, the potential for bioaccumulation and sorption of the test substance is considered to be low. The Henry Constant was calculated to be 2.85 Pa m^3/mol. A calculation with Simple Treat shows that the test substance will degrade in the Sewage Treatment Plant for > 88% with at maximum about 12% to end up in the water compartment.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Based on the data available, the chemical is not considered to cause serious damage to health from repeated oral and inhalation exposure. In a repeated dose oral toxicity study, Fischer rats (male/female, 10/sex/dose) were administered the chemical by oral gavage at doses of 0, 50, 100, 200, 400 or 800 mg/kg bw/day, five days a week, for 13 weeks. Mortalities and histopathological changes including lesions in the brain (degeneration and necrosis of the cerebellum and necrosis in the hippocampus), renal tubular necrosis, hyperplasia and/or hyperkeratosis of the forestomach, and degeneration of the liver were observed in both sexes at the highest tested dose level. Depressed body weights (26 % lower than controls) were also observed for male rats at this dose. A no observed adverse effect level (NOAEL) of 400 mg/kg bw/day was established (NTP, 1990; OECD, 2002; CIR, 2006; REACH). A similar repeated dose oral toxicity study on B6C3F1 mice (male/female, 10/sex/dose) was also conducted. The mice were administered the chemical by oral gavage at doses of 0, 75, 150, 300, 600 or 1200 mg/kg bw/day, five days a week, for 13 weeks. Within the first week of dosing, 9/10 males and 1/10 females died at the highest tested dose. Mild to moderate renal tubular degeneration in all males was observed in the high dose group and 1/10 males in the 600 mg/kg/day group. Depressed body weights (9 % lower than controls) were also observed for the males at 600 mg/kg bw/day. The NOAEL was determined to be 300 mg/kg bw/day for male mice and 600 mg/kg bw/day for female mice (NTP, 1990; OECD, 2002; CIR, 2006; REACH). In another repeated dose oral toxicity study, similar to OECD TG 408, groups of Osborne–Mendel rats (male/female, five/sex/dose) were fed a powdered diet containing the chemical at concentrations of 1000 ppm for 28 weeks, or 10000 ppm (approximately 500 mg/kg bw/day) daily for 16 weeks. No effects on body weight or haematological parameters and no macroscopic/microscopic changes in selected organs were noted at 10000 ppm (CIR, 2006; REACH). In a repeated dose inhalation toxicity study conducted similarly to OECD TG 412, groups of Sprague Dawley (SD) rats (male/female, 14/sex/dose) were exposed (whole body) to the vapours of the chemical at 0, 500, 750 and 1000 ppm, six hours a day for 14 days. Significant reduction in body weight was observed for all males but only at 1000 ppm for females. Mortalities occurred in the two higher dose groups. All groups exhibited clinical toxicity symptoms including reduced motor activity, hypothermia, respiratory problems and nasal and ocular irritation. With increased concentrations, the severity of nasal and ocular irritation increased. At the two highest doses, the rats displayed aggressive behaviour and central nervous system symptoms (tremors, piloerection, diuresis, seizures and sensitivity to noise). The most prominent histopathological observation was goblet cell metaplasia in the respiratory epithelial lining of the nasal septum, which was found in males at doses 500 and 1000 ppm, but not in females. A no observed adverse effect concentration (NOAEC) could not be determined due to the clinical observations (indicative of neurotoxicity), hypothermia, and goblet cell metaplasia which were seen at concentrations of 500 ppm and above. The lowest observed adverse effect concentration (LOAEC) was reported to be 500 ppm in this study (CIR, 2006; HSDB; REACH). In another repeated dose inhalation toxicity study with limited documentation (non-guideline), rats were exposed to the chemical at 186 ppm (803 mg/m^3), four hours a day, five days a week for two weeks. Respiratory irritation was observed during exposure. No other effects were reported (EC, 2000; OECD 2002).

Carcinogenicity	Although the chemical has been reported to have 'some evidence of carcinogenic activity' in B6C3F1 mice, there was 'no evidence of carcinogenic activity' in Fischer 344 rats receiving 200 or 400 mg/kg bw/day (NTP, 1990). It was further concluded that the increased incidences of pancreatic acinar cell neoplasms in male rats and squamous cell papillomas of the forestomach in mice were probably due to the high concentrations of corn oil (mild irritant and mitogen) used as a vehicle in these studies (US EPA, 2001). The chemical is also considered not to have mutagenic or genotoxic potential (see Genotoxicity). Therefore, the chemical is not considered to have carcinogenic potential. In a combined chronic toxicity–carcinogenicity study (OECD TG 451), groups of eight-week-old Fischer 344 rats (male/female, 50/sex/dose) were administered (gavage) the chemical in corn oil at doses of 200 or 400 mg/kg bw, five days a week for two years. At the highest dose, mortality in male rats was significantly higher than the controls. No dose-related effects on body weight and clinical signs were observed. As squamous cell papillomas of the forestomach were seen in only two female rats in the high dose group and there was a lack of supporting hyperplasia, these were not considered to be due to the administration of the chemical. Significant increases in the incidences of pancreatic acinar cell hyperplasia and tumours were observed in male rats only at the high dose. Unpublished National Toxicology Program (NTP) studies indicated that pancreatic acinar cell tumours found in rats gavaged with corn oil were not autunomous as these tumours failed to transplant. Therefore, based on the facts that these tumours failed to transplant, were present in variable numbers in control animals, and increased only at the high dose, it was concluded that pancreatic acinar cell hyperplasia and tumours were not considered as evidence of carcinogenic activity for the chemical (NTP, 1990; EC, 2000; HSDB; REACH). It was further concluded that the increased incidence of tumours specific to male rats in this study was probably due to the use of corn oil as a vehicle in this study (US EPA, 2001). In the same carcinogenicity study, groups of eight-week-old B6C3F1 mice (male and female, 50/sex/dose) were administered (gavage) the chemical in corn oil at doses of 200 or 400 mg/kg bw (in males), 300 or 600 mg/kg bw (in females), five days a week for two years. Although no significant differences in mean body weights and survival were observed between any groups of mice, effects were noted in the forestomach of mice. The incidences of uncommonly occurring squamous cell papillomas of the forestomach in both exposure groups were significantly greater as compared to the controls (male: vehicle control, 1/50; low dose, 2/50; high dose, 5/50; female: 0/50; 5/50; 6/50). The increased incidences of papillomas were accompanied by significantly increased incidences of focal hyperplasia in the forestomach in both sexes of the 400 mg/kg bw group and in females of the 200 mg/kg bw group, compared with vehicle controls. The NTP considered that the increase in papillomas was due to a concurrent increase in hyperplasia following treatment with the chemical and concluded that there was 'some evidence of carcinogenicity' in mice. It was also concluded male and female mice might have been able to tolerate higher doses (NTP, 1990; REACH).

Mutagenicity/ Genotoxicity	Overall, the data indicate that the chemical has no mutagenic or genotoxic potential. Although there is no mutagenic activity in bacterial systems, the chemical does have weak clastogenic effects in some mammalian cell assays. There are also no in vivo data available. The chemical gave negative results in several in vitro bacterial reverse mutation assays with Salmonella typhimurium at concentrations up to 3333 mg/plate. Induction of chromosomal aberrations was also not observed in Chinese hamster ovary (CHO) cells, treated with the chemical up to 500 mg/mL in the absence of S9 or with up to 1600 ug/mL with S9 (NTP, 1990; REACH). In an in vitro chromosomal aberration assay (OECD TG 473) in the Chinese hamster cell line B241, a significant percentage (13 %; 21/162) of the cells displayed abnormalities following exposure to a concentration of 5.3 nM of the chemical for 24 hours (CIR, 2006). Cytogenetic tests with CHO cells reported an increased number of sister chromatid exchanges at doses of 50 mg/ml and 160 mg/ml in the absence of S9 or at 1600 mg/mL with S9 (NTP, 1990; HSDB; REACH). The chemical gave positive results in a mouse lymphoma forward mutation assay (OECD TG 476) with mouse lymphoma L5178Y cells. The concentrations of the chemical tested in this assay were 0, 50, 100, 200, 400, and 800 mg/mL. Although significant increases in mutant fractions were observed at a dose of 400 mg/mL, the positive response was noted to be close to the cytotoxic dose of 640 mg/ml (HSDB; REACH). Negative results were obtained with the chemicals in an in vivo sex-linked recessive lethal test with Drosophila melanogaster (NTP, 1990; OECD, 2002; HSDB; REACH).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Although limited data are available, the available information indicates that the chemical does not show specific reproductive or developmental toxicity. Benzyl derivatives, including benzaldehyde, have been reported to produce no evidence of reproductive and developmental toxicity during various studies. It was also stated that as benzyl derivatives generally follow similar metabolic pathways, studies conducted on benzyl derivatives provide adequate evidence for benzaldehyde (US EPA, 2001). As part of reviewing the reproductive toxicity and teratogenicity of benzaldehyde and related compounds (benzyl acetate, benzyl alcohol, and benzoic acid and its salts), the Joint Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) Expert Committee on Food Additives concluded that 'delayed development and reduced foetal and postnatal pup body weights were observed in developmental toxicity studies in rats, mice, hamsters and rabbits, but only at doses that were toxic to the mother' (CIR, 2006). In a poorly-documented one-generation reproductive toxicity study (non-guideline), male and female rats were administered the chemical by oral gavage at doses of 0 or 5 mg/kg bw/day in oil, once every second day for 32 weeks. Dosing commenced at 75 days before breeding with untreated males; two pregnancies per rat were studied, one at 75 days and one at 180 days. The number of gestating females, number of live-born offspring, pup weights at birth and on postnatal days 7 and 21, and pup viability were recorded. The incidences of pregnancy were reported to be lower for treated females compared with controls. All other parameters were reported to be similar between the treatment and control groups. It was concluded that the treatment did not cause a significant change in any of the reproductive parameters measured. (US EPA, 2001; OECD, 2002; CIR, 2006; REACH).

Acute Toxicity	In an acute oral toxicity study conducted similar to the Organisation for Economic Co-operation and Development (OECD) Test Guideline (TG) 401, groups of male Wistar rats were administered (by gavage) the chemical at doses of 0.8, 1.0, 1.1, 1.2, 1.3, 1.5, and 1.8 mL/kg bw and observed twice daily for 14 days. The acute median lethal dose (LD50) was reported to be 1.43 mL/kg bw (1430 mg/kg bw), with a mortality rate of 100 % (10/10) at the highest tested dose. Observed sub-lethal effects included sedation, staggering, weight loss and a rough coat (REACH). In another acute oral toxicity study with limited data, male and female rats were administered the chemical at doses of 1100–1540 mg/kg bw. An LD50 of 1300 mg/kg bw was established (OECD, 2002; REACH). Although limited information is available, the chemical is likely to have low acute dermal toxicity in animal tests following dermal exposure. In an acute dermal toxicity study in rabbits with limited available data, an LD50 of >1250 mg/kg bw was reported (OECD, 2002; HSDB; REACH). Although limited data are available, the available information indicates that the chemical has moderate acute toxicity in animal tests following inhalation exposure and is recommended for classification. In an acute inhalation toxicity study conducted according to OECD TG 436, Wistar rats (male/female) were exposed (nose only) to the vapours of the chemical at 1 and 5 mg/L for four hours and observed up to 14 days. Clinical effects were observed in most animals following exposure at 5 mg/L including lethargy, flat/hunched postures, ventrolateral recumbency, respiratory difficulties and piloerection. Four animals out of six (one male and three females) died following exposure at 5 mg/L. A median lethal concentration (LC50) of <5mg/L was established, based on mortalities at the highest tested dose (REACH). An increased incidence of respiratory symptoms was noted among workers exposed to vapour of the chemical at atmospheric concentrations of >5 mg/m^3 (OECD, 2002).
Irritation	Although limited data are available, the available information indicates that the chemical is not likely to be a skin irritant. In two skin irritation studies (non-guideline) with limited data, the undiluted chemical (500 mg) was applied to the intact or abraded skin of New Zealand White rabbits for 24 hours with observation up to seven days. Although the exact details were not provided, slight skin irritation was observed (EC, 2000). Although limited data are available, the chemical had been reported to be an eye irritant in animal studies. The available information is not sufficient to support a classification. In an eye irritation study (non-guideline), one drop of the undiluted chemical was applied to the conjunctival sac of a rabbit. Observations were made at one, 24 and 48 hours following application. Immediate irritation effects were noted at one hour and within 24 hours, the anterior portion of the cornea was damaged. The cornea was cleared within 48 hours and only erythema of the conjunctiva and nictitating membrane was noted at this stage. Although the rabbit died on the sixth day, the death was not related to the application of the chemical (CIR, 2006; REACH). In another eye irritation study (non-guideline) with limited data, the chemical (100 µL, concentration not stated) was instilled into the eyes of two rabbits and observed for seven days. The chemical was observed to be slightly irritating to the eyes (REACH).

Sensitisation	Although the chemical has produced skin sensitisation reactions in some tests, based on the weight of evidence, the chemical is not likely to be a skin sensitiser. It is also noted that the chemical is rapidly metabolised to benzoic acid in the skin. Clinical reports of allergy to the chemical are rare and benzoic acid has also been reported not to produce sensitisation in clinical trials in humans (CIR, 2006). In a Magnusson-Kligman skin sensitisation test conducted by the US EPA, guinea pigs (10/group) were initially exposed to the chemical intradermally by a 0.1 mL injection of 3 % chemical in paraffin oil followed by topical application to a patch of skin (occluded for 48 hours) of 15 % chemical in petrolatum. The skin was later challenged by a topical application (occluded for 24 hours) of 7 % chemical in petrolatum on a patch of skin. As the chemical failed to induce erythema in either group, the chemical was concluded not to be a skin sensitiser (CIR, 2006). In a skin sensitisation study that compared four testing methods of 32 fragrance materials on Himalayan guinea pigs, the chemical tested positive for allergenicity in the Draize test (DT), the maximisation test (MT) and Freund's complete adjuvant (FCA) test. The guinea pigs were injected intradermally with the chemical at doses of 0.05 mL (0.1 % solution), 0.1 mL (5 % solution) and 0.05 mL (undiluted) for DT, MT and FCA, respectively (EC, 2000; CIR, 2006; REACH). The chemical was reported to be non-sensitising in the open epicutaneous test (OET) for the same study as reported above. The guinea pigs were exposed to the chemical (undiluted, 0.03 , 0.1, 0.3, 1, 3, 10, or 30 %) at a dose of 0.1 mL on an 8 cm2 area of shaved skin on the flank. Applications were repeated once a day for 21 days and the sites were scored for signs of irritation 24 hours following each treatment. The acute minimum irritating concentration was 10 % and after 21 exposures was 3 %. The animals were challenged with 3 % (minimum irritating concentration for day 21) or an unspecified lower concentration on a 2 cm2 area of shaved skin at two weeks post-exposure. The sites were scored at 24, 48 and 72 hours. No sensitisation effects were observed (CIR, 2006; REACH). In a guinea pig skin maximisation test (OECD TG 406), animals were injected intradermally with 2.7 % of the chemical and followed by three epidermal challenges with 2.1, 2.1 and 0.64 % of the chemical. It was noted that only one intradermal induction was performed and no additional topical induction. Also, there were three challenge reactions instead of one. The time between induction and challenge applications was also not stated. No sensitisation effects were observed (REACH).
Health Effects Summary	The critical health effects for risk characterisation include systemic acute effects (acute toxicity from oral and inhalation exposure).
Key Study/Critical Effect for Screening Criteria	The chemical has been reported to possibly cause respiratory failure, depression of the CNS and convulsions at high concentrations (HSDB). A young woman died after ingesting 50–60 ml (700–2000 mg/kg) of the chemical. At autopsy, yellowish-white pulp with a strong odour of bitter almond was found in the stomach. The time between consumption and death was not specified. In another case, a man had to be revived from near death following ingestion of 40 ml of a derivative of the chemical (o-hydroxybenzaldehyde). Based on these two studies, a lethal oral dose of 600–900 mg/kg bw was calculated for the chemical in the absence of prompt treatment (NTP, 1990; EC, 2000; CIR, 2006). In a case study, workers exposed to vapour of the chemical at atmospheric concentrations of >5 mg/m^3 reported an increased incidence of respiratory symptoms (OECD, 2002). In an inhalation toxicity study, human volunteers were exposed to 4.5 ppm (19.5 mg/m^3) of the chemical for one minute. Irritation of the eyes and upper respiratory tract were observed. In an occupational study, workers exposed to the chemical vapour at atmospheric concentrations of >5 mg/m^3 reported symptoms of slight eye irritation and considerable skin irritation (OECD, 2002).

Ecological Toxicity [2,3]	
Aquatic Toxicity	Acute LC50 for freshwater fish is 1.07 mg/L, freshwater invertebrates is 16.2 mg/L and EC10 for freshwater algae is 20 mg/L. Chronic NOEC for freshwater fish is 0.12 mg/L. The overall acute dataset on aquatic organisms yields a lowest LC50 value for fish of 1.07 mg/L and a NOEC of 0.12 mg/L. However, the substance is readily biodegradable and has a low potential for bioaccumulation. Based on the second ATP to CLP the test substance was classified as Chronic category 3 for aquatic toxicity.
Determination of PNEC aquatic	Ecotoxicological data indicate that benzaldehyde is acutely toxic to fish, harmful to daphnia and very slightly toxic to algae. Using an uncertainty factor of 100 on the lowest LC50 to fish a PNEC (Predicted No Effect Concentration) of 10.7 ug/L is calculated, for aquatic organisms.
Current Regulatory Controls [1]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Harmful if swallowed, Xn; R22 (Acute toxicity)
Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica). The chemical has an exposure standard of 5 mg/m^3 time weighted average (TWA) in Bulgaria, Hungary, Latvia and Russia; 10 mg/m^3 in Poland; and 2 ppm in the USA. Short-term exposure limits (STEL) of 4 ppm in the USA and Canada; 10 mg/m^3 in Hungary; and 40 mg/m^3 in Poland have been reported.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is 1.4 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The chronic aquatic toxicity of the chemical is > 0.01 mg/L. Hence the substance does not fulfil the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier II Assessment for Benzaldehyde: Retrieved 2019: https://www.nicnas.gov.au
2. ECHA REACH, Benzaldehyde, Retrieved 2019: https://echa.europa.eu/
3. OECD (2002) SIDS Initial Assessment Profile for Benzaldehyde

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Toxicity Summary - Butyl alcohol

Chemical and Physical Properties[1,2,3]	
CAS number	71-36-3
Molecular formula	C4H10O
Molecular weight	74.12
Solubility in water	77 g/l at 20 °C
Melting point	-89.9 °C
Boiling point	117.6 °C
Vapour pressure	0.56 kPa at 20 °C
Henrys law constant	0.054 Pa m³/mol
Explosive potential	Non-explosive
Flammability potential	Flammable
Colour/Form	Colourless liquid with a mildly alcoholic odour.
Overview	n-Butyl alcohol is used as a solvent in surface coatings. These can include varnishes, resins, waxes and gums. It is also used in the manufacture of other butyl compounds. n-Butyl alcohol is a product of fermentation. It has also been detected in the volatiles of foods such as cheese, muskmelon and cooked rice. People that work in industries where products containing n-butyl alcohol are used will have the highest exposure. These could include varnishing of automobiles, painting shops and fabric coating. Exposure will happen by eating foods containing n-butyl alcohol and breathing in fumes from cooking certain foods. n-Butyl alcohol can be found in surface water and air. It is often found in indoor air of new construction. It breaks down in air by reaction with radicals. It is expected to evaporate from soil and water surfaces. n-Butyl alcohol that remains in soil or water will be broken down by microorganisms. It is not expected to build up in aquatic organisms.
Environmental Fate[1]	
Soil/Water/Air	Based on level III fugacity modelling, BA will partition 83.5% in air, 5.9% in soil, 10.6% in water, <0.1% in suspended solids, and <0.1% in biota and in sediment. BA degrades in air by reaction with hydroxyl radicals, having a half-life in air of 1.2 to 2.3 days. The volatilization half-life for BA in water is estimated to be 2.4 hours for streams, 3.9 hours for rivers and 126 days for lakes.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	A no observed adverse effect level (NOAEL) of 125 mg/kg bw/day and a lowest observed adverse effect level (LOAEL) of 500 mg/kg bw/day in male and female CD rats was reported based on results from a repeat dose oral study using the chemical (OECD 2001). Groups of male and female rats (30/sex/group) were administered the chemical via gavage at 0, 30, 125 or 500 mg/kg/day for 13 weeks. It was reported that ataxia (impaired muscle coordination) and hypoactivity were observed at the highest dose during the final six weeks of the study. No treatment related effects were reported in the 30 and 125 mg/kg/ bw/day dose groups (OECD 2001). In a non-guideline study, the chemical was applied to the skin of rabbits under occlusive conditions over a period of 21 days. Local effects were reported such as drying of the skin, cracking, wrinkling and exfoliation of the epidermis. However, no systemic toxicity was reported (REACH). In another non-guideline repeat dose dermal study on rabbits, 42 to 55 mL/kg of the chemical applied to the skin of rabbits over four consecutive days resulted in 100 % mortality. However, the same study reported that 30 applications of 20 mL/kg of the chemical over six weeks did not produce any deaths (OECD 2001).

Carcinogenicity	OECD (2001) reported that based on the number of negative mutagenicity and clastogenicity findings, the chemical is not expected to be a carcinogen. A weight of evidence study reported that the chemical is not expected to have carcinogenic potential as it does not contain structural components to support carcinogenicity (REACH, HSDB).
Mutagenicity/ Genotoxicity	The chemical is not expected to be genotoxic. The chemical tested negative in a number of tests for genotoxicity. These included several in vitro tests (OECD Guideline 473: mammalian chromosome aberration test on Chinese hamster lung fibroblasts V79; OECD Guideline 471: bacterial reverse mutation assay on S. typhimurium TA 98, TA 100, TA 98, TA 1535 and TA 1537; OECD Guideline 476: mammalian cell gene mutation test on Chinese hamster lung fibroblasts V79) and in vivo tests (OECD Guideline 474: mouse micronucleus) (OECD 2001, REACH).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The chemical is not expected to be toxic to reproduction (OECD 2001). In a non-guideline study, male and female Sprague Dawley (SD) rats were exposed to the chemical via inhalation at 0, 3000 or 6000 ppm for seven hours/day. Female rats were exposed to the chemical throughout gestation, while males were exposed to the chemical for six weeks prior to mating. No harmful effects on fertility or pregnancy rate were reported at any of the dose levels. In another non-guideline study, no testicular toxicity (effect on testes weight or histopathology) was reported in SD male rats that were administered the chemical via oral intubation at 533 mg/kg bw/day over six days (OECD 2001). Any developmental effects were only reported to be observed secondary to maternal toxicity, so the chemical is not expected to be a developmental toxin. OECD (2001) reported that the chemical showed mild foetotoxicity and developmental variations in offspring only at or near the maternally toxic and, in some cases, lethal dose of 8000 ppm. Offspring of female SD rats exposed via inhalation to 0, 3500, 6000 or 8000 ppm of the chemical on gestations days 1 to 19, reported a reduction of foetal weights at 6000 and 8000 ppm and a slight increase in skeletal malformations at 8000 ppm but not at the lower dosage levels. At a maternally toxic dose of 8000 ppm, decreased weight gain, food consumption and dam deaths were reported. The NOAEL for offspring and dams was 3500 ppm as there was a slight decrease in foetal weight at the 6000 ppm dose level. In another 20 day study in male and female SD rats exposed to 0, 3000 or 6000 ppm of the chemical via inhalation, a small number of behavioural and neurochemical variations in offspring at 6000 ppm were reported. No maternal toxicity was reported throughout gestation for females or for six weeks prior to mating for males as a result of maternal or paternal exposure. However, the effects observed in offspring were not regarded as biologically significant by the authors due to inconsistences between dose-response patterns.
Acute Toxicity	The chemical is reported to be slightly acutely toxic via the oral route of exposure. Oral median lethal doses (LD50s) in rats were reported between 790 and 4360 mg/kg bw (OECD 2001). The chemical is reported to have low toxicity via the dermal route of exposure. The lowest LD50 in rabbits was reported to be 3402 mg/kg bw (OECD 2001). The chemical is reported to be of low acute toxicity via the inhalation route of exposure. The median lethal concentration (LC50) in rats was reported to be greater than 5000 ppm (OECD 2001).

Irritation	Based on an inhalation study in mice, it was reported that 1268 ppm (3909 mg/ m³) of the chemical was predicted to be intolerable in humans, 127 ppm (390.9 mg/ m³) would be uncomfortable in humans and 13 ppm (40 mg/ m³) was expected to have no effect on humans (OECD 2001). Moderate irritation was reported in a 24 hour patch test (non-guideline study) where 405 or 500 mg of the chemical was applied to the skin of the rabbits. It was reported that these effects may be due to the chemical's defatting (chemical dissolving of dermal lipids from the skin) and drying characteristics (OECD 2001). Another non-guideline study reported the chemical was a skin irritant in several Vienna white rabbits exposed to 0.5 mL of the chemical for five minutes, one hour or two hours under occlusive conditions. The animals were observed for eight days. The authors concluded that exposure for two hours under occlusive conditions resulted in higher Draize scores and observed superficial necrosis (death of tissue). However, there was no full thickness destruction of the skin (REACH). The chemical was reported to be a severe eye irritant when tested according to OECD Test Guideline (TG) 405 using 0.1 mL of the chemical applied to three New Zealand white rabbits. Severe occular lesions were present at the end of the seven day observation period, indicating severe eye damage and irreversible effects on the eye (REACH). The chemical was reported to be a severe eye irritant in rabbits in non-guideline studies where 1.62 or 20 mg of the chemical was applied into rabbit eyes over a 24 or 72 hour period (OECD 2001). An additional non-guideline study reported severe corneal irritation when 0.005 mL of the chemical was applied into rabbit eyes.
Sensitisation	Based on available repeat dose dermal studies, the chemical is not expected to be a skin sensitiser. OECD (2001) reported that human studies and experience show that the chemical is not likely to be a skin sensitiser.
Health Effects Summary	The critical health effects for risk characterisation include local effects (serious damage to the eyes and respiratory irritation). The chemical also possesses hazardous properties such as skin irritation, harm if ingested and chemical vapours causing drowsiness and dizziness.
Key Study/Critical Effect for Screening Criteria	n-Butyl alcohol was only slightly toxic to experimental animals following acute oral, dermal, or inhalation exposure. The acute oral LD50 values for female rats ranged from 790 to 4360 mg/kg.
Ecological Toxicity [3]	
Aquatic Toxicity	Results on acute aquatic toxicity are available for fish (Pimephales promelas, LC50 (96h) 1376 mg/l), invertebrates (Daphnia magna, EC50 (48h) 1328 mg/L), and algae (Selenastrum capricornutum, EC50 (96h) 225 mg/L). EC10 (17h) as determined for Pseudomonas putida was 2476 mg/L. Furthermore, based on the chronic NOECrepro (21d) of 4.1 mg/L for Daphnia magna butan-1-ol is very likely not harmful to aquatic organisms. Thus, no adverse effects were observed.
Determination of PNEC aquatic	A PNECaqua = 0.082 mg/L can be calculated based on the lowest chronic toxicity value (21 day NOEC = 4.1 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 50.
Current Regulatory Controls[4]	
Australian Hazard Classification	The chemical is classified as hazardous with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) Safe Work Australia: Xn; R22 (Harmful if swallowed) Xi; R37/38-41 (Irritating to respiratory system and skin. Risk of serious damage to eyes) R67 (Vapours may cause drowsiness and dizziness)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 152 mg/m³ (50 ppm) Peak limitation Time Weighted Average (Ceiling TWA).

International Occupational Exposure Standards	The following exposure standards were identified (Galleria Chemica): Ceiling TWA: 150- 152 mg/m³ (50 ppm). India, Indonesia, Japan (OEL), Malaysia and USA [National Institute for Occupational Safety and Health (NIOSH)]. Ceiling TWA: 90 mg/m³ (30 ppm). Canada (British Colombia), Estonia, Russia and Sweden. TWA: 150- 154 mg/m³ (50 ppm). Canada (Yukon), Chile, Denmark, Egypt, Iceland, Poland and Switzerland. TWA: 300- 310 mg/m³ (100 ppm). Germany, Greece, Taiwan and USA [Occupational Safety and Health Administration (OSHA)]. TWA: 45- 75 mg/m³ (15-25 ppm). Canada (Alberta, British Colombia, Saskatchewan), Estonia, Hungary, Ireland, Japan [Workplace Exposure Standards (WES) and Working Environment Evaluation Standards (WEES)], Norway and Sweden.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. n-Butanol is considered readily biodegradable.
B/vB criteria fulfilled?	No. Due to the low log Pow (1.0), accumulation in organisms is not to be expected.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus butyl alcohol does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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1. NICNAS (2017) Human Health Tier II Assessment for 1-Butanol: Retrieved 2019: https://www.nicnas.gov.au
2. OECD (2005) SIDS Initial Assessment Profile on 1-Butanol
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Toxicity Summary - Chlorous acid, sodium salt

Chemical and Physical Properties [1,2,3]	
CAS number	7758-19-2
Molecular formula	ClHO2.Na
Molecular weight	90.4
Solubility in water	571 g/L at 20 °C
Melting point	234 °C
Boiling point	Decomposes > 170 °C. Poor purity of test substance, accurate value cannot be obtained.
Vapour pressure	1.1×10^{-7} Pa at 25°C
Henrys law constant	No data available.
Explosive potential	At normal temperature and pressure, the natural form of chlorine dioxide is unstable, highly reactive (an oxidizing agent) and explosive. It is explosive when its concentration in air exceeds 10% v/v when it is easily detonated by sunlight, heat, contact with mercury or carbon monoxide (O'Neil et al. 2001).
Flammability potential	Non-flammable
Colour/Form	White crystals or crystalline powder, odourless
Overview	The commercial production of sodium chlorite is carried out in two steps: firstly, sodium chlorate is reacted with an acid to generate chlorine dioxide (gas) and secondly, chlorine dioxide is reacted with caustic soda, catalysed by hydrogen peroxide, to form sodium chlorite. The industrial product formed is a solution of 34.5%; the commercial grade is obtained by dilution with water. Chlorine dioxide may also be produced from sodium chlorate. The total amount of sodium chlorite (as 100%) sold on average in the EU Member States (15) for the years 1998-2000 was 11 800 tonnes per year. This includes use as preservatives for liquid cooling and processing systems; food and feed area disinfectants; food or feedstocks; molluscicides; and slimicides and other non-defined biocidal use. The estimated annual total consumption of sodium chlorite in Japan is 4000 tonnes.
Environmental Fate [2]	
Soil/Water/Air	Irradiation of sodium chlorite solutions indicated a photodegradation half-life of about 30 minutes with a steady increase in pH (pH 8 to 12.6) and major products identified as hydroxide, chlorine dioxide and chloride with chlorate and hypochlorite as minor products and trace amounts of chlorine. The radiation dose (9000 j/m^2) needed to produce a 50% reduction in chlorite concentration suggests that the doses (200-250 j/m^2) used for drinking water disinfection would not result in a significant reduction in chlorite concentrations (Cosson and Ernst, 1994; Leitner et al., 1992). It is not considered technically appropriate to perform a ready biodegradation test on sodium chlorite. As ready biodegradation studies measure oxygen consumption or carbon dioxide production, none of these techniques can be used to analyse mineralization of this compound. However, sodium chlorite is expected to be rapidly reduced to sodium chloride in the environment, especially in anaerobic conditions. Due to its extremely low lipophilicity and high instability in water, sodium chlorite and hence chlorine dioxide are not expected to bioaccumulate in fish.

Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	In a study used by the World Health Organization (WHO) to establish a drinking water guideline for chlorite in 1993, rats were administered sodium chlorite at doses of 0, 10, 50, 100, 250 and 500 mg/L (equivalent to 0, 1, 5, 10, 25 and 50 mg/kg bw/day) via drinking water for 30, 60 or 90 days (Heffernan et al. 1979). After 30 days, haematological parameters were depressed indicating slight anaemia at 10 and 25 mg/kg bw/day. These were correcting at 60 days and returned to near normal levels by 90 days. Decreases in erythrocyte glutathione levels were observed at 5 mg/kg bw/day and above, but given the magnitude of variations normally seen in mammals, the toxicological significance of these changes was uncertain. The No Observed Adverse Effect Level (NOAEL) established from this study was 5 mg/kg bw/day. In a 14-day range finding study conducted to OECD TG 407, rats were administered sodium chlorite daily by gavage at doses of 0, 25, 50, 100 or 200 mg/kg bw day (CMA 1992a; Harrington et al. 1995a). At 200 mg/kg bw/day, 3 of 10 animals died. At 100 mg/kg bw/day, changes in haematological parameters were seen and body weight gains were reduced. At 50 mg/kg bw/day, body weights in males were reduced and at both 25 and 50 mg/kg bw/day haematocrits were slightly reduced. A follow-up 90-day study was performed in which rats were administered sodium chlorite daily by gavage at doses of 0, 10, 25 or 80 mg/kg bw day (CMA 1992b; Harrington et al. 1995a). At 80 mg/kg bw/day, four of 30 animals died and surviving animals displayed hypoactivity, piloerection and hunched posture. At 25 mg/kg bw/day, one of 30 animals died. Increased salivation was observed at both doses. Treatment-related haematological changes consisting of reduced erythrocyte counts, reduced associated erythrocyte parameters and morphological changes in erythrocytes were observed at 80 mg/kg bw/day. These were accompanied by increases in absolute and relative spleen weights, histopathological abnormalities in the spleen and evidence of irritation of the gastric mucosa. At 25 mg/kg bw/day, minor clinical signs and occasional histopathological abnormalities in the stomach mucosa were seen. There were no haematological changes considered treatment related at this dose. A NOAEL was established at 10 mg/kg bw/day. Data on repeat dose toxicity were also available from a two-generation reproductive toxicity study in rats conducted to OECD TG 416 (Chlorine Dioxide Panel of the Chemical Manufacturers Association 1996; Gill et al. 2000). This study was used by the WHO to revise an earlier drinking water quality guideline for chlorite and chlorate (WHO 2005). A NOAEL of 35 ppm (approximately 3.9 mg/kg bw/day) was derived based on decreased liver weights in two generations. Repeated dose toxicity studies have also been performed in mice. Mice were treated for 30 days with doses equivalent to 0, 0.19, 1.9 and 19 mg/kg bw/day sodium chlorite in drinking water (Moore and Calabrese 1980). Slight changes in haematological parameters suggestive of effects on erythrocyte cell membranes were seen at 19 mg/kg bw/day. A NOAEL of 1.9 mg/kg bw day was established. Similarly, in more limited studies, mice were administered sodium chlorite in drinking water at doses up to approximately 17 mg/kg bw/day for 30, 90 or 180 days. No effects on water consumption, body weight gain, kidney weights or kidney histology were seen (Connor et al. 1985). Also, no dose-related immunomodulatory effects were seen in a study of immunotoxicity in mice receiving sodium chlorite in drinking water at levels up to 30 mg/L for 28 days (Karrow et al. 2001). In conclusion, several rodent studies of 30 to 90 days' duration have reported haemotoxicity from repeated doses of sodium chlorite. A guideline 90-day repeated dose toxicity study in rats reported reduced erythrocyte counts, reduced associated erythrocyte parameters and morphological changes in erythrocytes at 80 mg/kg bw/day. At lower doses, minor clinical signs and occasional histopathological abnormalities in the stomach mucosa were seen. A NOAEL for repeated dose oral toxicity was established from this 90-day study at 10 mg/kg bw/day.

Carcinogenicity	A limited number of carcinogenicity studies indicated that sodium chlorite is not carcinogenic in laboratory animals. In an oral carcinogenicity study conducted similarly to OECD TG 451, groups of 50 male and 50 female rats were exposed to sodium chlorite in drinking water at concentrations of 0, 300 or 600 mg/L (estimated to be 0, 18 or 32 mg/kg bw/day for males and 0, 28 or 41 mg/kg bw/day for females) for 85 weeks. The original study envisaged an exposure period of 104 weeks, but was stopped at 85 weeks due to infections in all groups. At this time there were no significant changes in organ weights and haematological or clinical chemistry findings between groups. Tumours developed in the testis, uterus, pituitary gland, thyroid gland (males) and adrenal gland (males) of both treated and control rats. However, the incidences of tumours and non-neoplastic lesions in the three groups were not significantly different. There were no findings suggestive of a carcinogenic effect of sodium chlorite (Shimoyama et al., 1985). In another oral carcinogenicity study conducted similarly to OECD TG 451, groups of 50 male and 50 female B6C3F1 mice were exposed to sodium chlorite in drinking water at concentrations of 0, 250 or 500 mg/L (estimated to be 0, 36 and 71 mg/kg bw/day) for 85 weeks (Yokose et al., 1987). After 85 weeks, surviving animals were euthanised and histopathological examinations were performed. Although tumours developed in a variety of organs in all animals including controls, the only significant change was an increase in lung adenomas in highest dose males: 5/43 (12 %) in this group, compared with 0/35 (0 %) in the control group. Based on an absence of dose-related increases in the incidence of lung adenomas and the lack of increased incidence of lung adenocarcinomas, the authors concluded that sodium chlorite had no carcinogenic potential.
Mutagenicity/ Genotoxicity	Sodium chlorite is not mutagenic or genotoxic. In vitro genotoxicity test results for sodium chlorite are not available. In the three in vivo tests that looked at chromosomal damage or sperm head abnormality, sodium chlorite gave negative results for genotoxicity (Meier et al., 1985). In vitro tests using chlorine dioxide have been reported in the literature. Chlorite (and chlorate) ions are produced following dissolution of chlorine dioxide in aqueous media. Therefore, in vitro test results for chlorine dioxide are regarded as relevant to sodium chlorite. Two of the three in vitro tests, the mouse lymphoma forward mutation assay and in vitro transformation of BALB/3T3 cells, were negative for chlorine dioxide, whereas the chromosome aberration frequencies test in Chinese hamster ovary cells was positive (Scopas, 1986a, Scopas, 1986b and Scopas, 1986c). Across all available studies, data suggest that sodium chlorite (and chlorine dioxide) has low genotoxic potential.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on a series of studies of fertility and sperm parameters in rats, sodium chlorite is not considered to be toxic to the reproductive system. Studies in rats and rabbits did not show any effect of sodium chlorite on development. In a rabbit study conducted according to US EPA guidelines, sodium chlorite was administered via drinking water to groups of 16 pregnant New Zealand White rabbits at concentrations of 0, 200, 600 or 1200 mg/L during gestation days (GD) 7–19 (Harrington et al., 1995b). At 600 and 1200 mg/L, dose-related reductions in water consumption (due to palatability problems), food consumption and body weight gain were observed. No treatment-related abnormalities were observed at maternal necropsy. Overall, data indicate that sodium chlorite does not cause developmental toxicity at doses below those associated with maternal toxicity. In a two-generation reproduction study in rats conducted according to OECD TG 416 (Gill et al. 2000), groups of 30 male and 30 female Sprague-Dawley rats were administered sodium chlorite via drinking water at doses of 0, 35, 70 or 300 ppm (approximately 0, 4, 7.6 or 28.2 mg/kg bw/day for males and 0, 3.9, 8 and 38.7 mg/kg bw/day for females) (Chlorine Dioxide Panel of the Chemical Manufacturers Association 1996; Gill et al. 2000). Dosing was conducted in the parental F0 generation commencing 10 weeks prior to mating, until weaning of the F2 generation. Males were exposed through mating and then sacrificed. Females were exposed through mating, pregnancy and lactation and were sacrificed following weaning of litters. F1 pups were continued on the same treatment regime as the parents. At 14 weeks they were mated to produce the F2 generation. Reductions in food and water consumption and body weight gain were observed for all generations, attributed to unpalatability of the formulated drinking water. At 35 and 70 ppm, minor reductions in several haematological parameters were observed in F1 female pups. These appeared within the range of historical control data and were not regarded as toxicologically significant. At 70 ppm, a reduction in liver weight was also observed in F0 females and F1 males and females. A slight decrease in the maximum response to auditory startle stimulus was also observed in F2 pups. At 300 ppm, reductions in haematological parameters were seen in F1 male and female pups and adults. Reduced liver weights were seen in F0 adult males, F1 adult males and females and F1 pups. Reduced thymus and spleen weights were also seen in both generations. A slight decrease in absolute brain weight was seen in F1 male pups at post-natal day (PND) 11 but not at PND 25. In F2 pups at this dose, there was a slightly lowered incidence of normal righting reflexes and a slight decrease in the maximum response to auditory startle stimulus. Reduced pup body weight at birth and during lactation in F1 and F2 generations were also observed. Delays in preputial separation and vaginal openings were reported for F1 pups. Despite systemic toxicity, the authors reported no treatment-related changes to oestrous cyclicity, sperm motility, sperm morphology, or mating, fertility or gestational indices. Also, there were no treatment-related changes in number of pups born, sex ratios, live birth index or pup survival indices. There were no treatment-related changes in serum T3 or T4 in F1 pups or F1 adults. On the basis of historical data, delays in preputial separation and vaginal openings reported for F1 pups were attributed to reduced body weight rather than a direct treatment-related effect. Similarly, slight decreases in brain weight in male pups were consistent with decreased body weight. The toxicological significance of decreases in auditory startle stimulus response at 70 and 300 ppm was unclear. The magnitude of responses was small compared to known neuroactive chemicals, dose response to the stimulus was weak, there was a lack of corroborative evidence from neuropathology or other test of motor function or arousal, and the decreases in response were not replicated upon later examination of the same animals at PND 60 (Gill et al. 2000). A NOAEL of 35 ppm (approximately 3.9 mg/kg bw/day) with a LOAEL at 70 ppm (approximately 7.6 mg/kg bw/day) were derived based on decreased liver weights.

Acute Toxicity	Sodium chlorite has moderate acute oral toxicity. An acute oral toxicity study in rats, similar to OECD Test Guideline TG 401, derived a lethal median dose (LD50) of 284 mg/kg bw for sodium chlorite. At doses of 250 mg/kg bw and above, the main clinical signs were prostration and cyanosis (Atochem, 1984). Sodium chlorite has high acute dermal toxicity. In a dermal toxicity study in rabbits, conducted according to US EPA test guidelines, various doses of an aqueous slurry (80 %) of sodium chlorite were administered under semi-occlusive dressings to over 10 % of the body surface area for 24 hours. Animals were observed for clinical signs immediately after dosing, at one and four hours and then once daily for 14 days following exposure. Slight depression and dose-related dermal irritation consisting of skin thickening, epidermal scaling, necrosis and sloughing were noted in all animals. The study reported a dermal LD50 of 134 mg/kg bw (Degussa Corporation, 1984).
Irritation	Sodium chlorite is a severe skin irritant. Necrosis was observed in rabbits in the skin irritation studies. In one skin irritation study conducted according to US EPA test guidelines, 0.5 g sodium chlorite powder (80 % pure) was applied to three male and three female New Zealand White rabbits under occlusive conditions for four hours. Dermal responses were assessed at 30–60 minutes on day one, and once daily for 21 days after application. Irritation consisted of erythema (grades 1–3) in all sites at 30–60 minutes and 24 hours after dosing, persisting through day seven at two sites. Oedema (grade one) was observed at one site at 30–60 minutes and at two sites at 48 hours. Other dermal effects included blanching, thickening, necrosis, sloughing, and blackened areas (REACH, 2014). In another study in rabbits, edema cutis and subcutis were observed immediately after patch removal followed by formation of eschar within 24–48h. Dose and other details of the test were not provided (REACH, 2014) A 34.5 % solution of sodium chlorite, applied to rabbit skin for four hours under semi-occlusive conditions, did not elicit any irritation effects. Only one of three animals displayed slight erythema and dryness of the skin (Elf Atochem SA, 1994). In the only eye irritation study available and conducted according to US EPA test guidelines, sodium chlorite was found to be a severe eye irritant. A 31.5 % sodium chlorite solution was applied to the eyes of rabbits. Six of the nine rabbits showed corneal opacity that did not reverse by rinsing the eyes 30 seconds after instillation. All animals showed iris damage and exhibited moderate to severe redness and chemosis which was also not abolished by rinsing. Superficial corneal vascularisation and transient cases of haemorrhaging and adhesion of conjunctivae to cornea were also seen (Atochem, 1985).
Sensitisation	Sodium chlorite is not considered to be a skin sensitiser. A guinea pig maximisation test conducted according to OECD TG 406 reported no clinical signs and no cutaneous reactions upon a challenge application of 1 % sodium chlorite in normal saline. Sodium chlorite was concluded not to be a skin sensitiser (CEFIC sodium chlorite sector group, 2002).
Health Effects Summary	The critical health effects for risk characterisation include acute effects from oral and dermal exposure, and severe skin and eye irritation and repeated dose toxicity from oral exposure.
Key Study/Critical Effect for Screening Criteria	A guideline two-generation reproductive toxicity study in rats also reported haemotoxicity, as well as hepatotoxicity and slight neurobehavioural changes at doses below those associated with no effects in repeated dose studies. The study reported no effects on fertility or development. Accordingly, a NOAEL for hepatotoxicity was established from this 2- generation study at 3.9 mg/kg bw/day. The LOAEL was approximately 7.6 mg/kg bw/day. This NOAEL is used for this human health risk assessment.
Ecological Toxicity [2]	

Aquatic Toxicity	Sodium chlorite, in general, shows low acute toxicity to fish with LC50 values above 100 mg/l for zebrafish, sheepshead minnow and rainbow trout and slightly lower for bluegill sunfish. Due to extremely low lipophilicity and high instability in water, sodium chlorite is not expected to bioaccumulate in fish. Sodium chlorite is more toxic to invertebrates with high toxicity to Daphnia magna (sodium chlorite, LC50 48-hour = 0.063 mg/l) and the crustacean, Mysidopsis bahia (sodium chlorite LC50 96-hour = 0.65 mg/l). However, the mollusc, Crassostrea virginica was much less sensitive (sodium chlorite 96 hours NOEC was 70.6 mg/l and the EC50 (shell growth) was 129 mg/l). The green algae were more sensitive to sodium chlorite than fish or oyster and toxicity increased with time (ECr50 value at 72 hours was recorded as 1.2 mg/l).
Determination of PNEC aquatic	Using an uncertainty factor of 100 on the lowest LC50 to Daphnia a PNEC (Predicted No Effect Concentration) of 0.63 ug/L is calculated, for aquatic organisms.
Current Regulatory Controls[1]	
Australian Hazard Classification	The chemical is not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).
Australian Occupational Exposure Standards	There is no specific exposure standard for sodium chlorite. However, the permissible exposure limits for dusts apply: · Time Weighted Average (TWA): 10 mg/m^3 measured as inspirable dust.
International Occupational Exposure Standards	There are no specific exposure standards for sodium chlorite. However, the following exposure standards for particulates are identified (Galleria Chemica 2013). TWA: · 10 mg/m^3 [Canada, Ireland, Spain] · 5 mg/m^3 [US] · 1 mg/m^3 [Latvia].
Australian Food Standards	Sodium chlorite has the following listings in the Australia New Zealand Food Standards Code – Standard 1.3.3 Processing Aids (Food Standards Australia and New Zealand 2013): · As a permitted bleaching agent, washing and peeling agent (maximum level 1 mg/kg available chlorine) · As a permitted processing aid with miscellaneous functions (anti-microbial agent for meat, fish, fruit and vegetables; maximum level is the limit of determination for chlorite, chlorate, chlorous acid and chlorine dioxide).
Australian Drinking Water Guidelines	The National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines lists chlorite under microbial, chemical and physical characteristics as a by-product of chlorine dioxide disinfection. The guideline value for chlorite based on health considerations is 0.8 mg/L (NHMRC 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. Not expected to be persistent due to its instability.
B/vB criteria fulfilled?	No. There is no concern for potential bioaccumulation from chlorine chlorite.
T criteria fulfilled?	Yes. Acutely toxic to aquatic invertebrates.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - Cinnamaldehyde

Chemical and Physical Properties [1,2,3,4]	
CAS number	104-55-2
Molecular formula	C9H8O
Molecular weight	132.16
Solubility in water	2.11 g/L at 22 °C
Melting point	-18 °C
Boiling point	250°C
Vapour pressure	3.85 Pa at 25 °C
Henrys law constant	0.162 Pa.m³.mol-1 at 25 °C
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Yellowish oily liquid with strong odour of cinnamon
Overview	Cinnamaldehyde is a plant natural product that is present in some essential oils extracted from plants. For large scale applications such as in the flavouring and fragrance industries, this chemical is synthesised.
Environmental Fate [1,3]	
Soil/Water/Air	Cinnamaldehyde is expected to remain in soil, or partition to water and sediment, when released as a result of industrial uses. It is not expected to be persistent in the environment and is expected to undergo rapid and ultimate biodegradation in water. Cinnamaldehyde is not expected to bioaccumulate in aquatic organisms. No evidence has been identified to indicate that Cinnamaldehyde biomagnify through the aquatic food chain. The atmospheric oxidation half-life of cinnamaldehyde was estimated using the level III multimedia model. It was estimated that the substance is not persistent in air medium as the half-life period of cinnamaldehyde in air is only 0.31 days. This indicates that cinnamaldehyde is rapidly phototransformed in air. The Hydrolysis rate constant of Cinnamaldehyde is estimated to be 3.36 x 10-17 cm3/molecule-sec. at half-life of 3.411 days indicating that the substance is slowly hydrolysable.
Human Health Toxicity Summary [2,4]	
Chronic Repeated Dose Toxicity	Cinnamaldehyde is 'generally regarded as safe' for use as a flavour ingredient by the US Food and Drug Administration (US FDA, 2015), reflecting the low level of concern regarding its potential for long-term toxicity via the oral route. Considering the no observed adverse effect levels (NOAELs) of 68–200 mg/kg bw/day, based on 17-week to 2-year rat studies (read across), and no toxicologically significant treatment-related effects reported in various studies, repeated oral exposure to the chemical is not considered to cause serious damage to health. Based on the limited data available, the chemical is not considered to cause serious damage to health by repeated dermal exposure.
Carcinogenicity	Based on the limited data available for cinnamaldehyde and trans-cinnamaldehyde (CAS No. 14371-10-9), the chemical is not expected to have carcinogenic potential. In a two-year carcinogenicity study, groups of F344/N rats and B6C3F1 mice (50 animals/sex/dose) were fed microencapsulated trans-cinnamaldehyde (CAS No. 14371-10-9) by daily gavage at doses of 0, 1000, 2100 or 4100 ppm (equivalent to 0, 50, 100 or 200 mg/kg bw/day). Increased incidences of preputial and prostate gland adenomas and mononuclear cell leukaemia were considered to be within the historical range in controls, or likely to represent biological variations unrelated to exposure to the chemical. No other treatment-related neoplasms or non-neoplastic lesions were reported in either species (Adams et al., 2004; NTP, 2004; REACH; US HPVIS, 2009).

Mutagenicity/ Genotoxicity	The chemical cinnamaldehyde contains an a,b-unsaturated aldehyde group, a common structural alert for genotoxicity due to the ability of the chemical to form DNA adducts. However, based on the available data, the chemical is not considered to be genotoxic. The chemical cinnamaldehyde and the isomer trans-cinnamaldehyde (CAS No. 14371-10-9) were negative for point mutations in almost all strains of Salmonella typhimurium in the Ames test. A positive result was found only with TA100 strain, and in only two out of eleven tests. Evidence of genotoxic activity was also observed in isolated mammalian cells. However, these results were weakly positive and observed at cytotoxic concentrations. A sex-linked recessive lethal test in Drosophila melanogaster demonstrated that systemically-available chemical (administered via injection) could enter germ cells and induce mutations; however, oral dosing did not produce the same effect. Importantly, the reported activity in in vitro and insect studies did not translate into significant genotoxic activity in mammalian systems in vivo.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The chemical is not expected to have the potential for reproductive or developmental toxicity. Any developmental effects were only observed secondary to maternal toxicity. In a two-generation study in rats (strains not reported), cinnamaldehyde (absolute dose 2 mg—route not specified) was dosed every two days for 223 and 210 days and did not have any effects on body weight gain, reproductive ability, development or viability of offspring (NTP, 2004). Cinnamaldehyde in olive oil was administered to female SD rats via oral gavage at doses of 0, 5, 25 or 250 mg/kg bw/day on gestation days (GD) 7–17. Treatment-related, increased incidence of defective cranial ossification in all dose groups was observed. Renal abnormalities including dilated pelvis and reduced papilla and dilated ureters were observed at low and mid doses, but not at high dose. Offspring at ≥25 mg/kg bw/day had significantly increased instances of reduced ossification of the tympanic bulla. An increase in the incidence of abnormal sternebrae was also reported in the 25 mg/kg bw/day group. However, these effects were not found to be dose-related and may be attributed to a decrease in maternal weight gain that was noted in the mid- and high-dose groups. A LOAEL of 5 mg/kg bw/day for developmental toxicity was reported based on the reduced cranial ossification and kidney variations. A LOAEL of 25 mg/kg bw/day was reported for maternal toxicity based on the reduced weight gain observed in the dams (Adams et al., 2004; NTP, 2004; US HPVIS, 2009; HSDB; REACH). No signs of toxicity were reported in the dams or in the offspring of CD-1 mice after exposure to 1200 mg/kg bw/day during GD 6–13 (cinnamaldehyde) or GD 7–14 (trans-cinnamaldehyde) (NTP, 2004; US HPVIS, 2009; REACH).
Acute Toxicity	Cinnamaldehyde has low acute oral toxicity based on animal studies. The median lethal dose (LD50) in rats is >2000 mg/kg bw. Cinnamaldehyde has moderate acute dermal toxicity based on animal studies, warranting hazard classification. The dermal LD50 in rabbits was in the range of 620–1260 mg/kg bw (Bickers et al., 2005; Cocchiara et al., 2005; FFHBVC, 2005; and US HPVIS, 2009). Albino rabbits (2 animals/dose) were administered a single dose of cinnamaldehyde (0, 0.25, 0.50, 1.0, 2.0 or 4.0 mL/kg bw—equivalent to 0, 263, 525, 1050, 2100 or 4200 mg/kg bw) by application to intact and abraded skin. All animals in the 1.0 mL/kg and higher dose groups died after treatment. The LD50 was reported to be 620 mg/kg bw (Cocchiara et al., 2005; FFHPVC, 2005; US HPVIS, 2009; REACH).
Irritation	Respiratory irritation was assessed in CF-1 female mice by recording their respiratory rate following exposure to nebulised cinnamaldehyde for 1 minute, either through nose-only breathing or via a tracheal cannula. Marked respiratory depression with nose-only inhalation was observed. The ED25 (dose providing a 25 % reduction in respiratory rate) was calculated to be 241 µg/L. No significant effects were observed when inhalation was through the tracheal cannula (Cocchiara et al., 2005). Cinnamaldehyde produced severe irritation in rabbits when applied undiluted, mild irritation in mice and guinea pigs at concentrations of 3–5 %, and was non-irritating to rabbits at 1 % (Bickers et al., 2005). The US EPA considers cinnamaldehyde a strong skin irritant in guinea pigs (no study details provided) (US HPVIS, 2009). Several international agencies have concluded that cinnamaldehyde is an eye irritant (US HPVIS, 2009; REACH), and a number of notifications to the Classification and Labelling Inventory by industry in the European Union have indicated the chemical as irritating to the eyes (ECHA C&L).

Sensitisation	The chemical was considered to be a moderate to strong skin sensitiser based on the positive results in several local lymph node assays (LLNA). The EC3 value (concentration required to provoke a 3-fold increase in lymph node cell proliferative activity compared with controls) was reported to be as low as 0.2 % (SCCS, 2012).
Health Effects Summary	Cinnamaldehyde is a well-recognised and frequently reported consumer contact allergen (SCCNFP, 1999; RIVM, 2009; SCCS, 2012; IFRA, 2013). It is one of eight components of the diagnostic test, the fragrance mix, used by dermatologists to determine if a patient has allergies to common chemicals used in fragrances. It is an established contact allergen in humans according to the Scientific Committee on Consumer Safety (2012), and accounts for 5–36 % of the reactions to the fragrance mix (SCCNFP, 1999). A number of human repeat insult patch tests (HRIPTs) have been undertaken to determine the skin sensitisation potential of cinnamaldehyde in healthy volunteers, as well as groups of subjects suspected of skin allergies to fragrances (SCCNFP, 1999; NTP, 2004; Cocchiara et al., 2005). Although fewer cases of sensitisation were found when the concentration of the chemical was less than 1 %, positive allergic responses have been reported in cases where the administered concentration of cinnamaldehyde was as low as 0.2 % (Cocchiara et al., 2005). Skin irritation effects were generally predominant at concentrations above 3 % cinnamaldehyde, and often impeded the interpretation of results from the patch testing (SCCNFP, 1999; NTP, 2004). Many cases of skin sensitisation have occurred following occupational and consumer exposure to the chemical. Workers in spice manufacturing plants, hairdressing salons and bakeries have reported cases of contact dermatitis that were traced back to cinnamaldehyde. In addition, exposure of consumers to toothpaste, cosmetics and perfumes containing the chemical as a fragrance ingredient have resulted in a number of case studies identifying cinnamaldehyde as an agent responsible for the allergic reactions (see SCCNFP, 1999; NTP, 2004; Cocchiara et al., 2005 for review).
Key Study/Critical Effect for Screening Criteria	The critical health effect for risk characterisation is skin sensitisation. Other observed health effects include systemic acute effects (acute toxicity from dermal exposure) and local effects (eye/skin/respiratory irritation).
Ecological Toxicity [1]	
Aquatic Toxicity	The following data are measured acute toxicity values for cinnamaldehyde: Danio rerio (Zebrafish) EC Directive 92/69/EEC C.1 Acute Toxicity for Fish: 96 h LC50 = 3.1 mg/L; Daphnia magna (Water flea) OECD TG 202: 48 h EC50 = 3.86 mg/L; Pseudokirchneriella subcapitata (Green algae) OECD TG 201: 72 h EC50 = 4.07 mg/L. In the chronic toxicity study, the 72 h NOEC value of 2.0 mg/L was reported for Pseudokirchneriella subcapitata (Green algae) OECD TG 201.
Determination of PNEC aquatic	A PNECaqua = 0.2 mg/L can be calculated based on the chronic toxicity value (72 h NOEC = 2 mg/L) for green algae with the assessment factor of 10.
Current Regulatory Controls[4]	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substances Information System (HSIS) (Safe Work Australia).
Australian Occupational Exposure Standards	No specific exposure standards are available for the chemical.
International Occupational Exposure Standards	The US Temporary Emergency Exposure Limits (TEELs) for cinnamaldehyde are 14, 150 and 670 mg/m^3 (Galleria Chemica).
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.

PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and hydroxide ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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2. NICNAS (2017b) Human Health Tier II assessment for 2-Propenal, 3-phenyl-
3. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
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Toxicity Summary - Citric acid

Chemical and Physical Properties[2,3,5]	
CAS number	77-92-9
Molecular formula	C6-H8-O7
Product name	--
Molecular weight	192.124
Solubility in water	1000000 mg/L
pH	2 to 2.2
Melting point	Decomposition > 175 C
Boiling point	152 to159 C
Vapour pressure	White powder or granules
Henrys law constant	1.7 $x10^{-8}$ mm Hg at 25 deg C
Explosive potential	4.39 x 10^{-09} $Pa.m^3/mol$
Flammability potential	Dust explosion possible if powder or granular form, mixed with air
Colour/Form	Melts and decomposes in fire, a non-hazardous reaction.
Overview	Citric acid is a water soluble organic solid. It is a natural substance that appears as an intermediate in the basic physiological citric acid or Krebs cycle in every eukaryote cell. Citric acid has been produced for many years in high volumes. It has wide dispersive use, being added to processed food and beverages, used in pharmaceutical preparations and in household cleaners as well as in special technical applications. Citric acid is recognised by Food Standards Australia New Zealand (FSANZ) and the WHO JECFA as safe as a multipurpose food additive. No upper limit of concentrations has been established in food products. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[2,5]	
Soil/Water/Air	Citric acid is highly mobile in the environment and is extremely soluble in water. The pKa of citric acid is 2.79, indicating that this compound will exist almost entirely in the anion form in the environment. The compound does not sorb to soil or particles in the water column and is readily and rapidly degraded in surface waters and in soil. (OECD, hsdb)

Human Health Toxicity Summary [1,2,4,5]	
Chronic Repeated Dose Toxicity	A 2-year chronic oral study in rats being given 5% or 3% citric acid in feed (approx. 2 resp. 1.2 g/kg/d) found slightly decreased growth in the higher dosage group but no tissue abnormalities in the major organs. From the lower dosage a NOAEL of 1200 mg/kg/d results. Similarly, NOAELs of 1500 mg/kg/d (rabbit) and of 1400 mg/kg/d (dog) have been determined. In general, citric acid is a strong chelating agent, the dietary uptake of which may interfere with biological availability, absorption and excretion of metals. Further, loss of superficial enamel and erosion of teeth as well as local irritation result from frequent ingestion of citric acid in beverages including natural fruit juices; citric acid fumes were reported to apparently affect the teeth of exposed workers. The average daily intake of citric acid from natural sources in the diet and food additives was estimated at about 40 mg/kg for women, 130 mg/kg for infants and 400 mg/kg for individuals on slimming diets; maximum daily intake is reported to reach levels of 500 mg/kg. No formal ADI (acceptable daily intake) level has been specified for citric acid and its common salts by the Joint FAO/WHO Expert Committee on Food Additives nor by the EC Scientific Committee for Food.
Carcinogenicity	Citric acid has not been classified by the IARC.
Mutagenicity/ Genotoxicity	In several in vitro and in vivo tests citric acid was not mutagenic. The substance was not mutagenic either in bacterial tests with Salmonella typhimurium (Ames test, 2 studies) and Escherichia coli, with and without metabolic activation.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a two-generation 90 days study with male and female rats fed 1.2 % citric acid no adverse effect on reproductive parameters nor any teratogenicity of dietary citric acid was seen. There were no indications of teratogenic or other adverse effects in three shorter term reproductive studies in rats with dietary dosage of either 5% citric acid (approx. 2.5 g/kg/d) previous, during and after mating (NOEL = 2500 mg/kg/d), or 295 mg/kg/d (route unspecified) during days 6–15 of pregnancy
Acute Toxicity	Citric acid has a low acute toxicity by oral application in both rat (LD50 = 3,000–12,000 mg/kg, 3 different values) and mouse (LD50 = 5,400 mg/kg). General effects comprised physiological disturbances (acidosis and calcium deficiency), while “high” doses caused nervous system effects as well as severe damage to the stomach mucosa.
Irritation	Local effects of citric acid to the skin (rabbit) are reported as slightly irritating in two studies and as not irritating in a third study using a 30% aqueous solution. In an acute eye irritation/corrosion test in rabbits according to OECD 405 citric acid was highly irritating.
Sensitisation	The sensitising potential is low.
Key Study/Critical Effect for Screening Criteria	A 2-year chronic oral study in rats being given 5% or 3% citric acid in feed resulted in a NOAEL of 1200 mg/kg/d. Uncertainty factors: 10 (interspecies variability) and 10 (intraspecies variability). Drinking water guideline = 4.7 ppm
Ecological Toxicity [1,5]	
Aquatic Toxicity	The 96-hour LC50 values for citric acid to fish are from 440 to 1,516 mg/L. The acute toxicity 24 hour EC50 value for invertebrates is 85 mg/L. The 7 day toxic limit concentration (TLC) values for algae range from 300 to 640 mg/L. In an 8 day freshwater static test for the algae Scenedesmus quadricauda, the NOEC is 425 mg/L. In freshwater, citric acid appears to be of low toxicity to aquatic acute test standard organisms, fish, daphnia and algae, with consistent LC50/EC50 values of several hundred milligrams per litre.

Determination of PNEC aquatic	$PNEC_{aquatic}$: Experimental results are available for three trophic levels. Acute $E(L)C_{50}$ values are available for fish (440 mg/L), Daphnia (85 mg/L). A TLC value of 300 mg/L was obtained for algae from which no dependable EC50 can be derived. Even though a NOEC was obtained from the algae study, there were no chronic studies conducted on fish or Daphnia. On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 85 mg/L for Daphnia Magna. The $PNEC_{aquatic}$ was calculated to be 0.085 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	
Australian Occupational Exposure Standards	
International Occupational Exposure Standards	
Australian Food Standards	
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
Australian Hazard Classification	
PBT Assessment[1]	
P/vP Criteria fulfilled?	Citric acid is expected to be readily biodegradable and does not persist in the environment
B/vB criteria fulfilled?	Based on the low Log Kow and widespread natural occurrence, citric acid is not expected to have potential for bioaccumulation.
T criteria fulfilled?	Long term data not available (acute data >0.1 mg/L); potentially not toxic.
Overall conclusion	Not a PBT substance (based on screening data).

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3. IPCS Citric Acid, Retrieved 2015: http://www.inchem.org
4. JECFA http://apps.who.int/ipsc/database/evaluations/chemical.aspx?chemID=4785
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Toxicity Summary - Crystalline silica-cristobalite, crystalline silica-quartz

Chemical and Physical Properties[1,3]	
CAS number	Crystalline Silica (Cristobalite) : 14464-46-1 Crystalline Silica (Quartz): 14808-60-7 Diatomacous Earth (Calcined silica): 91053-39-3
Molecular formula	Crystalline Silica (Cristobalite): SiO_2 Crystalline Silica (Quartz): SiO_2 Diatomacous Earth (Calcined silica): SiO_2
Molecular weight	60.09 g/mol
Solubility in water	Insoluble/negligible
pH	-
Melting point	1713◦C (Cristobalite) 1610◦C (Quartz)
Boiling point	2230 ◦C
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	Transparent crystals
Overview	Silica is an off-white granule that occurs naturally in various crystalline and amorphous or other non-crystalline forms. Crystalline silica is characterized by silicon dioxide (SiO2) molecules oriented in fixed, periodic patterns to form stable crystals. The primary crystalline form of silica is quartz. Other crystalline forms of silica include cristobalite, tripoli and tridymite. Particle size is a key determinate of silica toxicity, since toxicity is restricted to particles that are small enough to be deposited into the target regions of the respiratory tract. Uncalcined diatomaceous earth typically contains around 1%crystalline silica. When diatomaceous earth is subjected to pressure or is processed ("calcined") at temperatures above 1000°C some of the amorphous silica is converted to crystalline silica in the form of cristobalite. Calcined diatomaceous earth can contain anywhere from 1% to 75% cristobalite.
Environmental Fate [1,2]	
Soil/Water/Air	Crystalline Silica consists of diatomaceous earth, a naturally occurring material. Its primary component, silica, is found in common materials like quartz, sand and agate. The materials are ubiquitous and unlikely to react chemically with any other substance in the environment.

Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	A number of animal studies have found that cristobalite is more toxic to the lung than quartz, and more tumorigenic (e.g., King et al. 1953; Wagner et al. 1980). However, several other authors concluded that this is not the case (Bolsaitis and Wallace 1996; Guthrie and Heaney 1995). OSHA (2013) has examined evidence on the comparative toxicity of the silica polymorphs (quartz, cristobalite, and tridymite) and found no difference in toxicity effects between cristobalite and quartz. Furthermore, no difference in toxicity between cristobalite and quartz has been observed in epidemiologic studies (NIOSH 2002). There is no information on the repeat dose oral, inhalation or dermal effect of calcined silica. However, since calcined diatomaceous earth contains varying amounts of crystalline silica in the form of cristobalite, and may also contain small amounts of quartz and tridymite, it is expected that any long-term health hazards associated with diatomaceous earth would mainly be due to the effects of crystalline silica. In humans, the most prevalent effect identified from long term exposure in occupational settings is silicosis, a diffused nodular pulmonary fibrosis (US EPA 1996).
Carcinogenicity	IARC (2012) concluded that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources. There is sufficient evidence in experimental animals for the carcinogenicity of quartz and cristobalite. The IARC has also concluded that inhaled crystalline silica in the form of cristobalite or quartz from occupational sources is carcinogenic to humans (Group 1) (IARC 2012).
Mutagenicity/ Genotoxicity	Conflicting results have been reported in genotoxicity studies with crystalline quartz or cristobalite, and a direct genotoxic effect for crystalline silica has not been confirmed or ruled out. Studies on genotoxicity of calcined diatomaceous silica are not available.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available. Most acute toxicity studies for quartz or cristobalite were conducted using intratracheal instillation. Single intratracheal instillation of quartz caused inflammatory effects and formation of discrete silicotic nodules in rats, mice and hamsters (IARC 2012; WHO 2000). Other effects like oxidative stress, cellular proliferation and increases in water, protein, and phospholipid content of rat lungs, apoptosis (programmed cell death) and lung cancer were also noted. In general, exposure to high concentrations of dust may cause coughing and mild, temporary irritation (CCOHS 2001).
Sensitisation	No data available. However, based on the structure and physico-chemical properties, the three forms of crystalline silica or the calcined diatomaceous silica are not expected to cause skin sensitisation.
Health Effects Summary	The substances are not skin or eye irritants but acute inhalation of dust may cause discomfort and stress as well as signs of local irritation to nasal, bronchiolar and ocular mucous membranes. Based on the evaluation of the epidemiological data it is concluded that inhalation exposure to crystalline silica results in lung cancer. This conclusion is also supported by animal studies in which inhalation and intratracheal exposure to crystalline silica resulted in lung tumours. The most common types of lung tumour observed in rats were lung adenocarcinomas.
Key Study/Critical Effect for Screening Criteria	Not applicable.

Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Aquatic toxicity studies performed at saturation concentrations of synthetic amorphous silica showed no acute toxicity to fish, Daphnia, or algae, though some physical effects were observed with loading rates of greater than or equal to 10 g/L (OECD 2004). Any harmful effects to aquatic ecosystems are therefore not ecotoxicological in nature. No chronic toxicity data were identified.
Determination of PNEC aquatic	Not applicable.
Current Regulatory Controls [3]	
Australian Hazard Classification	Quartz and cristobalite are listed in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2014a) as hazardous substances. Calcined silica is not listed in the HSIS.
Australian Occupational Exposure Standards	Time Weighted Average (TWA) occupational exposure standard of 0.1 mg/m³ for quartz and cristobalite are recommended in Australia (Safework Australia 2013). A Short-Term Exposure Limit (STEL) is not recommended for any of the compounds.
International Occupational Exposure Standards	TWA for quartz, cristobalite: Canada: 0.025 mg/m³ France: 0.05 mg/m^3 Japan: 0.03 mg/m³ Sweden: 0.05 mg/m^3 US (ACGIH): 0.025 mg/m^3 US (NIOSH): 0.05 mg/m^3 US (OSHA): 0.1 mg/m^3 US: 0.3, 0.9, 1.5, 500 mg/m^3 Temporary Emergency Exposure Limits (TEEL) (Diatomaceous silica, calcined)
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	The Australian Drinking Water Guidelines state: 'To minimise an undesirable scale build up on surfaces, silica (SiO¬2) within drinking water should not exceed 80 mg/L' (National Health and Medical Research Council (NHMRC) 2001).
Aquatic Toxicity Guidelines	No data found.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
T criteria fulfilled?	No. Long term data not available (acute data >0.1 mg/L).
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment (UNECE 2007; US EPA 2007). Further assessment of the environmental risks from the use of this chemical is not required as identified by DoEE
Revised	April 2018

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3. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

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Toxicity Summary - Diethanolamine

Chemical and Physical Properties [1,2,4]	
CAS number	111-42-2
Molecular formula	C4H11NO2
Molecular weight	105.14
Solubility in water	1,000 g/L @ 20 °C
Melting point	27 °C at 101.3 kPa
Boiling point	269.9 °C at 101.325 kPa
Vapour pressure	0.0028 hPa (25 °C)
Henrys law constant	3.97 x 10-6 Pa*m^3/mol
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Colourless crystals or a white syrupy liquid with a mild ammonical odour.
Overview	2,2'-Iminodiethanol (diethanolamine, DEA) belongs to the ethanolamines group that includes monoethanolamine (MEA), diethanolamine (DEA) and triethanolamine (TEA). Large-scale production of DEA is carried out by the reaction of ethylene oxide and excess ammonia, followed by fractionation of the three ethanolamines (mono-, di- and triethanolamine). Ethanolamines are used widely as intermediates in the production of anionic and non-ionic surfactants, which have become commercially important as detergents, textile and leather chemicals, and emulsifiers. Their uses range from drilling and cutting oils to medicinal soaps and high-quality toiletries. DEA is an important additive of corrosion inhibitors, particularly in coolants for automobile engines. DEA is also employed as an additive in lubricants and in cement/concrete production. Large amounts of DEA are used as such in closed systems for absorptive gas purification to remove weakly acidic components. In the production of detergents, cleaners, fabric softeners and metalworking fluids DEA is used for acid neutralization and to prevent soil deposition. DEA is also used as an intermediate in the production of morpholine, photographic chemicals and polyurethanes. In addition, DEA is used as a building block for agrochemicals.
Environmental Fate[4]	
Soil/Water/Air	The colourless solid DEA is completely miscible with water at ambient temperature and has a negligible vapour pressure of 0.0028 hPa (25 °C). The measured log KOW of -2.18 (25 °C) and the calculated BCF of 3.16 indicate a low potential for bioaccumulation. The Henry's law constant of 3.97 x 10-6 Pa*m^3/mol (uncharged) is considered as an indication for low volatility. The calculated Koc of uncharged DEA is 1 (corrected log Koc = 0). Thus, the potential for adsorption to soil, sediment, and suspended solid may be low. However, binding of the substance to the matrix of soils (and sediments) with high capacities for cation exchange (e.g. clay) cannot be excluded for the charged molecule. The measured pKa value of 8.92 (23 °C) indicates that at environmentally relevant conditions of pH 6 – 8, the molecule will predominantly occur in the charged (cationic) form. At pH values > 9, DEA will predominantly be present as the uncharged species. According to Mackay Level I modelling, uncharged DEA will distribute almost completely into water (99.99 %). DEA is readily biodegradable according to OECD criteria. Potential for anaerobic degradation of DEA was also observed. In the atmosphere, it will be photodegraded by reactions with OH radicals (calculated half-life of the uncharged molecule for a 12-hour day and 1.5E06 OH/cm^3: 2.4 hours = 0.1 day; for a 24-h day and 0.5E06 OH/cm^3: 4.2 hours = 0.2 days). At environmental pH conditions hydrolysis is not expected to be a relevant degradation process due to the absence of hydrolysable groups
Human Health Toxicity Summary [1,2]	

Chronic Repeated Dose Toxicity	In a 90 day oral gavage study conducted similarly to OECD TG 408 in F344 rats, lowest observed adverse effect levels (LOAEL) of 320 and 160 ppm (equivalent to 25 and 14 mg/kg bw/day, respectively) was reported in male and female rats, respectively. These were the lowest doses tested. Mortality was observed in males (2/10 animals) at the highest dose (5000 ppm) before the completion of the study (REACH; OECD, 2008). Signs of toxicity were observed across all dose groups (160 - 2500 ppm), and included tremors, extreme weight loss, abnormal posture and a dose dependent increase in microcytic anaemia. Dose related (≥ 320 ppm in males and ≥ 160 ppm in females) changes in kidney weights were associated with an increase in nephropathy and renal cell necrosis. Dose related (≥ 320 ppm in males and ≥ 630 ppm in females) increase in liver weight was associated with a moderate increase in serum bile acid concentration (REACH; OECD, 2008). Based on treatment-related effects reported with a LOAEL of 32 and 80 mg/kg bw/day in rat and mouse studies, respectively, the chemical is considered to cause serious damage to health from repeated oral exposure. In a 90 day dermal application study conducted similarly to OECD TG 411 in F344 rats, a LOAEL of 32 mg/kg bw/day was reported in male and female rats. Mortality occurred in one male and two female rats administered the highest dose of 500 mg/kg bw/day (REACH; OECD, 2008). Ulceration, inflammation, hyperkeratosis, and acanthosis occurred at all administered doses (32 - 500 mg/kg bw/day). Other signs of toxicity included reductions in body weight gain, anaemia, renal function changes and liver weight increases. Demyelination in the brain, nephropathy and renal tubular necrosis were also observed (REACH; OECD, 2008). In a similar study conducted similarly to OECD TG 411 in B6C3F1 mice, a LOAEL of 80 mg/kg bw/day was reported in male and female mice. Effects on the skin were noted at all doses (80 - 1250 mg/kg bw/day) and consisted of acanthosis at the lower doses and a dose-dependent increase in ulcerations, inflammation and hyperkeratosis at higher dose levels (630 and 1250 mg/kg bw/day in males and females, respectively) (REACH; OECD, 2008). Further signs of toxicity included dose dependent increases in liver and kidney weights. The increase in liver weight was associated with hepatocellular changes consisting of enlarged hepatocytes and, at the higher dose levels, the presence of multinucleated, giant hepatocytes. Liver damage (hepatocellular necrosis) was observed in male mice only (REACH; OECD, 2008). Based on the available data no adverse systemic toxicity was evident. Local effects were observed at a lowest observed adverse effect concentration (LOAEC) of 0.15 mg/L in one study. The available data do not warrant a hazard classification for repeated dose inhalation toxicity. However, a classification for respiratory irritation is warranted. In a 90 day inhalation study conducted according to OECD TG 413 in Wistar rats, a LOAEC of 0.15 mg/L was reported in male and female rats. Local inflammation (focal squamous metaplasia and hyperplasia) was evident in the larynx (0.15 mg/L) and trachea (0.4 mg/L) in a concentration dependent manner (REACH, SIDS, 2008). Marginal increases in liver weight and serum alkaline phosphatase levels occurred at the mid - high doses (0.15 and 0.4 mg/L, respectively), although, no histopathological changes were noted. In females, erosions of the glandular stomach occurred in a dose dependent manner (0.15 mg/L and 0.4 mg/L) (REACH; OECD, 2008). A further study conducted according to OECD TG 413 in male and female Wistar rats using lower doses (0.0015, 0.003 or 0.008 mg/L) showed similar local irritation effects (focal squamous metaplasia) after 90 days of exposure. After 90 days of exposure to the chemical, a group of 10 animals were given three months of recovery. At the end of the recovery period, no treatment related systemic effects were observed, indicating reversibility in the laryngeal epithelium up to the highest dose administered (0.008 mg/L) (REACH, OECD, 2008).

Carcinogenicity	Limited data are available on the carcinogenicity of DEA. A two-year carcinogenicity study was conducted by the United States National Toxicology Program (NTP, 1999). Based on the pattern of occupational and consumer exposure, dermal administration was considered the most appropriate route for the carcinogenicity study in rats and mice. Groups of 50 male F344/N rats were administered dermal doses of 0, 16, 32, or 64 mg/kg bw DEA in ethanol solutions, 5 days per week for 103 weeks. Female rats were administered 0, 8, 16, or 32 mg/kg bw, and male and female B6C3F1 mice were administered 0, 40, 80, or 160 mg/kg bw DEA dermally, 5 days per week for 103 weeks. Mean body weights of treated rats were generally lower than those of the control rats. The only clinical finding attributed to DEA administration was irritation of the skin at the site of application. This effect was dose-related. Exudate, consisting of focal accumulations of serum and cellular debris on the epidermal surface, occurred at significantly increased incidences in 64 mg/kg bw males and in all dosed female groups. In rats, the main histopathological effects were noted in kidneys of female rats with nephropathy, renal tubular epithelial cell necrosis and/or mineralisation, which increased in incidence and/or severity in a dose-dependent manner. The incidence of nephropathy in dosed female groups was significantly greater than that in the vehicle controls; but no such effects were seen in male rats. There was no neoplastic response in the skin or any organ associated with DEA exposure during the two-year study. The incidence of basophilic foci was significantly decreased in all dosed groups of males and females. The incidence of fibroadenoma in mammary glands in female rats occurred with a negative trend, being lower in all dosed groups compared to the historical control range. In mice, mean body weights of treated groups were depressed, more so in female mice than in male mice. The liver was clearly the most affected organ, and female mice were more sensitive than males. Exposure to diethanolamine for two years produced a marked neoplastic response in the liver characterised by significant increases in the incidences and multiplicity of hepatocellular adenomas (males: 31/50, 42/50, 49/50, 45/50 and females: 32/50, 50/50, 48/50, 48/50) and hepatocellular carcinoma (males: 12/50, 17/50, 33/50, 34/50 and females: 5/50, 19/50, 38/50, 42/50) at 0, 40, 80 and 160 mg/kg bw/day, respectively. The microscopic appearance of these liver neoplasms was typical of those usually observed spontaneously in B6C3F1 mice. There was a morphologic continuum from adenoma to carcinoma, with less differentiation and typical trabecular formations in the carcinomas. Increased mortality was noted in female mice and this, along with reduced body weights, was considered to be a consequence of the presence of liver neoplasms. The incidence of hepatoblastomas, uncommon phenotypic variants of hepatocellular carcinoma, was significantly increased in male mice, but not in females. In addition, the incidence of syncytial alteration, a non-neoplastic lesion characterised by the presence of hepatocytes containing multiple (three or more) nuclei, was increased in all groups of dosed mice; this lesion was not present in the controls. Centrilobular cytoplasmic alteration was increased in treated males but was not present in females. There were no neoplasms of the skin in mice. Effects in the kidneys included increased organ weights and increased incidence of tubular epithelial cell necrosis. The incidences of renal tubule adenoma and renal tubule adenoma or carcinoma (combined) occurred with a positive trend in male mice, but renal tubule carcinoma did not follow the same pattern. Detailed evaluation of the renal neoplasms indicated a treatment- and dose-related increase in the incidences of renal tubule adenoma (1/50, 4/50, 6/50 and 6/50) and adenoma or carcinoma (combined) (3/50, 5/50, 6/50 and 8/50 at 0, 40, 80 and 160 mg/kg, respectively). Diethanolamine is eliminated in urine as the parent compound. The data on the mode of action are insufficient to conclude that diethanolamine-induced tumours in mice are relevant for humans and, therefore, based on the available information, diethanolamine is not classified for carcinogenicity.

Mutagenicity/ Genotoxicity	The chemical tested negative in several in vitro (Ames test with and without metabolic activation, reverse mutation assay, cytogenic assay and the mouse lymphoma assay) and in vivo (micronucleus assay and the alkaline elution assay) tests for gene mutation and clastogenicity (NICNAS; OECD, 2008).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No reproductive toxicity studies are available for diethanolamine. Repeated dose studies were conducted in F344/N rats and B6C3F1 mice of both sexes for 13 weeks (10/sex/species/dose) to characterise the effects of oral and dermal exposure (NTP, 1992). No reproductive toxicity in male or female rats was reported following dermal administration of the chemical for 13 weeks. There were no morphological effects on male or female reproductive organs or in sperm parameters (NTP, 1992). It is likely that testicular degeneration in a 90-day drinking water study is a direct toxic effect of diethanolamine. However, no effect on the reproductive organs of the female rats was noted. The NOAEL for reproductive effects in males is 630 ppm (48 mg/kg bw/day). In an inhalation study, conducted according to OECD TG 413, male and female Wistar rats were exposed to the chemical via inhalation (0.015, 0.15 or 0.4 mg/L), five times a week for 90 days. Reproductive effects in males were reported at the highest concentration (0.4 mg/L) and these included testicular atrophy and slight atrophy of the prostate. No changes were observed in female rats (OECD, 2008). The effects of diethanolamine on the male reproductive system are indicative of a potential to impair reproductive capability. However, more detailed reproductive toxicity studies are needed to confirm the potential effects on fertility observed in male rats. The current information is insufficient to classify diethanolamine for reproductive toxicity. Developmental effects were tested following exposure of dams to diethanolamine by oral, dermal and inhalation routes. In almost all the rodent studies, developmental effects were seen only at higher doses, at which maternal effects were also noted. In a dermal study in rabbits, the overall incidence of malformation was similar to the incidence seen in control animals. The current data therefore do not allow for a clear delineation of reproductive and developmental toxicity of diethanolamine in experimental animals. Classification of diethanolamine for reproductive and developmental toxicity is, therefore, not recommended at this stage.

Acute Toxicity	The reported oral median lethal dose (LD50) values in rats ranged from 780 - 3540 mg/kg bw (OECD, 2008). In one study male Sprague Dawley (SD) rats administered a single oral dose of aqueous DEA (100 – 6400 mg/kg bw) resulting in 90 % mortality at the highest dose. Doses greater than 100 mg/kg bw resulted in an increase in liver weight. An increase in the relative kidney weight was observed at doses greater than 1600 mg/kg bw. Clinical chemistry changes were reported for the liver at doses greater than 200 mg/kg bw and for the kidney at greater than 400 mg/kg bw (OECD, 2008). The chemical was of low acute toxicity in animal tests following dermal exposure. The median lethal dose (LD50) in rabbits is greater than 12000 mg/kg bw (IUCLID, 2000). The chemical was of low acute toxicity in animal tests following inhalation exposure. The median lethal concentration (LC50) in rats is 6.4 mg/L. The available data do not warrant hazard classification. Acute inhalation exposure to the chemical for 1.5 – 4 hours at concentrations between 30 – 1476 ppm (0.13 - 6.4 mg/L) caused mortality in 5/8 rats after 105 minutes of exposure to 6.4 mg/L. Exposure to 3.35 mg/L (768 ppm) for up to 4 hours resulted in no mortality. It was reported that the exposure was to vapours or aerosols (most likely at the higher concentration). Observed sub-lethal effects included lethargy, increased breathing, increased blood pressure, congestion in the lung and discolouration in the kidney and thymus (REACH; OECD 2008).
Irritation	The chemical on unabraded rabbit skin produced skin irritation after 1 - 15 minutes and marked irritation after 20 hours. Over 72 hours, erythema increased and oedema decreased (REACH). After 20 hours of exposure the mean Draize scores for erythema and oedema formation were 2 and 1.33, respectively. While the Draize scores for erythema and oedema returned to normal after 8 days, severe desquamation of the skin persisted. The chemical is also reported to cause ulceration, inflammation and hyperkeratosis following repeated exposure. In an eye irritation study in Vienna White rabbits, 0.05 mL of the chemical was instilled into the rabbit's eyes and observed for eight days. The chemical caused signs of severe irritation consisting of superficial corrosion, corneal opacity, conjunctival bleeding, conjunctivitis and oedema (OECD, 2008; REACH). Extensive corrosion was evident at the end of the observation period. In a further study, 0.1 g of the chemical was applied into the conjunctival sac of New Zealand White rabbits. This resulted in strong irritation of the cornea, iris and conjunctiva, which did not completely resolve over seven days of observation (OECD, 2008).
Sensitisation	The chemical was not found to induce dermal sensitisation in the Guinea pig maximization test conducted according to OECD Test Guideline (TG) 406 (OECD, 2008).
Health Effects Summary	The critical health effects for risk characterisation include systemic acute effects (acute toxicity by the oral route of exposure) and local effects (skin, eye and respiratory irritation). The chemical may also cause harmful effects following repeated exposure through oral and dermal routes.
Key Study/Critical Effect for Screening Criteria	The lowest observed adverse effect levels (LOAEL) of 320 and 160 ppm (equivalent to 25 and 14 mg/kg bw/day, respectively) were reported in male and female rats, respectively, based on kidney and liver weights in the drinking water study (US NTP, 1992). In mice, the LOAEL was 630 ppm (104 mg/kg bw/day for males and 142 mg/kg bw/day for females) based on liver weight changes. It is reported that the fatal oral dose of the chemical is 20g in humans (HSDB).
Ecological Toxicity [3,4]	

Aquatic Toxicity	The lowest reliable acute toxicity values for aquatic species were as follows: Pimephales promelas (fish) 96-h LC50 = 1370 mg/l (nominal) Daphnia magna (invertebrates) 48-h EC50 = 55 mg/l (nominal) Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l (nominal) Pseudomonas sp. (microorganisms) 16-h TTC = 16 mg/l (nominal) In a chronic toxicity test on reproduction of the water flea Daphnia magna, the NOEC (21 days) was 0.78 mg/l (nominal, based on analytical verification).
Determination of PNEC aquatic	Using an uncertainty factor of 50 on the lowest NOEC to Daphnia a PNEC (Predicted No Effect Concentration) of 0.02 mg/L is calculated, for aquatic organisms.
Current Regulatory Controls [1]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xn; R22 (Acute toxicity) Xi; R38/41 (Irritation) Xn; R48/22 (Repeated dose toxicity)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 13 mg/m³ (3 ppm) time weighted average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 2 - 15 mg/m³ (0.46 – 3 ppm) in different countries such as USA (Alaska, Hawaii), Canada (Yukon), Norway and Switzerland.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	No. DEA is readily biodegradable according to OECD criteria.
B/vB criteria fulfilled?	No. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16, this chemical does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The chronic aquatic toxicity of the chemical is > 0.01 mg/L. Hence the substance does not fulfil the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - 2,2''-oxydiethanol (Diethylene glycol)

Chemical and Physical Properties[1,2,3,4]	
CAS number	111-46-6
Molecular formula	$C_4H_{10}O_3$
Molecular weight	106.1 g/mol
Solubility in water	Miscible
Melting point	-10°C
Boiling point	245°C
Vapour pressure	It has a low vapour pressure (<0.01 kPa at 25°C).
Henrys law constant	$2.0X10^{-9}$ atm-cu m/mol at 25 °C
Explosive potential	Not explosive
Flammability potential	Combustible
Colour/Form	Odourless, colourless, viscous and hygroscopic liquid with a sharply sweetish taste
Overview	Diethylene glycol (DEG) is produced via a non-catalytic reaction between ethylene oxide and water at high pressure temperature. The resulting crude ethylene glycols (EG) are dried. The water-free glycol mixture is subsequently fractionated by vacuum distillation into mono, di and triethylene glycol. Biodegradation of polyethylene glycols results in chain shortening with concomitant formation of ethylene glycol and diethylene glycol in nature DEG is a widely used chemical in industrial and household applications. It is also used in cosmetics for topical use. DEG is not an approved food additive in Australia. However, DEG is allowable in food in Australia as an impurity in polyethylene glycol (PEG) used as a processing aid or miscellaneous food additive. PEG used for this purpose must contain no more than 0.25% w/w DEG.
Environmental Fate[1,4]	
Soil/Water/Air	EGs emitted to the atmosphere readily undergo hydroxyl radical induced photodegradation, with half-lives ranging from about 2 to 15 hours. Particulate-phase EGs may be physically removed from the atmosphere by wet deposition (SRC, 2003). EGs have limited volatility, decreasing with increasing molecular weight. Level III fugacity modelling and Henry's Law constants ranging from 1.31×10^{-7} to 7.62×10^{-15} atm-m^3/mole indicate that volatilization from water to the atmosphere is limited. EGs are inherently to readily biodegraded in water. Since these substances are resistant to water hydrolysis, abiotic degradative processes in water are not major elimination pathways. Fugacity modelling indicates that EGs have a high affinity for soil as well as water. Low soil/sediment coefficients (Koc = 1 to 10) suggest that these substances are highly mobile in soil, have limited tendency to adsorb onto suspended solids and sediment, and are therefore subject to biodegradative elimination in either soil or water. Overall, the data suggest that EGs do not persist in the environment and that they have limited potential for bioaccumulation.

Human Health Toxicity Summary [1,2,3,4,5]	
Chronic Repeated Dose Toxicity	Two well-conducted studies were identified from which effect levels from long-term oral DEG administration could be derived (OECD, 2004; Health Council of the Netherlands 2007). In these two studies by Gaunt et al. (1976*) using DEG doses in food of 0%-4% (0.3-3.7 g/kg bw/d) for 98 days and 0%-2% (0.05-1.5 g/kg bw/d) for 225 days in Wistar rats (10-15/sex/dose), kidney effects were reported consisting of oxalate crystalluria, increased urine volumes and histopathological evidence of hydropic degeneration and tubular necrosis. For the crystalluria and increased urine volumes, there were inconsistent findings between male and female rats and questionable dose-response relationships. For example, the number of male rats with urinary oxalate crystals was not increased at the highest male dose of 1.2 g/kg bw/d in the 225 day study. In addition, the observed increase in urinary volumes was possibly caused by the osmotic diuretic effect of DEG and the oxalate crystalluria could not be explained in view of oxalic acid being a minor metabolite of DEG in rats. Therefore, the significance of elevated production of oxalate was regarded as unclear (Health Council of the Netherlands, 2007) and was viewed as a biomarker and not an indication of toxicity (OECD, 2004). OECD (2004) identified a LOAEL for kidney effects of 230 mg/kg bw/d from the 225 day study based on increases in urine volume. The NOAEL was 100 mg/kg bw/d. Health Council of the Netherlands (2007) regarded a NOAEL based on renal histopathological findings as more relevant than a NOAEL based on increased urine volumes. From the 98 day study, a LOAEL based on renal hydropic degeneration was established at 1.6 g/kg bw/day with the NOAEL at 300 mg/kg bw/d (Health Council of the Netherlands, 2007).
Carcinogenicity	The International Agency for Research on Cancer (IARC) has not evaluated DEG as a carcinogen. Urinary bladder calculus and tumour responses were recorded in some long-term oral studies in the rat. Bladder tumours were found associated with the formation of oxalate containing bladder stones in a 2-year feeding study by Fitzhugh and Nelson (1946*). On the other hand, Weil et al. (1965*, 1967*) found that DEG did not induce bladder tumours in rats unless a foreign body or lesion was present, such as an oxalate- containing bladder stone or a surgery-induced bladder lesion. These authors concluded that the bladder tumours seen were due to mechanical irritation by oxalate-containing bladder stones rather than the carcinogenic response to DEG. In more recent studies such as Ito et al. (1988*), Masui (1988*) and Hiasa et al. (1990* and 1991*), DEG did not demonstrate any evidence of carcinogenic effects after oral administration. Several studies in mice also showed that DEG is not carcinogenic after dermal application. No information was found in the literature concerning the occurrence of bladder stones in humans after ingestion of DEG. Overall, although some human carcinogenicity information are available, data are insufficient (e.g. lack of a quantitative estimate of DEG exposure and sound methodology) to evaluate the carcinogenic potential of DEG.
Mutagenicity/ Genotoxicity	DEG was shown to be negative in the majority of gene mutation and chromosome aberration studies in vitro. Some indications of chromosomal damage were seen in vivo only at high doses. Taken together, DEG is considered non-genotoxic.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In oral studies, adverse effects on fertility were seen in mice and foetal abnormalities occurred in rats and mice. Inhalation and injection studies in rabbits and hamsters also revealed foetal abnormalities and other adverse effects on the foetus. However, reduced fertility was observed only at high doses of DEG, up to 6.1 g/kg bw/d in mice with maternal toxicity. With regard to developmental toxicity, a significant decrease in mean foetal body weight in mice was seen at 10 g/kg bw/d in the presence of maternal toxicity. In addition, at an oral dose of 6.1 g/kg bw/d in a 2-generation study in mice, craniofacial malformations, including exencephaly and cleft palate, and related mortality were observed in the presence of maternal toxicity. In rats, a decreased foetal body weight with increased skeletal variations was seen at 4.5 g/kg bw/d in the presence of maternal toxicity. Foetal malformations were not observed at dose levels up to 8.9 g/kg bw/d. From these studies, the NOAEL for fertility and developmental effects is established at 3.1 g/kg bw/d with a LOAEL of 6.1 g/kg bw/d based on reductions in litters/pair, live pups/litter and live pup weight
Acute Toxicity	In animals, the acute oral, dermal and inhalational toxicity of DEG are low. Oral toxicity is similar for both rats and mice with LD50 values ranging 13-30 g/kg bw across both species. A single study of dermal toxicity in rabbits derived an LD50 value of 12.5 or 13.3 g/kg bw . Acute inhalational toxicity has also been tested in rats and mice. The 4-hour LC50 in rats was 4600 mg/m^3. In humans, mortality and morbidity are high in cases of inadvertent DEG ingestion, with most deaths occurring within the first 2 weeks post exposure. Neurological impairments observed after exposure include encephalopathy, demyelinating neuropathy, optic neuritis, facial paralysis, cerebral oedema and haemorrhages. Acute anuric renal failure with metabolic acidosis and concomitant severe neurological abnormalities progressing to coma and finally death were also noted during severe intoxications after uptake of DEG in patients with burns. A median lethal oral dose of 1.49 g/kg bw DEG (range 0.25-4.9 g/kg bw) was estimated from large-scale intoxication of Haitian children with a paracetamol syrup contaminated with DEG. However, large overlaps in ranges of lethal and non-lethal doses have been observed for adults and children. Accidents in humans following acute DEG exposure have been recorded. A large number of mass poisonings in humans involving substitution of DEG for more expensive, non-toxic, glycols in medicinal preparations have been documented over the past 70 years. Typical features of acute toxicity include neurological impairment, metabolic acidosis and acute renal failure. Early mortality and morbidity are high, with most deaths occurring within the first two weeks following DEG exposure. Humans appear to be 10 times more susceptible to acute oral toxic effects of DEG compared with experimental animals, with median lethal dose of 1490 mg/kg bw in humans compared with > 15000 mg/kg bw in rats (NICNAS, 2009).
Irritation	Overall, available data indicate that DEG causes no or only minimal skin and eye irritation in laboratory animals. Respiratory depression was reported in mice although the characteristics were reported as not typical of a pure airway irritant (OECD, 2004). No other information on respiratory irritation was available. Similar to experimental animals, DEG causes no or only minimal skin irritation in humans. Data for eye irritation in humans were not available.
Sensitisation	DEG does not cause skin sensitisation in guinea pigs. In humans, there is a single case study reporting skin sensitisation 2-4 weeks after a man had started smoking a brand of cigarettes containing DEG. However, overall, available data indicate that DEG is not a skin sensitiser in humans.
Health Effects Summary	The critical health effects for risk characterisation include systemic acute effects (acute toxicity from oral exposure).

Key Study/Critical Effect for Screening Criteria	The effects of diethylene glycol on the liver and kidneys after prolonged oral exposure are considered as the critical effects. Key study is the oral exposure study in rats carried out by Gaunt *et al.* (1976). the NOAEL for hydropic degeneration is 300 mg/kg bw/day (0.4% diethylene glycol in food) in the male rats (Health Council of the Netherlands, 2007). Uncertainty factors: 10 (interspecicies variability); 10 (intraspecies variability); 10 (sub-chronic to chronic) Oral RfD = 300/1000 = 0.3 mg/kg/day Drinking water guidance value = 1.17 mg/L
Ecological Toxicity [1,4]	
Aquatic Toxicity	Fish acute toxicity (measured as LC50 in mg/L) for DEG ranges from >1000 mg/L to 77900 mg/L. The lowest acute toxicity (LC50) to invertebrates (Daphnia) value was >100 mg/L (48hr LC50) . Algal toxicity has been tested for DEG with an EC50 of >1000 mg/L. Chronic toxicity to fish was also tested which resulted in a 7 day LC50 of 61,000 mg/L and chronic toxicity data on pentaEG are available for algae (NOEC – 100 mg/L)
Determination of PNEC aquatic	On the basis that short term results from three trophic levels and long term results from two trophic levels, an assessment factor of 50 has been applied to the lowest reported NOEC for algae (100 mg/L). The PNEC aquatic is 2.0 mg/L.
Current Regulatory Controls [6]	
Australian Hazard Classification	The chemical is classified as hazardous with the following risk phrase for human health in HSIS (Safe Work Australia): Xn; R22 (Harmful if swallowed)
Australian Occupational Exposure Standards	TWA (time weighted average) = 100 mg/m^3 (Safe Work Australia).
International Occupational Exposure Standards	TWA = 101 mg/m^3 [UK] (HSE, 2013).
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1,4]	
P/vP Criteria fulfilled?	DEG is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low.
T criteria fulfilled?	The acute aquatic toxicity of DEG is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T).
Overall conclusion	Not a PBT substance (based on screening data).
Revised	December 2018

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Toxicity Summary - Boric acid/sodium tetraborate / boronatrocalcite / boron sodium oxide

Chemical and Physical Properties[1,3,5,8]	
CAS number	Boric Acid: 10043-35-3 Sodium Tetraborate: 1330-43-4 Boronatrocalcite: 1319-33-1 Boron sodium oxide: 12008-41-2
Molecular formula	Boric acid: H_3BO_3 Sodium Tetraborate: $Na_2B_4O_7$ Boronatrocalcite: $CaNaH_{12}(BO_3)5.2H_2O$ Boron sodium oxide: $B_8Na_2O_{13}$
Molecular weight	Boric acid: 61.833 g/mol Sodium Tetraborate: 201.220 g/mol Boronatrocalcite: 405.23 g/mol Boron sodium oxide: 340.47
Solubility in water	Boric acid: 49.20 g/l @ 20± 0.5 °C Sodium Tetraborate: 3.1% at 25 °C Boronatrocalcite: no data found Boron sodium oxide: 223.65 g/L @ 20 °C
pH	Boric acid: 6.1 in a 0.1% (wt) solution Sodium Tetraborate: 9.3 at 20 °C (3% solution) Boronatrocalcite: no data found Boron sodium oxide: no data found
Melting point	Boric Acid: 170.9 °C Sodium Tetraborate: 743 °C Boronatrocalcite: no data found Boron sodium oxide: 813 °C
Boiling point	Boric Acid: 300 C Sodium Tetraborate: 1,575 °C (decomposes) Boronatrocalcite: no data found Boron sodium oxide: no data found
Vapour pressure	Boric acid: 9.9×10^{-6} Pa @ 25 °C Sodium Tetraborate: Negligible at 20 °C Boronatrocalcite: no data found Boron sodium oxide: no data found
Henrys law constant	No data found
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	Boric Acid: Colourless, transparent crystals or white granules or powder. Sodium Tetraborate: Colourless, monoclinic crystalline salt; also occurs as a white powder. Boronatrocalcite: Silky white rounded crystalline masses or parallel fibres. Boron sodium oxide: Solid white powder. Odourless.

Overview	Limited toxicity data is available for sodium tetraborate (Borax anhydrous) and boronatrocalcite (Ulexite) as such; this toxicity profile includes data on boron and boric acid. Boric acid and borate salts exist naturally in rocks, soil, plants and water as forms of the naturally occurring element boron. Anhydrous Borax is a free flowing mixture of clear, glass-like particles and white granules formed by the crushing of relatively large masses of fused materials. Borax is a salt of boric acid. Borax occurs naturally in evaporite deposits produced by the repeated evaporation of seasonal lakes and has many applications in chemistry, mining and pharmaceuticals. Ulexite is a sodium-calcium-hydroborate and, like other borates, is a structurally complex mineral. It is composed of hydrogen (3.98 %), sodium (5.67 %), calcium (9.89 %), boron (13.34 %), and oxygen (67.12 %) There is a lack of data available in the literature to directly assess the toxicity of the chemical. The major component of the chemical is a borate ion, which is likely to be associated with human health hazards of the chemical. The other constituents are considered to be of low concern to human health (NICNAS, 2013). As the chemical will readily break down in the stomach pH to boric acid (H_3BO_3) following ingestion, the toxicokinetics and toxicity of the chemical will be driven predominantly by borate ions. Boron is a naturally occurring element that is found in the form of borates in the oceans, sedimentary rocks, coal, shale, and some soils. Boron is widely distributed in nature, with concentrations of about 10 mg/kg in the earth's crust (range 5 mg/kg in basalts to 100 mg/kg in shales) and about 4.5 mg/L in the ocean. Borates are used in glass, ceramics, detergents, wood treatment and insulation fiberglass industries. Boric acid and other borates are also used in a range of consumer products including cosmetic and personal care products and also in detergents. Moreover, borates are essential for all plants – their use as fertilizers increases crop yields (including grapes, potatoes, sugar beets, alfalfa and olives) and quality. Boron occurs in foods as borate and boric acid. Boron has not been established to be an essential nutrient for humans and no specific biochemical function for boron has been identified in higher animals or man. There is some evidence that, in humans, boron intake within the usual dietary range may influence the metabolism and utilisation of other nutrients, particularly calcium, and may have a beneficial effect on bone calcification and maintenance.
Environmental Fate[2,4]	
Soil/Water/Air	All of the chemical in this group will transform into boric acid in the aquatic environment. This simple mononuclear boron compound is highly water soluble and is the predominant form of dissolved boron in surface waters. It is a mobile species in the environment and is to be found in all major environmental compartments.

Human Health Toxicity Summary [2,3,4,8,9]	
Chronic Repeated Dose Toxicity	The haematological system and the testes have been identified as the major targets after oral repeat dose exposure to Boric acid. Studies after repeated dermal or inhalation exposure to boric acid are not available. A NOAEL for effects on testes and the blood system of 17.5 mg boron/kg bw/day can be derived (with a LOAEL of 58.5 mg boron/kg bw/day) from two 2-year studies in rats on boric acid. Results obtained with boric acid can be supported by findings obtained from other borates thus indicating that the boron ion is the toxicologically relevant species
Carcinogenicity	Boric acid is not listed as an IARC carcinogen. In long term feeding studies on boric acid and disodium tetraborate decahydrate in both rats and dogs, no carcinogenic effects were observed.
Mutagenicity/ Genotoxicity	Boric acid is not mutagenic either in vitro or in vivo.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	Results from animal experiments demonstrate that boric acid adversely effects fertility and development. Feeding studies in different animal species (rats, mice and dogs) have consistently demonstrated that the male reproductive system is the principle target in experimental animals, although effects on the female reproductive system have also been reported. Testicular damage ranging from mildly inhibited spermiation to complete atrophy has been demonstrated following oral administration of boric acid. Effects on fertility were observed at lower dose levels compared to dose levels, where signs of general toxicity appeared. Based on data from the two-year feeding studies with boric acid and borax in rats, 17.5 mg boron /kg bw/day (equivalent to 100 mg boric acid/kg bw/day)_was derived as a NOAEL for male and female fertility. Developmental effects have been observed in three species, rats, mice and rabbits. The most sensitive species appears to be rats, in which the effects observed at non maternally toxic doses include a reduction in foetal body weight and minor skeletal variations which, with the exception of short rib XIII, had reversed by 21 days post-natal. The NOAEL for developmental effects is 9.6 mg boron/kg bw/day (55 mg boric acid/kg/day).
Acute Toxicity	Boric acid is of low acute toxicity. LD50 oral rat > 3765 mg/kg bw (659 mg boron/kg/bw); LD50 dermal rabbits > 2000 mg/kg bw/day; 4 hour LC50 inhalation rat ≥ 2.03 mg/L.
Irritation	In rabbits, boric acid caused no/mild skin irritation, induced reversible conjunctival redness and chemosis with minor effects on the iris. In rats and mice, boric acid acts as a sensory irritant. The substance may irritate the eyes, nasal mucous membranes, skin and the respiratory tract, and may cause effects on the gastrointestinal tract, liver and kidneys.
Sensitisation	No borate tested has displayed skin sensitisation in Bheuler studies. No evidence of skin sensitisation has been seen in humans exposed occupationally to sodium borates, or in a human patch test with a 3% aqueous boric acid solution.
Health Effects Summary	Borates are of low acute toxicity and low skin irritation potential. It may cause sensory irritant effects on animals and humans with acute exposure. Borates were shown not to be skin sensitisers, genotoxic or carcinogenic. Repeated exposures to boron as boric acid induced effects on fertility (testes), development and the blood system.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 9.6 mg boron/kg bw/day. This NOAEL was the equivalent of 55 mg boric acid/kg bw/day; 38 mg disodium octaborate anhydrate/kg bw/day and 85 mg borax/kg bw/day), from feeding (dietary intake) studies based on developmental effects. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability); 10 (subacute to chronic). Drinking water guideline for boron: 3.5 ppm

Ecological Toxicity [3,9]	
Aquatic Toxicity	The most sensitive tests report that acute effects on fish are in the range of 10-20 mg-B/L although the quality of these studies was rated low. The lowest daphnid acute value is 133 mg-B/L. Algal and microbial inhibition studies suggest less toxicity: Selenastrum growth was not affected at 93 mg-B/L and activated sludge respiration showed minimal effects at 683 mg/L boric acid (119 mg-B/L). Chronic endpoints for Boric acid were available for Daphnia (6 mg/L) and Fish (2.1 mg/L).
Determination of PNEC aquatic	Canadian Water Quality Guidelines for the Protection of Aquatic Life: Long–term Exposure to Boron is 1.5 mg/L (2009). An assessment factor of 100 has been applied to the lowest reported chronic effect concentration of 2.1 mg/L for Fish. The PNECaquatic is 0.021 mg/L.
Current Regulatory Controls [9]	
Australian Hazard Classification	Boric acid and borax are classified as hazardous for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013) with the following risk phrases: · Toxic to reproduction (Repr.) Cat. 2; R60 (May impair fertility) · Repr. Cat. 2; R61 (May cause harm to the unborn child) Mixtures containing boric acid and borax are classified as hazardous with the following risk phrases based on the concentration (conc) of the chemicals in the mixtures. · Boric acid: Conc ≥5.5%: Toxic (T); R60; R61 · Borax: Conc ≥8.5%: T; R60; R61.
Australian Occupational Exposure Standards	There are no specific exposure standards for boric acid or disodium octaborate anhydrate. However, the permissible exposure limits (as the time weighted average (TWA)) for dusts apply (10 mg/m^3 measured as inspirable dust) (Safe Work Australia 2013b). The exposure standard for borax is 5 mg/m^3 TWA (Safe Work Australia 2013a).
International Occupational Exposure Standards	The following exposure standards were identified (Galleria Chemica 2013): · Boric acid − Canada 2 mg/m^3 TWA, 6 mg/m^3 Short-term exposure limit (STEL) (borate compounds) − Germany 10 mg/m^3 TWA; 1 mg/m^3 STEL − Spain 10 mg/m^3 TWA (insoluble particles) − US 2 mg/m^3 TWA; 6 mg/m^3 STEL (borate compounds), 5 mg/m^3 TWA (particulates, respirable fraction) · Disodium octaborate anhydrate − Canada 10 mg/m^3 TWA, (insoluble particles) − Spain 10 mg/m^3 TWA (particulates, inhalable fraction) − US 5 mg/m^3 TWA (particulates, respirable fraction) · Borax − Canada 1 to 5 mg/m^3 TWA, 6 mg/m^3 STEL (inorganic borate compounds) − Denmark 1 to 2 mg/m^3 TWA − Germany 0.5 mg/m^3 TWA − Spain 5 mg/m^3 TWA − Sweden and UK 2 mg/m^3 TWA − US 2 mg/m^3 TWA (inorganic borate compounds); 5 to 10 mg/m^3 TWA.
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values exist specifically for boric acid, disodium octaborate anhydrate or borax. However, the guidelines note that boron in the environment is likely to be predominantly in the form of boric acid and that based on health considerations, the concentration of boron in drinking water should not exceed 4 mg/L (NHMRC 2011).
Aquatic Toxicity Guidelines	For boron: 90 µg/L (ANZECC 2000 99% Freshwater)
PBT Assessment [9]	
P/vP Criteria fulfilled?	For the purposes of this PBT assessment, the persistent criteria is not considered applicable to this inorganic substance.

B/vB criteria fulfilled?	For the purposes of this PBT assessment, the bioaccumulation criteria is not considered applicable to this inorganic substance.
T criteria fulfilled?	No. The chronic toxicity data is >1 mg/L.
Overall conclusion	Not PBT
Revised	April 2018

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Toxicity Summary - Ethanol

Chemical and Physical Properties[1,2,3]	
CAS number	64-17-5
Molecular formula	C2H6O
Molecular weight	46.07
Solubility in water	1 x 10_3 g/L at 25 °C
Melting point	114.14 °C
Boiling point	78.3 °C
Vapour pressure	57.3 hPa at 20°C
Henrys law constant	0.000252
Explosive potential	Non explosive
Flammability potential	Highly flammable (100%)
Colour/Form	Clear, colourless liquid with a characteristic pleasant odour and burning taste.
Overview	Ethanol, also known as grain alcohol, is a clear, colourless liquid. It has an alcohol odour a burning taste. Ethanol mixes easily with water. Ethanol is present in emissions from plants, fires, volcanoes, animal wastes, insects and natural fermentation of sugars. Ethanol is an important commercial chemical used in alcoholic beverages, which may contain up to 50% ethanol. It is also used as a solvent in cleaners and as a fuel additive. Ethanol is used in the production of other chemicals, pharmaceuticals, perfumes, and cosmetics. It is also used as a fungicide and to regulate plant growth. It is an ingredient in many consumer products, such as cleaners, sprays, inks, mouthwash, perfume and aftershave, and human and veterinary medicines. Ethanol is a food additive.
Environmental Fate[3]	
Soil/Water/Air	Ethanol is stable to hydrolysis but is readily biodegradable (74% after 5 days) and is not likely to bioaccumulate (calculated logBCF=0.5). Ethanol is not persistent in the environment. Fugacity-based modelling shows that ethanol released into the environment will become distributed mainly into air and water. Relative distributions between compartments based on an emission pattern of 1000:100:10 were 57 % in air, 34 % in water, and 9 % in soil. These predictions are supported by the limited data available on prevailing concentrations, which shows that ethanol has been detected in outdoor air and in river water. The total tropospheric half-life of ethanol is estimated to be 10-36 hours, with degradation due to hydroxyl, NOx and SOx radical-mediated photooxidation. As a volatile organic compound in the atmosphere, ethanol is a potential contributor to tropospheric ozone formation under certain conditions, however its photochemical ozone creation potential is considered to be moderate to low (40-45 relative to ethylene as 100).
Human Health Toxicity Summary [1]	

Chronic Repeated Dose Toxicity	Many repeated dose studies of chemical have been conducted in many species, predominantly with the aim of assessing adverse effects associated with the consumption of alcoholic beverages. Consequently, these are mostly conducted through oral exposure and with doses well in excess of those that might be encountered in occupational exposure or consumer products (OECD, 2005), or unintentional public exposures from environmental contamination. Considering the lowest observed adverse effect level (LOAEL) available from a 90-day rat study (3600 mg/kg bw/day), and based on the treatment-related effects reported in various repeated dose toxicity studies, the chemical is not considered to cause serious damage to health from repeated oral exposure, except from exposure to high doses. In a well-conducted repeated dose toxicity study, the chemical was administered (in a liquid diet) to Sprague Dawley (SD) rats at a 1, 2, 3, 4, 5, and 10 % concentration for 90 days. Water consumption in the 10 % group was reduced relative to controls. There were no adverse clinical signs or mortality during the study. Serum liver enzymes were unaffected by treatment and kidney findings were reported to be minimal. A LOAEL was established at 3 % (approximately 3600 mg/kg bw/day), based on dose-related hepatic yellowing, centrilobular steatosis, increased frequency and severity of Mallory bodies (hyaline), and acidophilic degeneration and necrosis. The no observed adverse effect level (NOAEL) was 2 % (approximately 2400 mg/kg bw/day) (OECD, 2005; REACH). In another repeated dose toxicity study conducted in accordance with national test guidelines of USA (EPA OPPTS 870.3100), the chemical was administered in drinking water to Fischer 344 (F344) rats and B6C3F1 mice at a single dose of 5 % concentration for 90 days. Even though male rats showed minor changes in thymus weights, and some slight but inconsistent changes in haematology and clinical chemistry, these effects were not considered adverse. Based on water consumption data, this single dose study established a 5 % nominal NOAEL for male rats (approximately 3250 mg/kg bw/day). Although minor changes in clinical chemistry were also seen in female rats, some female rats (4/10) also exhibited liver nodules (diaphragmatic nodules) and small increases in liver weights. As no NOAEL could be established for female rats, a LOAEL of 4400 mg/kg bw/day was established. For male mice, a LOAEL at 9700 mg/kg bw/day was established, based on increased organ weights (liver, heart, kidney and lung) and decreased sperm counts in the cauda epididymis. Although female mice showed small changes in the length of dioestrus and pro-oestrus, the overall cycle length was unchanged. As biological significance of these changes was unclear, a NOAEL for female mice was established at 5 % (9400 mg/kg bw/day) (OECD, 2005; REACH). As properly conducted studies in animals are not available, there are no valid data on the effects of repeated inhalation exposure to the chemical. However, limited information is presented below to indicate that the chemical is likely to be of low toxicity following repeated inhalation exposure. In a repeated dose toxicity study, SD male rats (10/dose) were exposed to the chemical through inhalation (whole body exposure) continuously at 20 mg/L for three, six, nine, and 26 days. Although initial exposure to the chemical produced a number of transient effects (lethargy, ataxia and intoxication, mild hepatic vacuolisation and changes to clinical chemistry parameters), animals adapted and appeared normal at the end of the study. Induction of metabolic tolerance to the chemical was also indicated as it was noted that the levels of the chemical in the blood of animals exposed for 26 days were much lower than those exposed for shorter periods (REACH). In another repeated dose toxicity study, the chemical was administered through inhalation at 0 or 6300 ppm (1 ppm = 1.92 mg/m^3) to SD rats (10/sex/dose) for six hours/day, five days/week, for four weeks (total of 20 days exposure). Additional groups of animals (five/sex/dose) were also included in the study to determine reversibility of effects for a further four weeks following cessation of treatment. There were no treatment-related clinical signs of toxicity and there were also no gross pathological or histological changes reported of the major organs. Body weights, liver enzyme levels, haematology, and clinical chemistry parameters were otherwise normal (REACH).

Carcinogenicity	The International Agency for Research on Cancer (IARC) has concluded that there is sufficient evidence in humans and experimental animals to establish carcinogenicity of alcohol consumption and ethanol, respectively. It was also concluded that there is sufficient evidence in experimental animals to establish carcinogenicity of acetaldehyde (major metabolite of ethanol). Consequently, IARC has classified that 'alcohol consumption is carcinogenic to humans (Group 1)' and that 'ethanol in alcoholic beverages is carcinogenic to humans (Group 1)'. This conclusion was supported by an analysis of the expanded human dataset that carcinogenic effects appeared independent of the type of alcoholic beverage (IARC, 2010; IARC, 2012). As the use of the chemical in alcoholic beverages is not considered in this report, the above assessment of carcinogenicity of alcohol beverages may not be relevant to occupational exposure to the chemical or from using the chemical in consumer products (OECD, 2005). Furthermore, studies in animals conducted mostly through oral exposure at very high doses, exceeding the 'maximum tolerated dose', may be of little relevance when assessing risks associated with occupational exposure or using consumer products containing the chemical (OECD, 2005). Thus, classification is not considered appropriate.
Mutagenicity/ Genotoxicity	Overall, the data indicate that the chemical has no mutagenic or genotoxic potential (OECD, 2005; REACH). The results from numerous bacterial mutation assays of the chemical have generally been negative. A very weak positive effect of the chemical was found in an Escherichia coli DNA repair test but not in Ames tests with Salmonella typhimurium conducted by the same authors. In separate studies, there have been positive results reported in Ames tests, but only at concentrations of the chemical significantly greater than those specified in test guidelines. The chemical is therefore not considered mutagenic in bacteria.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The chemical does not show specific reproductive or developmental toxicity. Any reproductive and developmental effects were only observed secondary to maternal toxicity. As results of inhalation studies showed no developmental toxicity from chemical exposures even at maternally toxic doses, it can be concluded that deliberate oral consumption of alcoholic beverages is required for any reproductive or developmental toxicity (OECD, 2005).
Acute Toxicity	The chemical has low acute toxicity by oral exposure in animal tests. The median lethal dose (LD50) in rats is >2000 mg/kg bw. Observed sub-lethal effects included central nervous system depression, e.g. inebriation, disturbances of gait, dose-related decreases in responses to painful stimuli, respiratory depression, and coma. Deaths were reported due to cardiorespiratory failure (OECD, 2005; HSDB; REACH). Few studies are available on the dermal toxicity of the chemical. A poorly documented rabbit study reported death in one of four animals following a dose of 20000 mg/kg bw. Although limited data are available, the apparent low dermal toxicity from this study is regarded as consistent with low uptake of ethanol through intact skin. The median lethal dose (LD50) in rats is greater than 2000 mg/kg bw. Observed sub-lethal effects were not reported for the study (OECD, 2005; REACH). The chemical has low acute toxicity by inhalation exposure in animal tests. The lowest reported median lethal concentration (LC50) is 124.7 mg/L/four hours in rats. Observed sub-lethal effects included attempts to escape, reddish-watery eyes, nasal secretions, closing of eyelids, snout wiping, intermittent respiration, loss of pain reflex, abdominal position, and apathy (OECD, 2005; REACH).

Irritation	The chemical is not regarded as irritating to skin. In a skin irritation study conducted in accordance with OECD Test Guideline (TG) 404, the chemical was applied to six New Zealand White rabbits for four hours using exposure chambers. The mean score for erythema was one at 24 hours and remained zero at all other time points (48, 72 hours); the mean score for oedema remained zero at all time points (24, 48, 72 hours). The chemical was concluded not to be irritating to the skin of rabbits. Another skin irritation study in rabbits, where the chemical was applied under occlusion for 24 hours, also showed only very slight skin irritation (OECD, 2005; REACH). The chemical produced irritant effects in several eye irritation studies in rabbits. In an eye irritation study conducted in accordance with US Federal guideline (Fed. Reg. Vol. 38, No. 187, 1973), the chemical (0.1 mL) was applied on the conjuctival sac of one eye of each of three New Zealand White rabbits. Irritation responses were observed at 24, 48 and 72 hours and eight days following application. Mean Draize scores following grading at 24, 48 and 72 hours for three rabbits were 1 for corneal opacity, 0.22 for iritis, 2.45 for conjunctivitis, and 1.89 for chemosis. Mean Draize scores following grading at day eight were 0.67 for corneal opacity, 1.67 for conjunctivitis, and 1.33 for chemosis. While iris lesions were fully reversible by day eight, other eye lesions were not fully reversible at this time. Given the observation period did not extend to 21 days, it is difficult to conclude any findings on the reversibility of the irritation. The average response of 2/3 animals was sufficiently severe in terms of conjunctival effects (>2.5) and chemosis (³2) observed, that classification as an eye irritant is warranted (REACH). In another eye irritation study (OECD TG 405), the chemical (0.1 mL) was applied to the eyes of three rabbits (strain not specified) and observed up to 14 days. Mean Draize scores at 24, 48 and 72 hours were 2.11 for conjunctivitis, 1.33 for chemosis, 0.44 for iritis, and 1.11 for corneal opacity. Although all symptoms subsided by day 14, conjunctivitis was still present at day seven. As positive responses for corneal opacity (mean score >1 for 2/3 animals) and conjunctival redness (mean score >2 for 2/3 animals) were noted in the study, the chemical is considered to be an eye irritant (category 2A) (OECD, 2005; REACH). In an eye irritation study (OECD TG 405), the chemical (0.1 mL) was applied into the lower conjunctival sac of one eye of six New Zealand White rabbits and observed up to 72 hours. Reported average Draize scores at 24, 48 and 72 hours were 2.39 for redness of the conjunctivae, 1.2 for chemosis, 0.28 for iritis, and 1.2 for corneal opacity. As conjuctival redness persisted for 24 hours with a mean score of >2 and corneal opacity was noted with a mean score >1, the chemical is considered to be an eye irritant (category 2A) (OECD, 2005; REACH). In an eye irritation study conducted in accordance with US Federal guideline (Fed. Reg. 28 (119), 5582, 1963), the chemical (0.1 mL) was applied on the lower lid of one eye of six New Zealand White rabbits. The eyes were examined at 24, 48, and 72 hours and at day seven following administration of the chemical. Mean Draize scores following grading at 24, 48 and 72 hours were 1.72 for conjunctivitis, 1.78 for chemosis, 0.83 for iritis, and 1.28 for corneal opacity. While iris lesions were fully reversible at day seven, other eye lesions were not. Mean Draize scores following grading at day seven were 0.83 for conjunctivitis, 0.83 for chemosis, and 1.17 for corneal opacity. As corneal opacity was noted with a mean score >1, the chemical is considered an eye irritant (category 2A). In addition, whilst mean scores for conjunctival redness and chemosis were <2, scores ³2 were noted in four out of six animals (OECD, 2005; REACH).

Sensitisation	The available data indicate that the chemical does not induce skin sensitisation in animals. The chemical, at 75 % concentration, was used as a solvent in a Magnusson and Kligman guinea pig maximisation test of a polyalkalene glycol. Skin reactions were not observed at challenge with the polyalkalene glycol in 75 % ethanol in either the test or negative control animals (OECD, 2005). In a mouse ear swelling test, no increase in ear thickness was observed following a challenge application of the chemical at 95 % (OECD, 2005; REACH). In a mouse local lymph node assay (LLNA) (OECD TG429) the chemical, or diethyl phthalate, were used as vehicles to examine the skin sensitisation potential of four test fragrance materials. The concentration of the chemical in this study varied from 0–100 %. The level of induced T-lymphocyte proliferation was low for the chemical compared with that for fragrance materials known to be mild to moderate skin sensitisers, and comparable with the other negative control vehicle (diethyl phthalate). On the basis of a lack of sensitising potential up to a concentration of 100 %, the test concluded that the chemical is an appropriate vehicle for use in a local lymph node assay (REACH).
Health Effects Summary	While exposure to the chemical through consuming alcoholic beverages is associated with an increased risk of carcinogenicity and reproductive and developmental toxicity, these risks increase in a dose-dependent manner and are not considered relevant at doses relating to occupational exposure and using consumer products containing the substance such as mouthwash. Therefore the critical health effect for risk characterisation from industrial use of the chemical is a local effect: eye irritation.
Key Study/Critical Effect for Screening Criteria	Overall, the most sensitive endpoint for ethanol is repeat dose toxicity. The oral NOAEL was 2,400 mg/kg bw/day. This NOAEL is used in this human health risk assessment.
Ecological Toxicity [2,3]	
Aquatic Toxicity	The aquatic toxicity data in fish, invertebrates, and algae indicate a low order of acute toxicity with LC50/EC50 values greater than 1000 mg/L. The most sensitive species were algae Chlorella vulgaris with a 96hr EC50 of 1000 mg/L and the invertebrate Artemia Salina with a 24hr LC50 of 1833 mg/L. Valid chronic toxicity data are available for two trophic levels. NICNAS (2017) reported a measured chronic endpoint of 7800 mg/L for Daphnia.
Determination of PNEC aquatic	A PNECaqua = 780 mg/L can be calculated based on the chronic toxicity value (NOEC = 7800 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 10.
Current Regulatory Controls [1,4]	
Australian Hazard Classification	The chemical is not classified for health hazards on the Hazardous Substances Information System (HSIS) (Safe Work Australia).
Australian Occupational Exposure Standards	The chemical has an exposure standard of 1880 mg/m³ (1000 ppm) time weighted average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 960–1920 mg/m³ (500-1000 ppm) in countries such as Canada, Denmark, Germany, Sweden, South Africa, Switzerland, United Kingdom, and the United States of America. An exposure limit (STEL) of 1900–1920 mg/m³ (1000 ppm) in countries such as Canada, Sweden, and Switzerland.

Australian Food Standards	Ethanol has the following listings in the Australia New Zealand Food Standards Code (Food Standards Australia and New Zealand 2013): · as a permitted food additive subject to GMP (ethanol) (Standard 1.3.1 Food additives) · as a generally permitted processing aid (ethyl alcohol) (Standard 1.3.3 Processing aids) · as a permitted component of wine (alcohol) (Standard 2.7.3 Fruit wine and vegetable wine) · as subject to a composition limit in brewed soft drinks (no more than 1.15% alcohol/volume) (Standard 2.6.2 Non-alcoholic beverages and brewed soft drinks) · As subject to a composition limit in: − wine and sparkling wine (no less than 45mL ethanol/L and not to contain added ethanol) − fortified wine (no less than 150 mL ethanol/L and no more than 220 mL ethanol/L) − brandy (must contain no less than 250 mL/L of the spirit distilled at a strength of no more than 830 mL ethanol/L at 20°C (Standard 4.5.1 Wine production requirements).
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines (NHMRC 2011).
Aquatic Toxicity Guidelines	1400 µg/L (95% protection level) (ANZECC & ARMCANZ, 2000)
PBT Assessment [2]	
P/vP Criteria fulfilled?	No. Ethanol is readily biodegradable (74% after 5 days).
B/vB criteria fulfilled?	No. Ethanol is not likely to bioaccumulate (calculated logBCF=0.5).
T criteria fulfilled?	No. Chronic aquatic toxicity (NOEC) >1mg/l, thus ethanol does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - Ethylene glycol

Chemical and Physical Properties [1,2]	
CAS number	107-21-1
Molecular formula	C2H6O2
Molecular weight	62.07 g/mol
Solubility in water	Miscible with water.
pH	No data found
Melting point	-12.69 ºC
Boiling point	197.3 ºC
Vapour pressure	0.092 mm/Hg at 25C
Henrys law constant	Low. 6.00X10-8 atm-cu m/mol at 25 deg C
Explosive potential	Not explosive
Flammability potential	Lower flammable limit of 3.2% by volume; Flashpoint of 232 deg F (111 deg C). Not combustible.
Colour/Form	Colourless odourless liquid
Overview	Ethylene glycol is a clear, colourless, syrupy liquid with a sweet taste but no odour. It has low volatility. It is miscible with water and some other solvents, slightly soluble in ether, but practically insoluble in benzene, chlorinated hydrocarbons, petroleum ethers, and oils. As a small molecular weight alcohol, ethylene glycol readily passes through biological membranes and will be effectively absorbed from the gastrointestinal tract and via inhalation exposure. It is rapidly distributed in body water. The chemical has numerous domestic and commercial uses, and is found in cleaning products, cosmetics, hydraulic brake fluids, anti-freeze agents and corrosion inhibitors. Ethylene glycol has been assessed by NICNAS to be of low environmental concern when used in coal seam gas extraction.
Environmental Fate [1,3,5]	
Soil/Water/Air	Ethylene glycol released to the atmosphere will be degraded by reaction with hydroxyl radicals; the half-life for the compound in this reaction has been estimated at between 0.3 and 3.5 days. No hydrolysis of ethylene glycol is expected in surface waters. The compound has little or no capacity to bind to particulates and will be mobile in soil. The low octanol/water partition coefficient and measured bioconcentration factors indicate low capacity for bioaccumulation Ethylene glycol is readily biodegradable in standard tests using sewage sludge. Rapid degradation has been reported in surface waters (less in salt water than in fresh water), groundwater, and soil.

Human Health Toxicity Summary [1,2,3,4,6,7]	
Chronic Repeated Dose Toxicity	Considering the lowest observed adverse effect levels (LOAELs) available from 13–104 week studies (300–3000 mg/kgbw/d) (ATSDR, 2010), and based on the treatment-related effects reported in various repeated dose toxicity studies, the chemical is not considered to cause serious damage to health from repeated oral exposure. However, there is evidence of cumulative effects, as the nephropathy observed at high doses in acute toxicity studies also occurs after repeated exposure at lower doses. The National Toxicology Program (NTP) conducted a 13 week and a two year study in B6C3F1 mice. In the 13 week study, 10 male and 10 female mice were administered 0, 3200, 6300, 12500, 25000 or 50000 ppm ethylene glycol incorporated into feed. There were no reported deaths and no chemical-related clinical findings were reported. Histopathology showed chemical-related kidney and liver lesions, which were significantly elevated in the 25000 and 50000 ppm male mice. These lesions included nephropathy and centrilobular hepatocellular hyaline degeneration (NTP, 1993). The two year study used 60 male mice dosed with the chemical at 0, 6250, 12500 or 25000 ppm and 60 females dosed at 0, 12500, 25000 or 50000 ppm in feed. The doses in ppm were reported as being equivalent to: males - 0, 1500, 3000 or 6000 mg/kg bw/d and females - 0, 3000, 6000 or 12000 mg/kg bw/d. There were no significant differences in survival although male mice in the high dose (6000 mg/kg bw/d) group had to be housed separately after week 54 due to excessive fighting. Survival of mice was not affected by ethylene glycol administration at all doses. As with the 13 week study, mice did not show any adverse clinical signs. Histopathology showed hepatocellular degeneration in the mid and high dose male and high dose female mice. Pulmonary arterial hyperplasia occurred at a higher incidence in female mice than male mice exposed to the chemical. Some male mice in the high dose group had oxalate-like crystals and/or calculi in the renal system (NTP, 1993). Mice appear to be less sensitive than rats to ethylene glycol. A two-year study conducted in Fischer-344 (F344) rats found that administration of the chemical (40, 200 or 1000 mg/kg bw/d) resulted in excessive mortality in male rats in the high dose group after nine months. All male rats in the high dose group (1000 mg/kg bw/d) were reported dead by 15 months of the study. Survival was significantly reduced in male rats in the 1000 mg/kg bw/d group only. (Cruzan et al., 2004; DePass et al., 1986). Pathology investigation of the male rats concluded that extensive kidney damage was the reason for increased mortality in the 1000 mg/kg bw/d group. The NOAEL for male rats was reported as 200 mg/kg bw/d in this study (DePass et al., 1986). A further study indicates that the Wistar rat strain is more sensitive than the F344 strain. In a 16-week study, 10 male rats of each strain were exposed to the chemical (0, 50, 150, 500 or 1000 mg/kg bw/d) by incorporation in a normal diet. Mortality was reported in two Wistar rats at the highest dose and significant weight loss was observed in Wistar rats administered 500 and 1000 mg/kg bw/d, respectively. Both strains of rats treated with ≥ 500 mg/kg bw/d had increased calcium oxalate crystals in the kidney tubules as well as crystal associated nephropathy; this was reported as being more severe in the Wistar rat strain (Cruzan et al., 2004). Further repeated dose studies conducted in rodents have reported no observed adverse effect levels (NOAELs) in the range of 150–2000 mg/kg bw/d depending on species and strain studied. Overall, repeated oral exposure to ethylene glycol is consistently associated with adverse effects on the kidney such as crystal nephropathy in rodents (ATSDR, 2010).

	In a study conducted according to OECD TG 410, five male Beagle dogs per group were dermally exposed (60 % of the total body surface area) to 0.5, 2.0 or 8 mL/kg bw/d Glysantin G 105 (automotive coolant which contains ≥ 92.5 % ethylene glycol and ≥1.4 % p-tert.-butyl benzoate (PTBBA)) daily for four weeks. Mortality (4/5 animals) was reported at the highest dose (8 mL/kg). Prior to death, animals showed signs of toxicity including staggering gait, vomiting, diarrhoea and reduced food intake. Clinical analysis showed increased creatinine and urea levels and increased incidence of calcium oxalate crystals. Pathology investigation reported oxalate nephrosis, testicular atrophy and uraemic gastroenteritis. Similar pathology findings were reported at the mid dose (2 mL/kg), but only in one animal. No mortality or any further clinical or pathological adverse effects were reported at the mid and lower doses. Further studies conducted comparing pure ethylene glycol to Glysantin G105 showed that the testicular atrophy was associated with the presence of PTBBA in Glysantin G105 and not ethylene glycol (REACH). PTBBA has known testicular toxicity (NICNAS). Mortality was reported in 1/15 rats, 3/15 guinea pigs, 1/3 rabbits, 0/3 dogs and 0/3 monkeys after exposure to 12 mg/m3 of ethylene glycol aerosol for 90 days. Apart from mortality, no specific signs of clinical toxicity were reported. In a further study, no mortality or toxicity was observed in the same range of animal species exposed to either 10 or 57 mg/m3 ethylene glycol. The authors noted that as the exposure was whole body, further oral intake from grooming may have occurred, and therefore a reliable LOAEL could not be established (ATSDR, 2010).
Carcinogenicity	Based on the available data, ethylene glycol is not considered to be a carcinogen. Histopathological investigations showed no evidence of carcinogenicity in studies conducted in various rodent species. No tumours were reported in SD rats administered up to 3000 mg/kg bw/day in the diet for two years, F344 rats administered 1000 mg/kg bw/day in the diet for one year, B6C3F1 mice administered up to 12000 mg/kg bw/day in the diet for two years and CD-1 mice administered up to 1000 mg/kg bw/day in the diet for two years (NTP, 2004; WHO, 2002). A limited number of epidemiological studies have reported that exposure to the chemical does not increase the risk of cancer. Ethylene glycol exposure (inhalation) in 1666 chemical plant employees was not found to increase the odds ratio (OR) for any type of cancer (ATSDR, 2010).
Mutagenicity/ Genotoxicity	Based on the weight of evidence from the available in vitro and in vivo genotoxicity studies the chemical is not considered to be genotoxic. An Ames assay conducted according to OECD TG 471 reported that the chemical did not induce bacterial mutations in Salmonella typhimurium strains TA 1535, TA 1537, TA 98, TA 100 and Escherichia coli WP2 at a concentration up to 5000 □g/plate with or without metabolic activation (REACH). Further in vitro genotoxicity tests conducted with bacterial and mammalian cell lines were all negative for gene mutations and DNA strand breaks respectively (ATSDR, 2010). An in vivo study in mice reported no chromosomal aberrations in Swiss mice exposed to 638 mg/kg bw/day for two days (WHO, 2002). Negative results were found for dominant lethal mutations in F344 rats after administration of up to 1000 mg/kg bw/d ethylene glycol in a 155-day multi-generational study.

Reproductive Toxicity Developmental Toxicity/Teratogenicity	The available data from rat studies suggest that developmental effects were only observed secondary to maternal toxicity, so the chemical does not show specific developmental toxicity. The chemical is not toxic to reproduction. Having reviewed the available data the Centre for the Evaluation of Risks to Human Reproduction (CERHR) expert panel concluded that there are sufficient data to conclude that the chemical is not toxic to reproduction in rats orally exposed to 1000 mg/kg bw/day in diet (NTP, 2004). A study in mice gave negative results at doses up to 2826 mg/kg bw/day via drinking water. The expert panel also concluded that exposure of CD-1 mice to the chemical by the dermal route for 6 hours/d on gestation days (GD) 6-15 resulted in no evidence of developmental toxicity up to a dose of 3549 mg/kg bw/d. Developmental toxicity was also not observed in rabbits exposed orally via gavage on GD 6-19 to doses as high as 2000 mg/kg bw/d. Severe maternal toxicity was observed at the high dose with maternal deaths as well as oxalate crystals in the kidney. Data suggested that oral exposure to high doses of the chemical (≥500 mg/kg bw/d in CD-1 mice and ≥1000 mg/kg bw/d in SD rats) on GD 6-15 causes developmental effects in mice and rats such as axial skeletal malformations, external malformations, reduced body weights and increased post-implantation loss (NTP, 2004). The CERHR expert panel concluded that developmental toxicity may not be attributed directly to the chemical but from the accumulation of glycolic acid, which is a metabolic breakdown product of ethylene glycol. The developmental effects are seen at doses that exceed saturation of glycolic acid metabolism. Observations from rat studies suggest that oral doses resulting in developmental toxicity (1000 mg/kg bw/d) are greater than those associated with maternal and renal toxicity at 500 mg/kg bw/d.
Acute Toxicity	Ethylene glycol has low acute toxicity via oral, inhalation, or dermal exposure. LD50s for the oral administration of ethylene glycol in rats range from 4000 to 10 020 mg/kg body weight, while reported values in guinea-pigs and mice are 6610 mg/kg body weight and 5500–8350 mg/kg body weight, respectively. The minimum lethal oral dose in rats is 3.8 g/kg body weight (Clark et al., 1979). Oral LD50s of 5500 and 1650 mg ethylene glycol/kg body weight have also been reported in dogs and cats, respectively. A dermal LD50 of 10 600 mg/kg body weight has been reported for rabbits. In rats and mice, the lethal concentration following 2-h inhalation exposure has been reported to be >200 mg/m3.
Irritation	The available data show that the chemical is a mild skin irritant in animals. Mild dermal irritation was reported in rabbits and guinea pigs. No dermal effects were reported in female CD-1 mice exposed to 3549 mg/kg bw/day ethylene glycol under occlusive conditions for 6 hours/day on gestation days 6-15 (NTP, 2004; WHO, 2002). The available data indicate that the chemical is a mild eye irritant in animals. In a study conducted in six New Zealand White rabbits, 0.05 mL of the chemical (4 or 40 %) applied to one eye (while the other eye served as a control) at 10 minute intervals for a total of 35 applications in a six hour period was reported to cause chemosis, swelling and conjunctival redness. All eyes exposed to the chemical were reported to be normal on day seven of observation and no evidence of systemic toxicity was reported (REACH).
Sensitisation	The chemical was not found to induce dermal sensitisation when tested according to OECD Test Guideline (TG) 406 (REACH).
Health Effects Summary	Ethylene glycol demonstrates acute oral toxicity, is a mild skin and eye irritant and a respiratory irritant in humans. The chemical is not a skin sensitiser. Consistent adverse effects associated with repeated exposure to ethylene glycol in animals are the kidney effects, characterised by calcium oxalate crystal deposition and consequent renal lesions.

Key Study/Critical Effect for Screening Criteria	The key study chosen for the determination of a drinking water guidance value is the one-year rat feeding study by Wilson et al. (2005). No adverse chronic renal effects from ethylene glycol dosing were seen in animals exposed below 150 mg/kg/day. The oral RfD for ethylene glycol is thus based on the NOAEL of 150 mg/kg/day. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability) Oral RfD = 150/100 = 1.5 mg/kg/dayDrinking water guideline value = 0.59 ppm
Ecological Toxicity [3,8]	
Aquatic Toxicity	The aquatic toxicity of the 'ethylene glycol and higher glycols' (mono-, di-, tri-, tetra- and pentaethylene glycol) is evaluated as a category. Fish acute toxicity (measured as LC50 in mg/L) has been tested for all category members and ranges from 22800 for EG to greater than 50000 for pentaEG. Toxicity to Daphnia (measured as LC50 in mg/L) is greater than 20,000 for all category members except tetraEG (LC50=7800 mg/L) indicating low toxicity, but the toxicity was not as uniform as in fish. Toxicity evaluations in another invertebrate, brine shrimp (Artemia salina) were imprecise, but appear to be more consistent than the measured Daphnia toxicity values (no toxicity observed at the highest tested dose, 20g/l for EG, 10 g/l for DEG, TEG and tetraEG). Algal toxicity has been tested for EG, DEG, TEG, and PentaEG, and no toxicity was found at concentrations less than or equal to 100 mg/L. As a worst case assumption the limit test concentration of 100 mg/L was used as NOEC value for the PNEC derivation.
Determination of PNEC aquatic	PNECaquatic: An assessment factor of 10 has been applied to the lowest reported effect concentration of 100 mg/L. The PNECaquatic is determined to be 10 mg/L.
Current Regulatory Controls [7]	
Australian Hazard Classification	Xn (Harmful); R22 (Harmful if swallowed) (Safe Work Australia 2013) Acute Toxicity: Harmful if swallowed – Cat 4 (H302) (NICNAS)
Australian Occupational Exposure Standards	Ethylene glycol has an exposure standard of 10 mg/m^3 time weighted average (TWA). A further exposure standard for ethylene glycol (vapour) is 52 mg/m^3 (20 ppm) TWA and a short-term exposure limit (STEL) of 104 mg/m^3 (40 ppm) (Safe Work Australia 2013)
International Occupational Exposure Standards	TWA: 50 mg/m3 (20 ppm) [Belgium, Hungary, UK, Finland] 26 mg/m³ (10 ppm) [Denmark, Iceland, Sweden] 25 to 50 mg/m³ (63 to 125 ppm) [Mexico, Norway] 5 mg/m³ [Russia] STEL: 20 to 40 mg/m3 (50 to 104 ppm) [Belgium, Hungary, UK, Finland, Peru, Sweden] 10 mg/m³ [Russia]
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment [1,3,5]	
P/vP Criteria fulfilled?	Ethylene glycol is readily biodegradable both aerobically and anaerobically and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on the measured log Kow of -1.36 and a measured BCF of 10, Ethylene glycol is not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of Ethylene glycol is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).
Revised	April 2018

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Toxicity Summary - Fatty acids, tall-oil, ethoxylated

Chemical and Physical Properties[1]	
CAS number	61791-00-2
Molecular formula	C(18-50)H(34-98)O(3-8)
Molecular weight	UVCB
Solubility in water	No data available.
Melting point	-85 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified
Colour/Form	Liquid
Overview	This substance is used by consumers, in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
Environmental Fate[1]	
Soil/Water/Air	One study investigating the adsorption/desorption behaviour of Fatty acids, tall-oil, ethoxylated (CAS 61791-00-2) is available. The study was performed according to GLP and OECD guideline 121 (BASF 2017). 6 different peaks were observed with log Koc values ranging from < 1.8 to > 5.63. The two main components (> 85%) show log Koc values > 4. Thus, adsorption of Fatty acids, tall-oil, ethoxylated to solid soil is expected. The test with the source substance was conducted according to OECD Guideline 301B, under GLP conditions (BASF 2005). Domestic, non-adapted activated sludge was exposed to the test substance for 28 days at 22°C, and biodegradation was measured by CO2 consumption. After 28 days, the test substance reached a biodegradation of 90 - 100 %. Based on the results for the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable. The test substance consists of components with log Kow values in the range of 5 to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological mebranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be bioaccumulative.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats.
Carcinogenicity	No data available.

Mutagenicity/ Genotoxicity	The test substance is not mutagenic in bacteria, as determined in an OECD 471 study. The test substance is not chromosome damaging, as determined in an OECD 487 study. The test substance is not mutagenic in mammalian cells, as determined in an OECD 476 study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of the test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats. The NOAEL for reproductive performance and fertility was set to 1000 mg/kg bw/d for male and female Wistar rats.
Acute Toxicity	In an acute oral toxicity study performed similar to OECD guideline 401 (BASF 1971), three groups of rats consisting of 10 animals/sex/dose were treated by single gavage application with an aqueous solution of the test substance (10000, 8000, 6400 mg/kg bw). The animals were observed for mortality and for clinical symptoms of toxicity over a period of 7 days. At the end of the observation period, the surviving animals were sacrificed for the purpose of necropsy. No mortality occurred at the tested concentrations. At all doses mastication, irregular breathing, redness of the eyes and closed eyes were seen immediately after dosing. The next morning mastication and irregular breathing was observed. On the following days, no clinical sings were observed. Pathological examination revealed hydrometra in 3 animals exposed to 10000 mg/kg bw, 2 animals exposed to 8000 mg/kg bw, and 3 animals exposed to 6400 mg/kg bw. Based on the results obtained under the test conditions of this study, the acute oral LD50 was determined to be > 10000 mg/kg bw. To evaluate the potential acute inhalation toxicity of the test substance an Inhalation Risk Test conducted according to a BASF internal testing method (BASF 1971). The test demonstrates the toxicity of an atmosphere saturated with vapours of the volatile components of a test substance at the temperature chosen for vapour generation (20 °C). Rats were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. The animals were exposed for 8 hour. The exposure concentration was estimated to be 0.28 mg/L based on evaporated substance. In addition to mortality, clinical signs were recorded and necropsy on surviving animals performed. No mortality occurred and no clinical sign were noted during exposure and observation period. In one animal exposed for 8 hours hydrometra was observed after necropsy. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. In another Inhalation Risk Test of similar design, Rats (12 animals) were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. This time vapours were generated at 20 °C as well as 50 °C. The exposure concentrations were 0.04 mg/L and 0.34 mg/L. Rats were exposed for 8 hour. As in the previous study, no mortality occurred after exposure up to 8 hours. Clinical sings observed in the animals exposed to the vapour generated at 20°C included mild escape attempts when exposure began and at the end of the exposure period slight eye irritation was observed. The next day, the animals were without symptoms. In the animals exposed to the vapour generated at 50 °C escape attempts were noted in the first 60 minutes of exposure. Exposure to the saturated atmosphere caused slight eye irritation. At the end of the exposure period, all clinical signs were resolved. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. Based on the inhalation studies, no conclusion on LC50 can be drawn, because the tested concentrations are too low in relation to the classification criteria.

Irritation	The test substance was not irritant or corrosive to the skin in a GLP-compliant OECD 431 and 439 study. The test substance was not irritant to the eyes in a GLP-compliant OECD 492 study. Based on the available information, classification for skin and eye irritation is not warranted, in accordance with EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation No. (EC) 1272/2008.
Sensitisation	The test substance did not show an indication of skin sensitising potential in an OECD 429 (LLNA) study. However, an earlier Buehler test (OECD 406) did indicate skin sensitising potential of the substance.
Health Effects Summary	Possible sensitiser.
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [1]	
Aquatic Toxicity	Short-term toxicity tests with the target substance for all trophic levels (fish, daphnia, algae) are available. The test substance did not indicate to be harmful to freshwater fish (96h-LL50 > 100 mg/L), but showed to be toxic to aquatic invertebrates (48h-EL50 = 12.41 mg/L) and harmful to algae (72h-EL50 = 39.7 mg/L). Hence, aquatic invertebrates were most susceptible to the test substance and this effect value was used for the PNEC derivation. Long-term toxicity data with the source substance are only available for algae. The algal test revealed the substance to be of low toxicity to algae (72h-EL10 = 7.08 mg/L). In addition, data are available for toxicity to microorganisms. A test on respiration inhibition with activated sludge resulted in an 3h-EC10 of > 10000 mg/L indicating that detrimental effects in STPs are not to be expected.
Determination of PNEC aquatic	A PNECaqua = 0.012 mg/L can be calculated based on the lowest acute toxicity value (EL50 = 12.41 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 1000.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Based on the results from the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable.
B/vB criteria fulfilled?	No. The test substance consists of components with log Kow values in the range of xx to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological membranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester

	EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be B or vB.
T criteria fulfilled?	No. Available short-term and long-term toxicity tests with aquatic organisms resulted in effect values > 1 mg/L. Thus, this substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - Glutaraldehyde

Chemical and Physical Properties [1,2,3]	
CAS number	111-30-8
Molecular formula	C5H8O2
Molecular weight	100.11
Solubility in water	Soluble in all proportions in water and ethanol; soluble in benzene and ether.
Melting point	-14°C
Boiling point	188°C
Vapour pressure	2.03 x 10^{-3} kPa at 25 °C (50% solution)
Henrys law constant	0.011 Pa m³/mol @ 25 °C
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Colourless oily liquid. In the vapour state, glutaraldehyde has a pungent odour, with an odour threshold of 0.04 ppm.
Overview	Glutaraldehyde is manufactured in Germany by BASF and in the USA by Union Carbide Corporation. It is usually sold commercially as a 45% or 50% aqueous solution. Glutaraldehyde has a wide variety of uses throughout the world with its use spread over a number of different industries. It is used primarily as a biocide but it also has wide use as a fixative, and some use as a therapeutic agent. The principal health effects of glutaraldehyde are irritation of the skin, eye and respiratory tract, skin sensitisation and occupational asthma. Exposure data indicated that, in some situations, particularly the health care industry (disinfection), x-ray film processing and the animal health industry (spray use), health concerns may arise where available control measures such as ventilation have not been implemented to minimise exposure. Due to low and intermittent exposure, the public health risk from the industrial use of glutaraldehyde is minimal. For the use of glutaraldehyde in cosmetics, a safety margin of >400 for extensive use indicated low concern.
Environmental Fate[1]	
Soil/Water/Air	Glutaraldehyde is a hydrophilic substance that will be mainly associated with the aquatic compartment, with minor amounts partitioning to the atmosphere, following release to the environment. Hydrolysis is slow, but glutaraldehyde, like other aldehydes, undergoes aerial oxidation in solution. It biodegrades rapidly in aerobic and anaerobic aquatic environments at subcidal concentrations (below 10 mg/L) and will not bioaccumulate. Tropospheric degradation is also rapid.
Human Health Toxicity Summary [1,2,3]	

Chronic Repeated Dose Toxicity	A two-year chronic study was conducted in male and female Fischer 344 rats (NICNAS 1994). Groups of 100 male and 100 female rats were administered 0, 50, 250, or 1000 ppm w/v glutaraldehyde in drinking water (4, 17 and 64 mg/kg bw/day for the males and 6, 25 and 86 mg/kg/day for the females). The mortality rate over the treatment period was 25 to 30% for males and 19 to 23% for females with no dose-related increase. The major cause of death in all rats (control and dose groups) was large granular cell lymphatic leukaemia (LGLL). Small dose-related decreases in absolute body weight and body weight gain occurred at 250 and 1000 ppm in males and at 1000 ppm in females. Dose-related decrease in urine volumes and associated increase in osmolality were observed in higher dose animals. At necropsy at 52, 78 and 104 weeks, the only statistically significant changes in organ weights were for the kidney. Relative kidney weights were increased for males and females at 52 and 78 weeks. A significant dose-related increase in kidney weight relative to final body weight occurred for males and females in the 250 and 1000 ppm groups, including an increase in absolute kidney weight for the female rats. Changes in final body weights and the weights of other organs were minor and / or sporadic and were unlikely to be related to glutaraldehyde exposure. The total leucocyte count was significantly increased at week 104 in males at 250 and 1000 ppm, and in females at 250 ppm only. The variation in counts was large, possibly due to the large monocyte count at 250 and 1000 ppm. Changes in clinical chemistry parameters included decreases in the activities of some enzymes at 250 and 1000 ppm and occasional decreases in total protein, globulin and phosphorous; these were probably due to reduced food consumption and body weight. Gross pathology showed evidence of gastric inflammation, particularly in rats sacrificed at the end of the study, with irritation observed as ulceration, a multifocal colour change and thickening of the mucosa (dose groups not specified). Histologic examination of the tissues revealed squamous epithelial hyperplasia and keratinised cysts and oedema. Based on the observations, a NOAEL of 4 mg/kg bw/day for males and 6 mg/kg bw/day for females was established in this study. For the purpose of human health risk assessment, the lowest NOAEL (4 mg/kg bw/day) established in the two-year chronic study in rats will be used.
Carcinogenicity	In a two-year chronic/carcinogenicity study by Van Miller et al. (2002), groups of 100 male and 100 female Fischer 344 rats were treated with 0, 50, 250, or 1000 ppm w/v glutaraldehyde in drinking water. The mean glutaraldehyde consumption for each of the three groups was 4, 17 and 64 mg/kg bw/day for the males and 6, 25 and 86 mg/kg bw/day for the females. The mortality rate during the study period was 25 to 30% for males and 19 to 23% for females and was not dose-related. Gross pathology showed evidence of gastric inflammation. The main finding of the study was an increased incidence of large granular lymphocytic leukaemia (LGLL) in the spleen and liver of male and female rats in all groups, including the control group. Treated females showed a significantly increased incidence of LGLL and analysis for dose-response trend for the severity of LLGL revealed an increased severity in females at the higher dosages (53% in spleen and 54% in liver versus respectively 20% and 23% in untreated females) while no such observation were made for the males. No other significant oncogenic effects were observed during the study. Occurrence of LGLL was seen in all groups including controls; the incidence of LGLL in the 1000 ppm group was high compared to controls but no clear dose-response relationship was evident, and LGLL mainly affected treated females whereas the incidence in treated males was within the control range (REACH 2013). Historical control data for untreated Fischer 344 rats in NTP studies also indicates that the ranges for this tumour are 10 to 72% in males and 6 to 31% in females (REACH 2013). The control data in the Van Miller et al. study fitted in with the historical control data reported from NTP studies. The variability in control data for LGLL and the wide variation reported in the literature makes a definitive conclusion difficult. Base on this study, glutaraldehyde was considered not to be carcinogenic.

Mutagenicity/ Genotoxicity	Glutaraldehyde has been extensively tested for genetic activity in vitro and in vivo, however there is disagreement in the literature regarding glutaraldehyde's genetic activity (Zeiger et al. 2005). While all in vivo genotoxicity tests with glutaraldehyde gave negative results, mixed results were reported for in vitro mutagenicity tests. Early in vitro tests were negative (Watts 1984), but some recent bacterial assays and tests in mammalian cells indicated that glutaraldehyde could be mutagenic in vitro. A series of reverse mutation assays was carried out with various Salmonella typhimurium strains, with and without metabolic activation (REACH 2013). All assays with TA 100, 1535, 1537 and 98 were negative. Some assays with TA 102 and 104 gave positive results. Tests with Escherichia coli also yielded both positive as well as negative results. Glutaraldehyde induced sister chromatid exchanges in CHO cells with and without S9 metabolic activation in one laboratory, but was negative without S9 and only weakly positive with S9 in the second laboratory (NICNAS 1994). The difference in the results was attributed to slight differences between the data evaluation systems used in the two laboratories. Glutaraldehyde was not mutagenic in any of the in vivo assays such as peripheral blood micronucleus test, rat bone marrow chromosomal aberration assay and the Drosophila melanogaster sex-linked recessive lethal test (NICNAS 1994; REACH 2013). Chromosome aberrations in bone marrow cells were reported in only one out of eight studies using rats and mice, micronuclei were not induced in bone marrow cells of mice, and dominant lethal mutations were not induced in mice. Glutaraldehyde did not induce cell transformation in Syrian hamster embryo cells in vitro (Zeiger et al. 2005). In vivo, inhalation of glutaraldehyde induced cell proliferation in nasal tissue in rats and mice, but did not induce DNA damage at these sites. Based on these observations, it is concluded that glutaraldehyde is not a genotoxin.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Studies on the incidence of miscarriage in pregnant women have shown no difference between those exposed to glutaraldehyde and those not exposed to the chemical. Studies in female rats and mice have resulted in embryotoxicity/foetotoxicity for glutaraldehyde, but only at doses which are maternally toxic. A number of studies have found no evidence of teratogenicity.

Acute Toxicity	Several acute oral toxicity studies with glutaraldehyde have been reported in rats and other species. In one reliable study, administration of 0.2, 0.3, 0.5, 1.0, 1.7 mL/kg bw glutaraldehyde (corresponding to 226, 339, 565, 1130 and 1921 mg/kg bw, respectively) to male/female Wistar rats by gavage gave a median lethal dose (LD50) of 226 mg/kg bw (REACH 2013). Necropsy of animals that died during the observation period revealed congestion of the lungs and the abdominal viscera. In another study in Sprague-Dawley rats, the oral LD50 was 316 mg/kg bw for males and 285 mg/kg bw for females, when 10 mL of 2.15, 3.16, 4.64, 14.7% glutaraldehyde (corresponding to 215, 316, 464 and 1470 mg/kg bw) was administered by oral gavage (REACH 2013). In a separate study using different strengths of glutaraldehyde, Ballantyne (1986) showed that the oral LD50 for glutaraldehyde in rats varied with the concentration of the glutaraldehyde used. By using different concentrations of glutaraldehyde solutions (1% to 50%) and varying the administration volume to maintain a constant dose, oral LD50 in the range 66 to 733 mg/kg bw were obtained. These studies indicate that glutaraldehyde has high acute oral toxicity. Of the 18 acute dermal toxicity studies reported in REACH (2013) dossiers, results from 14 studies indicated LD50 higher than 2000 mg/kg bw. In four other studies, LD50 ranged between 250 and 1432 mg/kg bw. These studies however did not follow international guidelines and have low reliability. Based on these studies, glutaraldehyde is considered to have low acute dermal toxicity. In a well-defined study, 10 male and 10 female Sprague-Dawley rats per dose group were exposed to glutaraldehyde as liquid aerosol at 0.22, 0.31 and 0.63 mg/L for 4 hours (REACH 2013). Exposure was followed by an observation period of 14 days. During the exposure period slight nasal discharge, snout wiping, flank respiration and irregular to intermittent respiration were reported in rats. During the post-exposure period, bloody nasal discharge, red crusts surrounding the nose, whooping or gasping respiration with rasping sounds and a tremulous gait were observed. These symptoms disappeared in the surviving animals within 5 to 9 days post-exposure. Mortalities were noted in all treated groups. The determination of the LC50 values was based on the Probit Analysis. An LC50 of 0.48 mg/L was calculated for both male and female rats. In another acute inhalation study conducted in a similar manner to the above study, Sprague-Dawley rats, 10 rats per sex per dose group, were exposed to 0.1, 0.18, 0.28, 0.39 and 0.44 mg/L glutaraldehyde as liquid aerosol for 4 hours (REACH 2013). During and after exposure, mortality and clinical signs of toxicity were recorded at regular time intervals. The LC50 in this study was established as 0.28 mg/L for females and 0.39 mg/L for males. Based on the above studies, glutaraldehyde is considered to have high acute inhalation toxicity.
Irritation	Glutaraldehyde is corrosive to the skin and eyes of rabbits at high concentrations, with signs of skin irritation evident at 2%, and eye irritation at 0.2%. Exposure to glutaraldehyde vapours in acute inhalational studies resulted in nasal irritation and respiratory difficulties. Joint irritation was seen in rabbits after intra-articular administration.
Sensitisation	The skin sensitisation effect of glutaraldehyde was demonstrated in tests with guinea pigs.
Health Effects Summary	Glutaraldehyde has high acute oral and inhalation toxicity and low to moderate acute dermal toxicity. Based on human and animal data, it is corrosive, the vapours are irritating to the respiratory tract, and it has skin and respiratory sensitisation potential. Glutaraldehyde has high repeat dose oral and inhalation toxicity, with an oral No-Observed-Adverse-Effect Level (NOAEL) of 4 mg/kg bw/day based on changes in liver and kidney weights and clinical chemistry parameters. Glutaraldehyde is not genotoxic or carcinogenic. It did not have any adverse effects on the reproductive system of adult rats or on the development of foetuses. The critical adverse health effects of glutaraldehyde are corrosivity, skin and respiratory tract sensitisation and acute and repeat dose oral and inhalation toxicity.
Key Study/Critical Effect for Screening Criteria	From the hazard characterisation, the critical (most sensitive) adverse health effects for repeated exposures to the chemical are changes in clinical chemistry parameters and relative organ (liver and kidney) weights. Glutaraldehyde has high repeat dose oral toxicity with an oral NOAEL of 4 mg/kg bw/day. This NOAEL is used in this human health risk assessment.
Ecological Toxicity [1,2,3,4]	

Aquatic Toxicity	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduct'n Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L In summary, the test results indicate that glutaraldehyde is slightly to moderately toxic to aquatic fauna and moderately to highly toxic to algae. In some instances, glutaraldehyde appeared to be rapidly lost from test waters in the laboratory. Such behaviour in aquatic toxicity tests generally means that their results will underestimate the inherent toxicity of a substance. However, the toxicity that will prevail under environmental conditions is likely to be lower than that recorded in the laboratory in view of the rapid degradation that would be expected to occur in natural surface waters.
Determination of PNEC aquatic	As a wide selection of species is available, applying a safety factor of 10 to the NOEC (2.1 mg/L) derived from Daphnia seems most appropriate, giving a PNEC of 2100/10 = 0.21 mg/L for faunal species
Current Regulatory Controls [1,2,4]	
Australian Hazard Classification	Glutaraldehyde is classified as hazardous in the Hazardous Substances Information System (HSIS) with the following risk phrase (Safe Work Australia 2013): · T (Toxic); R23/25 (Toxic by inhalation and if swallowed) · C (Corrosive ; R34 (causes burns) · R42/43 (May cause sensitisation by inhalation and skin contact). Mixtures containing the chemical are classified as hazardous with the following risk phrases based on the concentration (Conc) of the chemical in the mixtures. The risk phrases for this chemical are: · Conc ≥50%: T; R23/25; R34; R42/43 (Toxic; toxic by inhalation and if swallowed; causes burns; may cause sensitisation by inhalation and skin contact) · ≥25% Conc <50%: T; R23; R22; R34; R42/43 (Toxic; toxic by inhalation, harmful if swallowed, causes burns; may cause sensitisation by inhalation and skin contact) · ≥10% Conc <25%: C; R20/22; R34; 42/43 (Corrosive; harmful by inhalation and if swallowed; causes burns; may cause sensitisation by inhalation and skin contact) · ≥2% Conc <10%: Xn; R20/22; R37/38; R41; R42/43 (Harmful; harmful by inhalation and if swallowed; irritating to respiratory system and skin; risk of serious eye damage; may cause sensitisation by inhalation and skin contact) · ≥1% Conc <2%: Xn; R36/37/38 R42/43 (Harmful; Irritating to eyes, respiratory system and skin; may cause sensitisation by inhalation and skin contact) · ≥0.5% Conc <1%: Xi; R36/37/38; R43 (Irritating; irritating to eyes, respiratory system and skin; may cause sensitisation by skin contact)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 0.41 mg/m³, 0.1 ppm; Time Weighted Average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013): · Occupational Exposure limit (TWA) of 0.2 mg/m3 [Canada, China, Denmark, Japan, Korea, UK] · 0.4 mg/m3 TWA [Sweden] · 0.8 mg/m3 TWA [US (NIOSH), Greece]
Australian Food Standards	No Australian food standards relating to the chemical have been identified (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines. (National Health and Medical Research Council (NHMRC) 2011).

Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	No. As the Log Pow is -0.01 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. Chronic toxicity data >1 mg/L in invertebrates, thus glutaraldehyde does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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Toxicity Summary - Guar gum

Chemical and Physical Properties[1,2,7]	
CAS number	9000-30-0
Molecular formula	NA.
Product name	
Molecular weight	220,000 g/mol
Solubility in water	Completely soluble in water
pH	No data were found.
Melting point	No data were found.
Boiling point	No data were found.
Vapour pressure	solid
Henrys law constant	NA
Explosive potential	NA
Flammability potential	NA
Colour/Form	NA
Overview	Guar gum is a yellowish-white free-flowing powder. It is completely soluble in water and practically insoluble in oils, greases, hydrocarbons, ketones and esters. Water solutions are tasteless, odourless and a pale, translucent grey colour and neutral. The powder has 5 to 8 times the thickening power of starch. Water solution may be converted to a gel by adding a small amount of borox and are stable to heat. Guar gum is extensively used, eg typically used as a protective colloid, stabilizer, thickening and film forming agent for cheese, salad dressing, milk products including ice cream and soups; disintegration agent in tablet formulations; in pharmaceutical jelly formulations; in suspension, emulsions, lotions, creams and toothpastes; in bulk laxatives and appetite depressants; in mining industry as a flocculent, for hydraulic fracturing aid in oil well recovery and as a filtering ages; gelling and waterproofing agent in explosive and in water treatment as a coagulant. Guar gum is approved for use as a food additive by the U.S. Food and Drug Administration and is on the list of substances "generally recognized as safe" (CFR 1974). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1]	
Soil/Water/Air	No information was found. Guar gum, being a polysaccharide composed of galactomannan, would be expected to be readily biodegradable

Human Health Toxicity Summary [1,2,3,5,6,7,8,9]	
Chronic Repeated Dose Toxicity	F344 rats and B6C3F1 mice were given diets containing 0, 6,300, 12,500, 25,000, 50,000 or 100,000 ppm guar gum for 13 weeks (NTP, 1982). Mean body weights were decreased in male rats (100,000 ppm group) and in female mice (50,000 and 100,000 ppm). A dose-related decrease in feed consumption was observed for male and female rats; male and female mice were comparable or higher than that of controls. There were no compound-related clinical signs or histopathological effects. F344 rats and B6C3F1 mice were given diets containing 0, 25,000 ppm or 50,000 ppm guar gum for 103 weeks (NTP, 1982). Mean body weights of the high-dose females were lower than those of the controls after week 20 for mice and week 40 for rats. No compound-related clinical signs or adverse effects on survival were observed. Feed consumption by dosed rats and mice of either sex was lower than that of controls. There were no non-neoplastic histopathological effects in either rats or mice that were treatment-related.
Carcinogenicity	F344 rats and B6C3F1 mice were given diets containing 0, 25,000 ppm or 50,000 ppm guar gum for 103 weeks (NTP, 1982). There were increased incidences of adenomas of the pituitary in male rats and pheochromocytomas of the adrenal in female rats that were statistically significant, but these differences were considered to be unrelated to guar gum administration. When pituitary adenomas or carcinomas and when pheochromocytomas or malignant pheochromocytomas are combined, the statistical differences disappear. Hepatocellular carcinomas occurred in treated male mice at incidences that were significantly lower than that in controls. The combined incidence of male mice with either hepatocellular adenomas or carcinomas was also significantly lower in the highdose group. It was concluded that under conditions of this bioassay, guar gum was not carcinogenic for F344 rats or B6C3F1 mice.
Mutagenicity/ Genotoxicity	Guar gum induced no consistent responses in dominant lethal gene tests to suggest that it was mutagenic to the rat. Guar gum was not mutagenic to Salmonella typhimurium TA 1530 or G-46 when tested without metabolic activation; however, it was mutagenic to Saccharomyces cerevisiae D- 3 (Green, 1977). Guar gum also was reported to cause chromosomal aberrations in human embryonic lung cells WI-38 (Green, 1977). No in vivo genotoxicity studies have been conducted on guar gum.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The developmental effects of guar gum were evaluated in groups of 20 rabbits by daily dermal administration of the test substance for 6 hours/day at dose levels of 0, 2, 10 and 50 mg/kg/day on days 6 through 18 of gestation. The number of early resorptions was significantly increased and the number of viable foetuses was correspondingly decreased at 50 mg/kg/day ($p<0.05$). The NOEL was 2 mg/kg/day. The frequency of foetal malformations and variations in the treated groups was comparable to that of the control group at all dose levels. Female rabbits were given daily (6 hours/day) dermal administration of 0, 2, 10 and 50 mg/kg guar gum during gestational days 6 through 18 (IRDC, 1988). Mortalities included 2 deaths at 50 mg/kg and 1 death at 10 mg/kg. A single animal was killed in extremis. A dose-related increase in dermal irritation (including erythema, edema, and desquamation) was observed in animals receiving 10 and 50 mg/kg. The number of early resorptions was significantly increased and the number of viable fetuses was correspondingly decreased at 50 mg/kg/day ($p<0.05$). The frequency of fetal malformations and variations in the treated groups was comparable to that of the control group at all dose levels. The NOEL for this study is 2 mg/kg/day.
Acute Toxicity	Guar gum has been blamed for causing esophageal obstruction. A death has the use of one guar gum tablet product, which apparently swelled in the esophagus, resulting in complications that caused the fatality. Mildly toxic by ingestion. The oral LD50 is 8,100 mg/kg for mice and 9,400 mg/kg for rats.
Irritation	No data were found.
Sensitisation	Occupational asthma has been reported in subjects of guar gum. A respiratory sensitizer There are reports of respiratory sensitization in workers exposed occupationally to guar gum dusts (Maio, 1986).

Key Study/Critical Effect for Screening Criteria	The key studies for the determination of a drinking water guidance value is the NTP two year chronic bioassays. The LOAELs are based on decreased mean body weights in female mice and rats fed 50,000 ppm guar gum in diet for 103 weeks. The NOAELs for these studies are 25,000 ppm guar gum. Rat: NOAEL (mg/kg/day) = 25,000 ppm * 0.05 = 1,250 mg/kg/day Mouse: NOAEL (mg/kg/day) = 25,000 ppm * 0.13 = 3,250 mg/kg/day Where 0.05 and 0.13 are the fraction of body weight that rats and mice, respectively, consume per day as food (U.S. EPA). The lowest NOAEL of 1,250 mg/kg/day for the rat will be used to derive a drinking water guidance value. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability) Oral RfD = 1,250/100 = 12.5 mg/kg/day Drinking water guideline = 49 ppm
Ecological Toxicity [1,7]	
Aquatic Toxicity	The lowest measured ecotoxicity endpoint for fish was reported to be 218 mg/L.
Determination of PNEC aquatic	PNECaquatic: On the basis that the data consists of only one short-term result from one trophic level, an assessment factor of 1,000 has been applied to the reported effect concentration of 218 mg/L for Fish. The PNECaquatic is 0.218 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
Australian Hazard Classification	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No biodegradation information was found on guar gum. However, guar gum is a naturally occurring polysaccharide which would be expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence
B/vB criteria fulfilled?	The molecular weight of guar gum ranges from 200,000 to 300,000 daltons, and it is also water soluble. Thus, guar gum is not expected to meet the criteria for bioaccumulation
T criteria fulfilled?	The acute aquatic toxicity of guar gum is >0.1 mg/L. Thus, guar gum is not expected to meet the screening criteria for toxicity
Overall conclusion	Not a PBT substance.

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Toxicity Summary - Hydrochloric acid

Chemical and Physical Properties [1,2]	
CAS number	7647-01-0
Molecular formula	HCl
Molecular weight	36.46 g/mol
Solubility in water	Soluble
Melting point	-114.22 °C
Boiling point	-85.05°C
Vapour pressure	35,424 mm Hg at 25 deg C
Henrys law constant	2.04 x106 mol/L atm
Explosive potential	Reacts with most metals producing explosive hydrogen gas
Flammability potential	Not combustible
Colour/Form	liquid
Overview	CAS Registry number. Since the gas becomes the acid in aqueous systems and volatilization of the gas can occur from aqueous systems, it is often difficult to determine which is being considered in a specific item in the literature. If released to water, hydrogen chloride dissociates readily in water to chloride and hydronium ions, decreasing the pH of the water. The solution in water is a strong acid, it reacts violently with bases and is corrosive. Reacts violently with oxidants forming toxic gas (chlorine). Attacks many metals in the presence of water forming flammable/explosive gas (hydrogen). Hydrochloric acid is one of the most widely used industrial chemicals. Uses include pickling and cleaning metals, food process, and cleaning of industrial equipment.
Environmental Fate [3,4]	
Soil/Water/Air	Hydrochloric acid is readily dissociated in water into hydrated protons and chloride ions. The increase in the concentration of hydrochloric acid in water decreases the pH in the aquatic ecosystem. Generally, the buffer capacity to maintain the pH in the aquatic ecosystem is important and the equilibrium between CO2, HCO3 - and CO3 2- in the aquatic ecosystem is mainly responsible for the buffer capacity of receiving water.

Human Health Toxicity Summary [1,2,3,8]	
Chronic Repeated Dose Toxicity	Frequent contact with aqueous solutions of hydrochloric acid may lead to dermatitis. For repeated dose toxicity, local irritation effects were observed in the groups of 10 ppm and above in a 90-day inhalation study. Rats were fed diets containing 280 to 1,250 mmol/kg hydrochloric acid (10.2 to 45.6 mg/kg) for 7-12 weeks. There was increased water intake in all treated groups. All animals fed diet containing 937 mmol/kg and above for 9 weeks, and half of the animals fed diet containing 900 mmol/kg for 12 weeks died. Also at doses >937 mmol/kg, there was decreased body weight, food consumption, blood pH, femur length, rate of ash in bone (Upton and L'Estrange, 1977). In another study with rats, hydrochloric acid was administered via drinking water at pH 2-3 (study duration not provided). Decreased protein levels in urine and decreased urine volumes were observed in the treatment groups (Clausing and Gottschalk, 1989).
Carcinogenicity	HCl is not classifiable as a human carcinogen. No evidence of treatment related carcinogenicity was observed either in other animal studies performed by inhalation, oral or dermal administration. In three industry-based human case studies conducted in the U.S, no association between hydrogen chloride exposure and cancers of the lung, brain, or kidney was observed. In one U.S study of steel-pickling workers an excess risk for cancer of the lung was identified in workers exposed primarily to hydrochloric acid. Under IARC definitions, HCl is not classifiable as to its carcinogenicity to humans (Group 3).
Mutagenicity/ Genotoxicity	In single studies, HCl induced mutation and chromosomal aberrations in mammalian cells and induced chromosomal aberrations in insects and in plants. It did not induce mutation in bacteria. For genetic toxicity, a negative result has been shown in the Ames test. A positive result, which is considered to be an artefact due to the low pH, has been obtained in a chromosome aberration test using Hamster ovary cells. The effects of low pH in in vitro studies are not a problem in vivo as the proton level is regulated systemically. Hydrochloric acid is not considered to be genotoxic.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No reliable studies have been reported regarding toxicity to reproduction and development in animals after oral, dermal or inhalation exposure to hydrogen chloride/hydrochloric acid. As protons and chloride ions are normal constituents in the body fluid of animal species, low concentrations of hydrogen chloride gas/mist or solution do not seem to cause adverse effects to animals. The cells of gastric glands secrete hydrochloric acid into the cavity of the stomach. No reliable conclusion could be drawn on the potential reproductive toxicity of hydrogen chloride/hydrochloric acid.

Acute Toxicity	Rapid evaporation of the liquid may cause frostbite. The substance is corrosive to the eyes, the skin and the respiratory tract and can cause serious skin burns and blurred/reduced vision or blindness. Inhalation of high concentrations of the gas may cause pneumonitis and lung oedema, resulting in reactive airways dysfunction syndrome. The effects may be delayed. Exposure to hydrochloric acid can produce burns on the skin and mucous membranes, with severity related to the concentration of the solution. Subsequent ulceration may occur, followed by keloid and retractile scarring. Dental decay, including yellowing, softening and breaking of teeth, and related digestive diseases have been recorded after exposures to hydrochloric acid. Mortality has been observed following ingestion of hydrochloric acid. Female rats orally administered 3.3% hydrochloric acid yielded an acute oral median lethal dose (LD50) in a range from 238 to 277 mg/kg bw (Hoechst 1966). No details of the study were available. In another study in rats, administration of a solution of undisclosed concentration induced stomach ulceration, inflammation of the intestine, discolouration of the liver and hyperaemia of the lung (Monsanto 1976). An LD50 of 700 mg/kg bw was reported. An acute dermal LD50 was established as >5010 mg/kg bw in rabbits however the dose levels administered were not reported (Monsanto 1976). Acute median lethal concentration (LC50) values of 8.3 mg/L and 3.2 mg/L were observed in rats and mice respectively after a 30 minute inhalation exposure to aerosolised hydrochloric acid (Darmer et al. 1974).
Irritation	In a skin irritation test in rabbits performed according to OECD TG 404, 37% hydrochloric acid (0.5 mL) was applied by both semi-occlusion and occlusion (Potokar 1985). The chemical was found to be corrosive under both conditions after one hour exposure. Concentrations >17% also caused corrosion in rabbits. Concentrations >3.3% caused skin irritation to rabbits after application for 5 days. Hydrochloric acid caused mild to severe eye irritation in animal studies. There were no data available for respiratory irritation however; inhalation of hydrochloric acid vapours is expected to cause irritation. In humans, the chemical was determined to be ‘irritating to skin’ (York et al. 1996).
Sensitisation	May cause dermatitis with frequent contact of aqueous solutions of hydrochloric acid.
Health Effects Summary	Hydrochloric acid has demonstrated acute oral toxicity, corrosive effects to the skin and eye, and irritant effects to the respiratory system. Hydrochloric acid is not a skin sensitiser based on the available studies. Only limited information on the repeated oral toxicity of hydrochloric acid is available. However, as the component ions are normal constituents of the human body (particularly the stomach), only localised effects are expected. No systemic effects from repeated exposures are expected. The chemical is not genotoxic. No evidence of treatment-related carcinogenicity was observed in animal studies performed by inhalation or dermal administration. In humans, no association between hydrogen chloride exposure and tumour incidence was observed. No reliable studies were identified regarding specific toxicity to reproduction and development in animals after exposure to hydrochloric acid/hydrogen chloride. Because protons and chloride ions are normal constituents in the body fluids, low concentrations of hydrochloric acid/hydrogen chloride would not be expected to cause adverse reproductive effects to animals. This conclusion is supported by the 90-day inhalation study of hydrogen chloride where no effects on the gonads of rodents were observed.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water guideline value for pH may apply to hydrochloric acid.

Ecological Toxicity [1,3,4,8]	
Aquatic Toxicity	The measured acute endpoint for: Algae = 0.492 mg/L Daphnia = 0.492 mg/L Fish = 4.92 mg/L The measured chronic endpoint for Daphnia is 62 mg/L
Determination of PNEC aquatic	On the basis that the data consists of short-term and long-term results from three trophic levels, an assessment factor of 10 has been applied to the lowest reported Chronic endpoint of 62 mg/L for Daphnia. The PNECaquatic is 6.2 mg/L.
Current Regulatory Controls [8]	
Australian Hazard Classification	C (Corrosive); R34 (Causes burns) Xi (Irritant); R37 (Irritating to respiratory system).
Australian Occupational Exposure Standards	There are no specific exposure standards for hydrochloric acid. However, the permissible exposure limits for hydrogen chloride gas apply (Safe Work Australia 2013): Time Weighted Average (TWA) of 7.5 mg/m^3 (5 ppm).
International Occupational Exposure Standards	The following exposure standards were identified for hydrogen chloride (Galleria Chemical 2013). TWA: 7 to 8 mg/m³ (5 ppm) [Austria, Belgium, Denmark, EU, Hungary, Japan, Korea, Mexico, The Netherlands, New Zealand, Norway, Sweden, Turkey] 2 to 5 mg/m³ (1-2 ppm) [Germany, Poland, Switzerland, UK]. Short Term Exposure Limit (STEL): 15 mg/m^3 (10 ppm) [Austria, Belgium, EU, Hungary]
Australian Food Standards	Hydrochloric acid is an additive permitted in accordance with Good Manufacturing Practice (GMP) in processed foods specified in Schedule 1 of the Australia New Zealand Food Standards Code – Standard 1.3.1 – Food Additives (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	Hydrochloric acid is listed as an endorsed drinking water treatment chemical in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	Hydrochloric acid is an organic salt that dissociates completely to hydrogen and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both hydrogen and chloride ions are also ubiquitous and are present in most water, soil and sediment. Thus, the persistent criteria is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Hydrogen and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, hydrochloric acid is not expected to bioaccumulate.
T criteria fulfilled?	No chronic toxicity data exist on hydrochloric acid; however, the acute EC(L)50s are >0.1 mg/L in fish, invertebrates and algae. Thus, hydrochloric acid does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2018

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7. Safe Work Australia Workplace Exposure Standards for Airborne Contaminants, 2013.
8. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

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Toxicity Summary - Distillates, Hydrotreated Light

Chemical and Physical Properties [1,2,3,4]	
CAS number	64742-47-8
Molecular formula	C48H94
Molecular weight	Not applicable - unknown or variable composition, complex reaction products or biological materials (UVCB)
Solubility in water	0.009 to 6.45 mg/L (at 25°C)
Melting point	-49 °C
Boiling point	146 to 299 °C
Vapour pressure	1 to 3.7 kPa at 37.8 °C
Henrys law constant	No data found.
Explosive potential	Above 66°C explosive vapour/air mixtures may be formed
Flammability potential	Combustible
Colour/Form	Liquid at room temperature
Overview	Distillates, hydrotreated light (also called deodorised kerosene) is a petroleum substance. The C_9-C_{14} Aliphatic [< 2% Aromatic] Hydrocarbon Solvents Category is comprised of complex aliphatic hydrocarbon solvents that contain >98% aliphatic constituents with carbon numbers in the range of C9-C14 and less than 2% aromatic constituents. The chemical is used as a component of a drilling fluid formulation for coal seam gas extraction.
Environmental Fate[1]	
Soil/Water/Air	Members of the C_9-C_{14} Aliphatic [≤2% aromatics] Hydrocarbon Solvents Category have the potential to volatilize from surface waters, based on Henry's Law constants (HLC) representing volatility for category members that range from 4.76×10^4 to 1.67×10^6 Pa-m^3/mole (at 25°C). In the air, category members have the potential to rapidly degrade through indirect photolytic processes mediated primarily by hydroxyl radicals (•OH) with calculated degradation half-lives ranging from 0.42 to 1.10 days or 10.8 to 26.4 hours based on a 12-hr day and an •OH concentration of 1.5×10^6 •OH/cm^3. These chemicals are unlikely to degrade by hydrolysis as they lack a functional group that is hydrolytically reactive.

Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a 90-day study conducted in accordance with OECD TG 408, Sprague-Dawley rats were administered deodorized kerosene by gavage at doses of 0, 100, 500 or 1000 mg/kg bw/day (REACH 2013). Microscopic changes, such as incidence of a2µ-globulin, were seen in male kidneys. These effects are not considered relevant to humans. No other treatment-related effects were observed. No Lowest Observed Adverse Effect Level (LOAEL) or No Observed Adverse Effect Level (NOAEL) could be established in this study. Repeated dermal exposures to members of the kerosene/jet fuel category showed minimal systemic effects (API 2010). Animal data on repeat dermal toxicity of kerosene (petroleum) are summarised from REACH (2013) and presented in Table A29.2. The LOAELs and NOAELs are indicated for each study. Prolonged skin exposure to kerosene (petroleum) in rats and rabbits were consistently associated with local irritation. In rabbits only, systemic effects included changes in bodyweight and organ weights. It is expected that deodorized kerosene would have similar effects in the animals. In a 13-week study, rats (strain not specified) were exposed to deodorized kerosene vapour at concentrations of 0, 0.02, 0.048 or 0.10 mg/L for six hours/day, five days/week. No treatment-related effects were reported (REACH 2013).
Carcinogenicity	A study for deodorized kerosene is available in the REACH Dossier (REACH 2013) but was not reported in enough detail to be able to determine the carcinogenicity of the substance. In a study conducted similarly to OECD TG 451, B6C3F1 mice were applied 0, 250 or 500 mg/kg bw/day kerosene (petroleum) in the interscapular region (type of wrapping not specified) for 103 weeks (REACH 2013). At the end of the study, less than 10% decrease in bodyweight gain was observed at the top dose in both sexes. Mortality in females was significantly higher at the two doses compared to controls. Increased incidence and severity of chronic dermatitis was seen in all treatment groups. At the top dose, increased incidence of the following non-neoplastic lesions was reported: amyloid in the liver, kidney, adrenal cortex (males only), spleen; granulocytic hyperplasia in the bone marrow; and hyperplasia of the axillary lymph nodes (females only). The only indication of neoplastic lesions was an increased incidence of malignant lymphomas observed in treated female animals but the values were within the range of historical controls. Under the conditions of the test, kerosene (petroleum) was not carcinogenic. The LOAEL for systemic effects is 250 mg/kg bw/day. The International Agency for Research on Cancer (IARC) concluded that there is inadequate evidence for the carcinogenicity of kerosene (petroleum) in experimental animals and humans, placing the chemical in Group 3 (Not classifiable as to its carcinogenicity to humans) (IARC 1989). Deodorized kerosene is not carcinogenic, based on reading across the information available for kerosene (petroleum).
Mutagenicity/ Genotoxicity	In vitro tests reported deodorized kerosene as negative both with and without metabolic activation in Ames tests conducted in accordance with OECD TG 471 (REACH 2013; OECD 2011) and in chromosomal aberration tests conducted in accordance with OECD TG 473 (OECD 2011, 2012). In an in vivo study, deodorized kerosene was negative in a dominant lethal assay, conducted in accordance with OECD TG 478, in male Swiss mice and Long Evans rats administered 10% deodorized kerosene intraperitoneally (REACH 2013). These studies demonstrate that deodorized kerosene is not genotoxic.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	C9-C14 aliphatic (≤2% aromatic) hydrocarbon solvents and C14-C20 aliphatic (≤2% aromatic) hydrocarbon solvents are not toxic to fertility (OECD 2011, 2012). Members of the kerosene/jet fuel category are not toxic to fertility (API 2010). Sprague-Dawley rats were administered undiluted kerosene (petroleum) by gavage at doses of 0, 750, 1500 or 3000 mg/kg bw/day in males treated for 70-90 days and 0, 325, 750 or 1500 mg/kg bw/day in females treated for 21 weeks. At 750 and 1500 mg/kg bw/day, increased absolute liver weight was observed in females but with no corresponding changes in clinical chemistry or histopathology. In females only, other effects included perianal dermatitis at 1500 mg/kg bw/day and stomach hyperplasia at 750 and 1500 mg/kg bw/day. These parameters were not measured in males. In males, the study indicated dose dependent decrease in male bodyweight that was linked to nephropathy specific to male rats. Data for this effect were not provided in the study description. There were no treatment related effects on fertility in both sexes (REACH 2013). The NOAEL for systemic effects in females only was 325 mg/kg bw/day. No NOAEL can be established for fertility effects. C9-C14 aliphatic (≤2% aromatic) hydrocarbon solvents and C14-C20 aliphatic (≤2% aromatic) hydrocarbon solvents are not developmental toxicants (OECD 2011, 2012). Members of the kerosene/jet fuel category are not developmental toxicants (API 2010). In a study conducted in accordance with OECD TG 414, Sprague-Dawley rats were administered kerosene (petroleum) by gavage on gestation days (GD) 6 to 15 at doses of 0, 500, 1000, 1500 or 2000 mg/kg bw/day (REACH 2013). Bodyweight gain was decreased at 1500 and 2000 mg/kg bw/day. Foetal weight was decreased at 1500 and 2000 mg/kg bw/day which may be attributed to decreased maternal bodyweight gain. No malformations were reported. The maternal NOAEL is 1000 mg/kg bw/day. In another study, Sprague-Dawley rats were exposed (whole body) to kerosene (petroleum) in air at concentrations of 0, 106 or 364 ppm on GD 6-15. There were no treatment-related effects observed in the dams and offspring (REACH 2013). Deodorized kerosene is not considered a developmental toxicant, based on reading across data available for kerosene (petroleum).
Acute Toxicity	The chemicals have low acute toxicity based on results from animal tests following oral exposure. The median lethal dose (LD50) in rats is >2000 mg/kg bw (OECD, 2011; US EPA, 2011; OECD, 2012a; OECD, 2012b; OECD, 2012c). The chemicals have low acute toxicity based on results from animal tests following dermal exposure. The LD50 in rats and rabbits is >2000 mg/kg bw (OECD, 2011; US EPA, 2011; OECD, 2012a; OECD, 2012b; OECD, 2012c). The chemicals have low acute toxicity based on results from animal tests following inhalation exposure.
Irritation	Semi-occlusive applications of commercial grade deodorized kerosene produced slight irritation in New Zealand White and SPF rabbits in dermal irritation studies conducted in accordance with OECD TG 404. The studies reported the range of erythema and oedema scores to be 0.3-0.9 and 0.2-1.0, respectively, based on Draize scoring at 24, 48 and 72 hours. Deodorized kerosene is slightly irritating to rabbit skin. Several studies conducted similarly to OECD TG 405 showed minimal effects to the eye with the reported range of conjunctival redness score to be 0-0.2 from instillation of undiluted deodorized kerosene in the eyes of New Zealand White and SPF rabbits (OECD 2011). Deodorized kerosene is slightly irritating to rabbit eye.
Sensitisation	The C9-C14 aliphatic (≤2% aromatics) Category members do not cause skin sensitization.

Health Effects Summary	Deodorised kerosene is an aspiration hazard since it has low viscosity and is composed of aliphatic and aromatic hydrocarbons up to 10%. Deodorised kerosene has low acute oral, dermal and inhalation toxicity, and is slightly irritating to the skin and eyes. The substance is not a skin sensitiser, based on reading across data available for kerosene (petroleum). No treatment-related effects were reported in repeated oral and inhalation exposures to deodorised kerosene. Prolonged dermal exposure to kerosene (petroleum) reported local irritation in rats and rabbits, and changes in bodyweight and organ weights in rabbits. It is expected that these effects would be similar for deodorised kerosene. Based on the absence of adverse effects observed in repeat dose toxicity studies, for the purposes of quantifying the health risk to the general worker and public, the highest dose tested in the study conducted in rats (1 000 mg/kg bw/day) is used in this risk assessment. The substance is not genotoxic. It is neither a carcinogen nor a reproductive toxicant, based on reading across data available for kerosene (petroleum).
Key Study/Critical Effect for Screening Criteria	The most appropriate No-Observed-Adverse-Effect Level (NOAEL) for risk assessment is 1 000 mg/kg bw/day based on maternal toxicity (decreased bodyweight gain) at the Lowest- Observed-Adverse-Effect Level (LOAEL) of 1 500 mg/kg bw/day from a developmental toxicity study on kerosene (petroleum).
Ecological Toxicity [2]	
Aquatic Toxicity	Lowest acute endpoint for Daphnia = 0.018 mg/L (modelled)
Determination of PNEC aquatic	Based on the lowest acute endpoint for Daphnia (0.018 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 1.80E-04 mg/L.
Current Regulatory Controls [2]	
Australian Hazard Classification	All of the chemicals are classified as hazardous, with the following risk phrase for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xn; R65 (acute toxicity) Mixtures containing the substance are classified as hazardous with the following risk phrase based on the concentration (Conc) of the substance in the mixtures: Conc ≥10%: Xn; R65 (May cause lung damage if swallowed)
Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	No specific exposure standards are available for this chemical.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[6] µg/L (ANZECC 2000)
PBT Assessment	
P/vP Criteria fulfilled?	No. This chemical is expected to be biodegradable. The ready biodegradability of SHELLSOL NF a solvent naphtha (petroleum), heavy aromatics (consists predominantly of C9 aromatics 25%m/m; C10 aromatics 65%, and indanes 10%) was studied in mineral nutrient medium inoculated with activated sludge (mixed liquor suspended solids 100-101 mg/L, pH 6.9) and incubated for 28 days at 20°C. SHELLSOL NF is readily biodegrade after 28 days but not within the 10 day window.
B/vB criteria fulfilled?	Category members have a potential to bioaccumulate, based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight, based on the Arnot and Gobas model, that take into account biotransformation of the chemicals in fish tissue. This chemical also has a log Kow of 6.025.

T criteria fulfilled?	Yes. The lowest acute endpoint is <1 mg/L.
Overall conclusion	Not PBT
Revised	January 2019

Human Health Risk Assessment

Occupational Exposure

Table 2 presents the calculated internal doses for adult workers associated with drilling chemical exposure/hydraulic fracturing chemical exposure.

Table 2 Calculated Internal Doses for Adult Workers

Occupational Activity	E_{derm} (mg/kg bw/day)	E_{inh} (mg/kg bw/day)	E_{total} (mg/kg bw/day)
Transport and storage	Negligible*	Negligible*	Negligible*
Mixing/blending drilling of hydraulic fracturing chemicals	0.06	0.750	**0.810**
Injection of drilling chemicals	Negligible*	Negligible*	Negligible*
Cleaning and maintenance (hydraulic fracturing)	0.012	0.150	**0.162**
Combined exposure Mixing/blending and cleaning and maintenance			**0.972**
Transport and storage of drilling muds	Negligible*	Negligible*	Negligible*

Ederm - Internal dose from dermal exposure; Einh – Internal dose from inhalation exposure; Etotal – Total internal dose from all routes.

* In the absence of accidents/incidents, repeated occupational exposures during transport and storage, or during injection of mixed/blended chemicals, are negligible. Similarly, repeated occupational exposures to the chemical via the transport and storage of drilling muds are negligible (NICNAS 2017).

Human Health Risk Characterisation

Uncertainty Factors

Using the Margin of Exposure (MOE) approach, conservative default uncertainty factors for intra- and inter-species variability are assumed to be 10 each. A MOE of less than 100 is considered a concern (NICNAS 2017).

Acute Health Risks

Acute exposure to the chemical is unlikely to result in adverse health effects. In addition, given the low concentration in the drilling fluids, exposure to the chemical via these fluids is of low concern for workers.

Chronic long-term health risks

The critical (most sensitive) adverse health effect is maternal toxicity (decreased bodyweight gain). The NOAEL established for this effect is 1000 mg/kg bw/day from a reproductive toxicity study. There are no adverse effects observed from repeated exposures to the chemical at any dose tested, up to 1000 mg/kg bw/day. This highest no-effect dose is applicable for a general worker. Margins of Exposure (MOE) for adverse health effects from repeated occupational exposures are calculated by comparing the NOAEL with exposures estimated for different occupational activities and combined activities. **Table 3** presents Margin of Exposure calculated for Adult Workers associated with drilling

chemical exposure/hydraulic fracturing chemical exposure. Risk characterisation calculations are presented in **Attachment A**.

Table3 Margins of exposure calculated for adult workers

Adult worker exposure scenario	E_{total} (mg/kg bw/day)	NOAEL (mg/kg bw/day)	Critical effect	MOE (NOAEL / E_{total})	Chemical is of concern? (MOE < 100)
Occupational Activity					
Mixing/blending drilling of hydraulic fracturing chemicals	0.810	1000	Maternal toxicity in rats	1235	No
Cleaning and maintenance (hydraulic fracturing)	0.162			6173	
Combined exposure Mixing/blending and cleaning and maintenance	0.972			1029	

Based on uncertainty factors derived for this risk characterisation, the MOEs indicate that the chemical is of low concern for workers from repeated exposures during certain operations.

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Toxicity Summary - Methanol

Chemical and Physical Properties[1,3,4]	
CAS number	67-56-1
Molecular formula	CH4O
Molecular weight	32.04
Solubility in water	1,000 g/L at 20 °C
Melting point	-98 °C
Boiling point	65 °C
Vapour pressure	16.927 kPa at 25 °C
Henrys law constant	0.461 Pa m³/mol
Explosive potential	Vapour/air mixtures are explosive
Flammability potential	Highly flammable
Colour/Form	Clear colourless liquid
Overview	Methanol occurs naturally in humans, animals and plants. The general population is exposed to methanol mainly through consumption of food and beverages and through use of consumer products such as paints, sealers and adhesives that contain methanol as a solvent.
Environmental Fate [1,3]	
Soil/Water/Air	Air is the main target compartment, based on a fugacity model calculation (Mackay Level III) with about 73 % of environmental methanol distributing to air and 16 % to water. Methanol is degraded in the atmosphere by photochemical, hydroxyl-radical dependent reactions. The estimated elimination half-life is calculated to be about 17-18 days with a rate constant of 0.93 x 10-2 cm3/molecule-sec. Methanol is completely miscible in water and has a low octanol/water partition coefficient. These properties are indicative of high mobility in soil.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Considering the no observed adverse effect level (NOAEL) available from a 90-day rat study (500 mg/kg bw/day), the chemical is not considered to cause serious damage to health by repeated oral exposure. In a 20-day inhalation study in monkeys, 3.9 mg/L (3000 mL/m3) was identified as the LOAEL (continuous exposure) where neurotoxic lesions appeared to progress in monkeys (according to NEDO 1987). This exposure concentration correlated with methanol blood levels 80 mg/L and formate levels 30 mg/L. There was no evidence of adverse effects in rats exposed to methanol up to 6.6 mg/L, six hours/day for 28 days, except local nasal irritation and increased relative spleen weights, which were observed only at the middle dose and not considered treatment-related (Andrews et al. 1987). A NOAEL could not be established in this study. In the chronic exposure studies in rats and mice, slight treatment-related decreases in body and organ weights were reported at the highest dose. These are however not considered as 'adverse' effects. In monkeys, slight degeneration of the inside nucleus of the thalamus was observed at 0.13 and 1.3 mg/L after seven months or more (NEDO 1987). One monkey at 0.13 mg/L and two at 1.3 mg/L showed slight but clear changes in peroneal nerves indicating damage to peripheral nerves. Some signs of fibrosis at 1.3 mg/L, which were considered borderline. There were mild but significant effects on heart and kidney at 0.13 and 1.3 mg/L. Histologically, a significant increase of Sudan positive granules was noted in the 1.3 mg group without pathological manifestations (e.g. fibrosis). Although the authors considered the lowest dose (0.013 mg/L) as the LOAEL, it was observed that effects at this dose were very mild and reversible and therefore not considered to be adverse effects. Based on these observations, a NOAEL of 0.013 mg/L was established in this study.

Carcinogenicity	The chemical is not likely to be a carcinogen. In a chronic inhalation study, Fisher rats and B6C3F1 mice were exposed to 0.013, 0.13, and 1.3 mg/L methanol for 24 and 18 months, respectively (NEDO 1987). No differences in survival were noted in the treatment groups compared with the control group. There was no evidence of an increase in liver tumours in rats or in the spontaneous liver tumour rate in mice. In the rats, some tumours such as papillary lung adenomas (males only), adrenal phaeochromocytomas (females only) and metastatic (transition) tumours appeared at a somewhat higher incidence in high-dose group rats after week 79 and 104 without clear dose-response relationship. However these tumour incidences were not statistically significantly different from those in the control group. In the mice, there were no appreciable differences from the control in either numbers of animals with tumours or in degree of malignancy observed. Proliferative effects on the astroglia cells were observed in monkeys continuously exposed to 0.013, 0.13 and 1.3 mg/L methanol by the inhalation route (NEDO 1987). These effects however were of a transient nature and disappeared after a six-month recovery period. There were no signs of histological degeneration.
Mutagenicity/ Genotoxicity	Methanol has been examined in numerous in vitro and in vivo test systems, including bacterial, mammalian and fungal test systems. Most in vitro studies did not demonstrate mutagenic activity. A small number of studies gave ambiguous results. All other studies produced negative results consistently. The majority of in vivo assays were negative for mutagenicity and clastogenicity (OECD 2004). Methanol was therefore concluded to be not mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No impairment of fertility or reproductive performance was reported in male and female rats exposed to the chemical, except at very high doses. Male mice had morphological anomalies in spermatozoa after repeated oral dosing at 1000 mg/kg bw/day (blood level > 500 to 1000 mg/L in mice) (OECD 2004). Rodent studies indicate that methanol has developmental toxicity effects. The rodent data on developmental toxicity are relevant for humans despite the known differences in methanol metabolism between the two species. However, rodents are considered adequate models for humans only at levels where formate does not accumulate (NTP 2003). Blood methanol levels associated with serious developmental effects in rodents were in the range associated with formate accumulation (1000 to 2000 mg methanol per litre of blood), which is likely to result in metabolic acidosis, and visual and clinical effects in humans (NTP 2003; OECD 2004). The limited data available in humans do not show an association between reproductive and developmental toxicity and methanol (NTP 2003). Following a review of the developmental toxicity studies, the NTP concluded that there is evidence to suggest that females with low folate levels may be more susceptible to the adverse developmental effects of methanol, but more information was necessary to clarify this issue (NTP 2003). Based on the data available, the chemical is not considered to have reproductive or developmental toxicity in humans.

Acute Toxicity	In rats, mice, rabbits and dogs, the LD50 values after single oral administration range from about 5600 to 14 400 mg/kg bw (EHC 1997). Adverse effects noted in these animals were ataxia, narcosis and coma after high methanol doses. The animals did not exhibit acidosis and ophthalmologic changes typically seen in humans at high lethal and sub-lethal doses In rhesus monkeys, no deaths were reported at doses of 1000 to 2000 mg/kg bw, while animals receiving 3000 to 8000 mg/kg bw died within two days (OECD 2004). Treated animals showed acidosis, and some exhibited semi-coma and ophthalmologic changes. Human data, however, indicate acute oral toxicity at comparatively lower doses of 300 to 1000 mg/kg bw (EHC 1997). The reported median lethal doses (LD50) for experimental animals are 7300 mg/kg bw (mouse), 5628 mg/kg bw (rat), 14 200 mg/kg bw (rabbit) and 7000 mg/kg bw (monkey). The lowest lethal dose (LDLo) for humans ranges from 143 to 428 mg/kg bw (ChemIDplus 2012). There are limited available dermal toxicity studies in animals. In one dermal exposure study all the rats survived after application of 35 000 mg/kg bw methanol to the skin under occlusive conditions, while deaths were reported at 45 000 mg/kg bw (Eulner and Gedicke 1955). In rabbits, a dermal LD50 of 17 000 mg/kg bw was reported although no details of the study were provided (Carnegie-Mellon 1981). Limited data in monkeys indicate that the chemical is toxic via the dermal route (McCord 1931). Humans have been found to be more susceptible to methanol as compared to monkeys. Therefore, acute dermal toxicity with methanol is expected in humans (OECD 2004). The lowest reported dermal LD50 is 17 000 mg/kg bw, which was recorded in rabbits. Median lethal concentrations (LC50) of 87.5 and 128.2 mg/L were reported in rats following six and four hour inhalation exposures to methanol, respectively (BASF 1980a, 1980b). Clinical signs of toxicity were secretions from eyes and nose, laboured breathing, staggering, apathy and narcosis. A similar LC50 value (79 mg/L) was reported for mice following 2.25 hours exposure (Von Burg 1994). In cats, LC50 values after six-hour exposures ranged from 26 to 48 mg/L. A shorter duration of 4.5 hours led to an LC50 of 85.4 mg/L (Von Burg 1994). Studies in Rhesus monkeys indicated lethal concentrations (percent mortality not reported) at 13 mg/L after 18 hour exposure and 52 mg/L after one to four hour exposure (OECD 2004).
Irritation	The chemical is not a skin irritant. The chemical is a slight eye irritant in rabbits. High concentration of methanol vapours may cause irritation of the respiratory tract. In a short-term exposure study (details not available), exposure of rats to an atmosphere saturated with methanol vapours produced severe irritation of mucous membranes and milky corneal opacity (BASF 1975). All animals died after eight hours (BASF 1975).
Sensitisation	The chemical is not a skin sensitiser.
Health Effects Summary	Methanol has low acute oral, dermal and inhalation toxicity in experimental animals but moderate to high acute oral and dermal toxicity in humans. A Lowest Lethal Dose (LDLo) of 143 - 428 mg/kg bw (humans) has been reported. It is not a skin or eye irritant but is expected to be a moderate respiratory irritant, based on its effect on the mucous membrane in rats exposed to methanol vapours and on the effects observed in repeat dose inhalation studies. Tests with guinea pigs indicated that methanol is not a skin sensitiser. The critical effects to human health are acute toxicity from inhalation, skin contact and swallowing, and possible irreversible effects from acute oral exposure. No deaths were reported in Rhesus monkeys dosed at 2 000 mg/kg bw, but treated animals showed acidosis, and some exhibited semi-coma and ophthalmic changes. Human data, however, indicate acute oral toxicity and ophthalmic changes at comparatively lower doses of 300 - 1 000 mg/kg bw. Information on repeated dose toxicity by the dermal route is not available. Methanol was not genotoxic or carcinogenic. Reproductive and developmental toxicity studies did not show any significant effects of relevance to humans.

Key Study/Critical Effect for Screening Criteria	A No-Observed-Adverse-Effect-Concentration (NOAEC) of 0.013 mg/L (13 mg/m3) is used for this risk assessment. This NOAEC is derived from a chronic inhalation study in monkeys, in which degenerative effects in the brain and slight damage to the optic and peripheral nerves were noted at 0.13 mg/L and above. Changes in peroneal nerves were also noted in higher dosed animals, indicating damage to peripheral nerves. An oral No Observed Adverse Effect Level (NOAEL) of 500 mg/kg bw/day was also established in rats in a 90-day oral study based on increased liver enzymes (enzymes not specified) and decreased absolute brain weights at the highest dose. This value is not used in this risk assessment because acute oral data indicate that humans are more sensitive to methanol toxicity than rodents.
Ecological Toxicity [2,3]	
Aquatic Toxicity	In several 96-hour studies in fish in which methanol concentrations were measured during the tests, LC50s ranged from 15,400 to 29,400 mg/L. In the chronic toxicity study to invertebrates, the NOEC was 32,000 mg/L.
Determination of PNEC aquatic	A PNECaqua = 3.20E+03 mg/L can be calculated based on the lowest chronic toxicity value for aquatic invertebrates (Daphnia) with the assessment factor of 10.
Current Regulatory Controls[4]	
Australian Hazard Classification	The chemical is classified as hazardous with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): T; R23/24/25 (acute toxicity) T; R39/23/24/25 (irreversible effects from acute exposure) Mixtures containing the chemical are classified as hazardous based on the concentration (Conc) of the chemical in the mixtures. The risk phrases for this chemical are: Conc ≥20%: T; R23/24/25; (Toxic: Toxic by inhalation, in contact with skin and if swallowed); R39/23/24/25; (Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed) 10% ≤Conc <20%: T; R20/21/22; (Toxic: Harmful by inhalation, in contact with skin and if swallowed); R39/23/24/25; (Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed) 3% ≤Conc <10%: Xn; R20/21/22; (Harmful: Harmful by inhalation, in contact with skin and if swallowed); R68/20/21/22; (Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed).
Australian Occupational Exposure Standards	The chemical has an exposure standard of 262 mg/m³ (200 ppm) Time Weighted Average (TWA) and 328 mg/m³ (250 ppm) Short-Term Exposure Limits (STEL) (Safe Work Australia).

International Occupational Exposure Standards	The following were identified (Galleria Chemica): 250-270 mg/m³ (200 ppm) TWA in USA, Canada, Denmark, United Kingdom, Germany, France, Estonia, Greece, Hungary, South Africa, Spain, Singapore, Taiwan, Sweden, Malta, Malaysia, Latvia, Japan, Indonesia, India, Iceland, Egypt, Ireland, Mexico, Philippines and Switzerland; 250-350 mg/m³ (250-328 ppm) STEL in USA, Canada, United Kingdom, Greece, South Africa, Singapore, Sweden, India, Egypt and Mexico; 50 mg/m³ TWA in Bulgaria; 100 mg/m³ TWA and 300 mg/m³ STEL in Poland; 133 mg/m³ TWA in Netherlands; 25 mg/m³ TWA and 50 mg/m³ STEL in China; 1300 mg/m³ (1000 ppm) STEL in France; and 1040 mg/m³ STEL in Hungary and Switzerland.
Australian Food Standards	No Australian food standards were identified (FSANZ 2013)
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for methanol in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Methanol is expected to be readily biodegradable.
B/vB criteria fulfilled?	No. The Log Kow for methanol is -0.82 to -0.64. Thus, methanol does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The EC50s from the acute aquatic toxicity data on methanol are >1 mg/L, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. NICNAS (2017) Human Health Tier II Assessment for Methanol
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS, 2017). National assessment of chemicals associated with coal seam gas extraction in Australia. Human health hazards of chemicals associated with coal seam gas extraction in Australia.
3. OECD (2008) SIDS Initial Assessment Profile on Methanol
4. ECHA REACH, Methanol, Retrieved 2017: https://echa.europa.eu/information-on-chemicals/registered-substances
5. IPCS Acetic Acid, Retrieved 2015: http://www.inchem.org

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Toxicity Summary - Polyethylene glycol

Chemical and Physical Properties	
CAS number	25322-68-3
Molecular formula	(C2H4O)nH2O
Molecular weight	UVCB
Solubility in water	40 g/L @ 30 °C
Melting point	-10 °C at 101.3 kPa
Boiling point	870 °C at 101.3 kPa
Vapour pressure	0 Pa @ 25 °C
Henrys law constant	
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Odourless, viscous transparent organic liquid
Overview	Polyethylene glycols, also known as PEGs, are clear, colourless, thick liquids to waxy solids, depending on the molecular weight. The molecular weight of PEGs ranges from 200 to over 6000. Some may have a faint odour and bitter taste. PEGs mix easily with water. PEGs are important commercial chemicals. They are used to make other chemicals, paper coatings, solvents, plasticizers and used in many household products, cosmetics and pharmaceuticals. One formulation, PEG 3500, is used as a laxative. PEGs are also used as food and animal feed additives.
Environmental Fate[1]	
Soil/Water/Air	Koc value of PEG was estimated as 10 L/kg by means of MCI method. This indicates that PEG will have a negligible tendency of sorption to soil and sediment and therefore have rapid migration potential to groundwater. The estimated half-life of the substance indicates that the substance is rapidly hydrolysable.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	The substance PEG exhibits repeated dose toxicity by oral, dermal and inhalation route. A study was designed to investigate the subacute repeated dose toxicity effects of Polyethylene Glycols (PEG 400) in Wistar rats (male/female) by oral route, in an overall study period of 90 days. Dose group (5 animals per group) was fed a solution ofPEG400 equivalent to 0, 2000, 4000, 8000, 16000 or 24000 mg/kg/day in the diet. The control group received no polyethylene glycol. During the study period, body weight as a ratio to the amount of nutrient consumed, body weight, liver weight, kidney weight, micro pathology of liver and kidneys were examined. No effects upon male and female rats were observed when PEG 400 was present in the diet at a level up to 8000 mg/kg/day (8%concentration) for 90 days study period. But at 16000 mg/kg/day it showed effects on organ weight (liver and kidney heavier than that of control rats); and a decrease in weight gain was observed. Thus, from overall conclusion of the study the NOAEL (no observed adverse effect level) for repeated dose oral toxicity was considered to be 8000 mg/kg/day. And the LOAEL (low observed adverse effect level) for subacute repeated dose toxicity was considered to be 16000 mg/kg/day. Rats were exposed to airborne concentrations of 100 mg/m^3 and 1000 mg/m^3 of PEG-200 for periods up to 13 weeks. Toxicological, physiological, hematological, blood chemical, and pathological effects were evaluated during the course of the exposures. No significant lesions observed in this study occurred exclusively in exposed animals and the severity of lesions which were found was not dose-related. It is our impression that there were no PEG 200 induced lesions in rat tissue at the dosage level and exposure/post exposure periods evaluated in this study. Organ:body weight ratios in rats at all concentrations and for the 6- and 13-week exposure periods and the 30-day post exposure period showed no pattern of significance that could be related to PEG 200. The mice organ:body weights for the 6-week·exposure period are unavailable. No pattern of significance could be related to PEG 200 exposure for the 13-week or the 30-day post exposure periods. There were no consistently significant changes in rat blood chemistry at the end of the 6- or 13-week exposures or the 30-day post exposure period. It appears that PEG-200 produced no positive effects in the rodents at the Inn and 1000 mg/m3 PEG 200 concentrations over the 13 weeks of exposure used in this study. Thus it is concluded that the NOAEC value of PEG-200 in rats was observed at dose level of 1000 mg/m^3. The NOAEL value of PEG in rabbit was observed at dose level of 760 mg/kg bw/day. The supporting study indicates the TDLo (TDLo - Lowest published toxic dose) of PEG was observed at a dose concentration of 30 mL/kg (30000 mg/kg) in a 30 days study period where the dosage of PEG was intermittently given to rodent-rabbit by the dermal route(full study is not available). Considering the above results it is concluded that PEG is non-toxic by dermal route.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	PEG was found to be non-genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The one generation reproductive toxicity NOAEL (no observed adverse effect level) of PEG in rat was observed at a dose concentration of 1698.09 mg/kg bw/day. On the basis of this NOAEL value it indicates that PEG does not exhibit toxic effects to rat below the above mention dose.
Acute Toxicity	Acute toxicity of PEG to mouse by the oral route indicates that the substance does not exhibits acute toxicity by the oral route. Similarly the acute values of inhalation also indicate that the substance does not exhibits acute toxicity by the inhalative route. Thus, it can be inferred that the target substance is non-toxic to any of the oral, dermal and inhalation route of exposure.
Irritation	The available studies indicate that the substance PEG is not classified as a skin and eye irritant according to CLP regulation within the dose levels mentioned in the study.
Sensitisation	In the human repeat insult patch test 216 subjects were enrolled and 200 subsequently completed the study. PEG 200 caused some degree of sensitization response in 1 of the 200 subjects. This subject was a 61 year old white woman.

Health Effects Summary	PEG is non acute toxic to oral, dermal and inhalation route, shows no irritation effect to skin and eye, is not genotoxic and is not developmental and reproductive toxic.
Key Study/Critical Effect for Screening Criteria	Oral: In chronic repeated dose toxicity study by polyethylene glycols (PEG) 400 showed no effect upon male and female dogs when present in the diet at a level of 500 mg/kg/day (2% concentration) for one year. Thus NOAELs (no observed adverse effect level) for repeated dose oral toxicity was considered to be 500 mg/kg/day. Inhalation: The NOAEC value of PEG-200 in rats was observed at dose level of 1000 mg/m^3. Dermal: The NOAEL value of PEG in rabbit was observed at dose level of 760 mg/kg bw/day.
Ecological Toxicity [1]	
Aquatic Toxicity	The toxicity values of fish, invertebrates and algae are LC50 = 100 mg/L, LC50 = 1000 mg/L and EC 50 = 15.91 mg/L, respectively.
Determination of PNEC aquatic	Acute LC50 values are reported for fish, aquatic invertebrates, and freshwater algae. Since there is valid acute toxicity data for three trophic levels, an assessment factor of 1000 is used (in accordance with EU guidance). Based on the EC50 for freshwater algae (the most sensitive species in short term tests), the aquatic PNEC is 15.91 µg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. PEG is non persistent in nature and so is considered to have rapid biodegradation in the environment.
B/vB criteria fulfilled?	No. The calculated BCF of PEG is 3.2 dimensionless and below the threshold of 2000.
T criteria fulfilled?	No. Acute toxicity data >1 mg/L in fish, invertebrates and algae, thus PEG does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

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Toxicity Summary - Sodium bisulfite

Chemical and Physical Properties [1]	
CAS number	7631-90-5
Molecular formula	H2O3S.Na
Molecular weight	104.06
Solubility in water	724 g/L @ 20 °C
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Sulfites in aqueous solutions involve complex equilibria among the different species of sulfur oxidation state IV. The composition of their mixture in solutions depends on the pH and temperature. Sulfur dioxide may be produced from sulfites at low pH. At a pH closer to 7, the concentration ratio of bisulfite ($HSO3^-$) to sulfur dioxide (SO2) is very high (Gunnison and Jacobsen, 1987). Sulfites occur naturally in some foods and beverages as a result of fermentation (e.g. in beer and wine). A small percentage of the population (up to 1 %) is sensitive to sulfites (FDA, cited in Grotheer et al., 2005), as sulfur dioxide may be generated from sulfites in the stomach at low pH (Simon, 1986). The sensitivity to sulfur dioxide can cause a wide range of reactions in humans ranging from mild to severe dermatological, pulmonary, gastrointestinal, or cardiovascular symptoms (Grotheer et al., 2005).
Environmental Fate[1]	
Soil/Water/Air	The substance has a very low vapour pressure, and also does not sublime. Therefore, the substance will not be present as a gas and no radical reactions can be expected. According to its chemical properties, hydrolysis is not expected/probable. Photodegradation in water is not relevant because it dissociates rapidly into ions and decomposes in water, and it not susceptible to visible light. The substance is an inorganic compound which does not undergo biodegradation. The substance readiliy dissociates in aqueous solution, as with soil moisture. Bioaccumulation is not to be expected. a low log Kow underlines this statement. Due to the ionic salt-character and other physico-chemical properties (negligible vapour pressure, very high water solubility and decomposition in water), the Henry constant is near to zero. Because of its ionic nature, sodium hydrogensulfite as well as its dissociation products are not volatile from aqueous solutions. Relevant adsorption onto soils, sediments or suspended matter is not expected.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Based on the data available for sodium metabisulfite, Sulfites are not considered to cause serious damage to health by repeated oral and inhalation exposure. In an 8-week study, SD rats (normal and sulfite oxidase enzyme—which oxidises sulfite to sulfate—deficient) were exposed to sodium metabisulfite (CAS No. 7681-57-4) or a mixture containing sodium metabisulfite and acetaldehyde hydroxysulfonate, in drinking water at doses of 0, 7, 70 or 175 mg/kg bw/day (as SO2). A no observed effect level (NOEL) for sodium metabisulfite was established as 70 mg/kg bw/day (as SO2) for all treated rats (normal and enzyme deficient), based on severe gastric lesions, significant body weight reduction and increased urine excretion with sulfites observed at the highest dose. The NOEL for the mixture was 7 mg/kg bw/day (as SO2) for enzyme-deficient rats, based on severe gastric and hepatic lesions at higher doses. At necropsy, lung oedema was observed in sodium metabisulfite treated, enzyme-deficient rats (Hui et al., 1989 cited in CIR, 2003). Groups of six rats (Sprague Dawley) were exposed to sodium sulfite (CAS No: 7757-83-7) aerosols with a particle size of approximately 1 µm at concentrations of 0.1, 1, 5 or 15 mg/m3 for three days. Mild pulmonary oedema at 5 mg/m3 and irritation of the tracheal epithelium at 15 mg/m^3 were observed (CIR, 2003). In a repeated dose study, eight dogs (beagle) were exposed to 1 mg/m3 of sodium metabisulfite (CAS No: 7681-57-4) aerosols with a mass median aerodynamic diameter (MMAD) of 0.63 µm for 290 days. Severe epithelial changes were observed with hyperplastic foci in the respiratory region of the nasal cavity. An increase in the nonciliated cell numbers in the membranous portion of the trachea of the animals was also observed. No other effects were reported (CIR, 2003).
Carcinogenicity	Based on a 104-week repeated dose toxicity study in rats, with up to 2 % sodium bisulfite in the diet, sodium bisulfite is not considered carcinogenic to rats (OECD, 2001).
Mutagenicity/ Genotoxicity	Based on the data available, Sulfites are not considered to be genotoxic. A mixture of sodium bisulfite (CAS No. 7631-90-5) and sodium sulfite (1:3) was tested at concentrations of 0.05–1 mmol/L in human peripheral lymphocytes. Positive results were obtained for chromosomal aberrations: micronucleus formation, and sister chromatid exchange (WHO, 1999). In an in vitro unscheduled DNA synthesis test with rat hepatocytes (OECD TG 486), and in an in vivo micronucleus test (OECD TG 474), sodium bisulfite (CAS No. 7631-90-5) did not show any evidence of mutagenicity (SCCNFP, 2003). Sodium bisulfite gave both positive and negative results in the mutagenicity testing. The positive results in Salmonella typhimurium strains containing his-G46 and his-D6610 mutations, and in some E.coli strains were suggested to be due to the presence of sulfurous acid under acidic conditions. At a neutral pH and lower concentrations, sodium bisulfite was not mutagenic to these strains. However, sodium bisulfite alone gave negative results in all in vivo studies with mammalian systems (rats and mice) (CIR, 2003).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the data available, Sulfites are not considered to cause reproductive or developmental toxicity. Pregnant rats (Wistar) were exposed by gavage to sodium bisulfite (CAS No. 7631-90-5) at 0, 1, 5, 24, or 110 mg/kg bw/day on days 6–15 of gestation. The NOAEL for maternal toxicity or embryo foetotoxicity was 110 mg/kg bw/day. A NOAEL of 123 mg/kg bw/day was established in a study with pregnant rabbits (Dutch belted) exposed to sodium metabisulfite (CAS No. 7681-57-4) at 0, 1.23, 5.71, 26.5 or 123 mg/kg bw/day on days 6–18 of gestation. In both these studies, there were no treatment related effects reported on nidation (nesting behaviour), maternal or foetal survival. The number of abnormalities in soft or skeletal tissues of the treated groups were similar to controls (OECD, 2001).

Acute Toxicity	Sodium bisulfite has an oral LD50 of 2000 mg/kg bw in rats (ChemIDplus). Based on the limited data available, sulfites are considered to be of low acute dermal toxicity. The LD50 for sodium metabisulfite in rats is >2000 mg/kg bw. Sulfites exhibit low acute toxicity in animal tests (US EPA, 2007). Based on the limited data available, no conclusion can be made on the acute inhalation toxicity of the chemicals in this group. A group of guinea pigs was exposed (whole body) for one hour to 0.204, 0.395 or 1.152 mg/m^3 of sodium sulfite (CAS No. 7757-83-7) aerosols with a mass median aerodynamic diameter (MMAD) of 0.36 µm. The chemical caused dose-related changes in the lung capacity parameters (bronchoconstriction) with a lowest observed adverse effect concentration (LOAEC) of 0.204 mg/m^3 (Chen et al., 1987 cited in CIR, 2003). Sodium bisulfite are classified as hazardous with the risk phrase 'Contact with acid liberates toxic gas' (Xi; R31) in the Hazardous Substances Information System (HSIS) (Safe Work Australia).
Irritation	No data are available on respiratory tract irritation from a single exposure. A 3-day repeated dose study indicated irritation of the tracheal epithelium in rats from exposure to sodium sulfite (CAS No. 7757-83-7) aerosols at 15 mg/m^3 (CIR, 2003). In acute dermal irritation studies (OECD TG 404) with sodium sulfite, sodium bisulfite and potassium sulfite, no skin irritation was observed in albino rabbits (SCCNFP, 2003). In acute eye irritation studies (OECD TG 405) with sodium sulfite and sodium bisulfite in rabbits, slight to severe effects in the cornea and the iris in most of the exposed animals persisted during the observation periods (eight and 15 days, respectively). Slight to moderate conjunctival effects (erythema and oedema) were also observed up to the end of the observation periods. Due to the persistency of eye effects, especially of increased corneal opacity, both chemicals were considered as severe eye irritants (SCCNFP, 2003).
Sensitisation	Based on the available data, Sulfites are not likely to be skin sensitisers.
Health Effects Summary	Severe eye irritation effects; acute oral toxicity; and the possibility of liberating toxic gas when the chemical is in contact with acids. Sensitivity to sulfites that causes allergic reactions in a small percentage of the population should also be considered.
Key Study/Critical Effect for Screening Criteria	The main critical effects to human health are severe eye irritation and acute oral toxicity. The chemicals in this group will liberate toxic gas when in contact with acid and therefore may cause effects in individuals with a high acid content in the stomach. A small percentage of the population (up to 1 %) are sensitive to sulfites (FDA, cited in Grotheer et al., 2005). Those who have asthma are most at risk to sulfite sensitivity and other forms of sulfite reactions. This sensitivity can cause a wide range of allergic reactions ranging from mild to severe.
Ecological Toxicity [2]	
Aquatic Toxicity	Acute and chronic toxicity data were available for the three main aquatic trophic levels that are considered for classification purposes. Classification is based on the lowest acute and chronic value, referred to as the acute and chronic toxicity reference value (TRV). The lowest acute effect concentration was observed for the alga S. subspicatus (72h-EC50), and was 36.8 mg sodium sulfite/L. Translating this value to HNaSO3 results in an acute TRV of 47.9 mg/L for this substance. For sulfite/disulfite compounds, the lowest chronic value was a NOEC of >8.41 mg sodium sulfite/L for the invertebrate D. magna. Translating this value to HNaSO3 results in a chronic TRV of 10.9 mg/L for this substance, i.e., > 1 mg/L.

Determination of PNEC aquatic	The lowest value for chronic toxicity was and unbounded NOEC of 8.41 mg sodium sulfite/L. Applying the AF of 10 results in a PNECaquatic of 0.84 mg sodium sulfite/L.Translating this value to HNaSO3 gives a PNECaquatic of 1.09 mg test substance/L. As the lowest NOEC-value is an unbounded value (i.e., no effect was noted at the highest test concentration), this value can be considered as a worst-case estimate. Further refinement of the NOEC-value for daphnids could increase the PNECaquatic up to a maximum value of 2.8 mg sodium sulfite/L (i.e., an assessment factor of 10 on the algal 72h-EC10 value), which is equivalent to 3.64 mg test substance/L.
Current Regulatory Controls [1]	
Australian Hazard Classification	Sodium bisulfite is classified as hazardous with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Sodium bisulfite (CAS No. 7631-90-5): Xn; R22 (acute toxicity) Xi; R31 (contact with acid liberates toxic gas)
Australian Occupational Exposure Standards	Sodium bisulfite has an exposure standard of 5 mg/m^3 time weighted average (TWA). The exposure standard for sulfur dioxide of 5.2 mg/m^3 (2 ppm) (TWA) is also relevant to uses of these chemicals that may generate sulfur dioxide.
International Occupational Exposure Standards	An exposure limit (OEL, TWA, STEL, PEL or STV) of 5–10 mg/m^3 in different countries such as USA, United Kingdom, Canada, Ireland, Spain, Norway and Switzerland.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [2]	
P/vP Criteria fulfilled?	Not applicable (inorganic substance)
B/vB criteria fulfilled?	Not applicable (inorganic substance)
T criteria fulfilled?	Not applicable (inorganic substance)
Overall conclusion	Not PBT
Revised	January 2019

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2. ECHA REACH, Sodium hydrogensulfite, Retrieved 2019: https://echa.europa.eu/

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Toxicity Summary - Sodium chloride

Chemical and Physical Properties [1,4]	
CAS number	7647-14-5
Molecular formula	NaCl
Molecular weight	58.44 g/mol
Solubility in water	3.57 x 10 5 g/m3 at 25oC
pH	In aqueous solution is neutral
Melting point	1 mm Hg at 865oC
Boiling point	1670 ^{o}C
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	light brown liquid or colourless crystals
Overview	Sodium, together with potassium is an essential mineral for the regulation of body fluid balance. Sodium is the most abundant cation in the extracellular fluid and sodium salts account for more than 90% of the osmotically active solute in the plasma and interstitial fluid. Consequently, sodium load is the major determinant of extracellular volume. Chloride is also important in maintaining the fluid balance and is an essential component of the gastric and intestinal secretions Sodium chloride occurs naturally as rock salt which comprises 95% to 99% NaCl. It is also widely used in food products. The NHMRC has established dietary guidelines for the intake of sodium per day (adults should consume less than 2300 mg sodium per day). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate [2,3]	
Soil/Water/Air	Due to its high solubility, sodium chloride is highly mobile in the environment. Once dissociated, chloride ions will migrate readily, however sodium ions will sorb to clay-rich materials limiting mobility. If released into the environment, sodium chloride is not likely to sorb to solid particles in the water column, is readily dissociated to form chloride and sodium ions, is not bioaccumulative in aquatic species or the food chain.

Human Health Toxicity Summary [2,3]	
Chronic Repeated Dose Toxicity	High sodium chloride intakes increase calcium excretion and may increase the risk of kidney stone formation. There is evidence for a causal relationship between the consumption of sodium (mainly from common salt) and both blood pressure and the age-related rise in blood pressure. Data suggest that30% of a normotensive population may be salt sensitive. Sodium chloride has been demonstrated to be a gastric tumour promoter in experimental animals and high sodium chloride intakes have been associated with incidence of stomach cancer in human populations with traditional diets of highly concentrated, salted foods.
Carcinogenicity	Not listed with IARC.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	Although rare, acute toxicity may be caused by ingestion of 500 – 1000 mg sodium chloride/kg body weight. Symptoms include vomiting, ulceration of the gastrointestinal tract, muscle weakness and renal damage, leading to dehydration, metabolic acidosis and severe peripheral and central neural effects.
Sensitisation	No data available.
Health Effects Summary	Sodium is an essential mineral for the regulation of body fluid balance. This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water guideline value for sodium and chloride may apply.
Ecological Toxicity [2,3,4]	
Aquatic Toxicity	A large number of studies are available in relation to the aquatic toxicity of sodium chloride with the USEPA ECOTOX database identifying 1712 records. The evaluation of ecological effects of sodium chloride has been evaluated in detail for the assessment of the use of rock salt in the US on roadways during the winter months. The following has been summarised from the US review: The presence of sodium chloride may result in the increased mobilisation of other contaminants (metals, nutrients etc) and a shift in the acid buffering capacity may compromise aquatic ecosystems. Most sensitive species are birds where a safe concentration of 1000 mg/L sodium chloride can be established. Salt tolerance of aquatic species varies significantly with EC50 concentrations ranging from 400 to 30000 mg/L. The measured acute endpoint for Fish was reported at 1290 mg/L. The measured NOEC for Daphnia is 314 mg/L.
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 100 has been applied to the lowest reported effect concentration of 314 mg/L. The PNECaquatic is determined to be 3.14 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available

Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [4]	
P/vP Criteria fulfilled?	Sodium chloride is an organic salt that dissociates completely to sodium and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both sodium and chloride ions are also ubiquitous and are present in most water, soil and sediment. The persistent criteria is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Sodium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, sodium chloride is not expected to bioaccumulate.
T criteria fulfilled?	The measured chronic toxicity data for sodium chloride was 314 mg/L for Daphnia Thus, sodium chloride does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2018

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2. UK 2003. Expert Group on Vitamins and Minerals, Risk Assessment - Sodium Chloride
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4. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

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Toxicity Summary - Sodium hydroxide

Chemical and Physical Properties	
CAS number	1310-73-2
Molecular formula	Na-O-H
Product name	40 g/mol
Molecular weight	1.11E+06 mg/L at 20C
Solubility in water	13
Melting point	318 °C
Boiling point	1388 °C
Vapour pressure	Negligible at 25 deg C
Henrys law constant	No data found.
Explosive potential	No
Flammability potential	No
Colour/Form	Anhydrous (pure) NaOH is a solid – *refer melting point above*. However it is a hygoscopic, ionic solid, and will absorb water from air and is highly soluble
Incompatibility	Avoid contact of solid NaOH with water due to strong exothermic reaction, leather, wood, acids, organic halogen compounds or organic nitro compounds. Carbon monoxide gas can form upon contact with reducing sugars, food and beverage products in enclosed spaces. NAoH is neither explosive, flammable, nor oxidising.
Overview	Vegetable oil refining, regenerating iron exchange resins, organic fusions, peeling of fruits and vegetables in the food industry, etching and electroplating.
Environmental Fate[1]	
Soil/Water/Air	Sodium hydroxide is highly soluble, not volatile and unlikely to materially adsorb to soil and is therefore predominately found in the aquatic environment if released to the environment. NaOH will readily dissociate to be present in the environment as sodium and hydroxyl ions, both being ubiquitous in the environment. NaOH is a strong alkali, so it's dissolution in water may locally raise the pH of the affected environment. The dissolution reaction is also strongly exothermic.

Human Health Toxicity Summary [1,2,,3]	
Chronic Repeated Dose Toxicity	No animal data are available on repeated dose toxicity studies by oral or dermal routes for sodium hydroxide. In a repeat dose inhalation study, twenty seven white rats died within a month, mostly from bronchopneumonia, after being exposed twice weekly to an aerosol of unknown airborne concentration of sodium hydroxide, generated from an aqueous 40% sodium hydroxide solution (NIOSH 1975). When exposed to an aerosol generated from a 20% sodium hydroxide solution, the bronchi were dilated, the epithelial cover was thin and frequently desquamated, and the septa were dilated and cracked. A light round cell infiltration of the sub-mucus membrane tissue was also observed. Few changes occurred in a group of rats exposed to aerosols from 10% sodium hydroxide, but rats exposed to an aerosol of 5% sodium hydroxide had dilation of the bronchi and a slight degeneration of the mucus membrane and thickened strata of lymphadenoid tissue surrounding the bronchi. A NOAEL could not be established in this study. Workers exposed to 0.24 to 1.86 mg/m^3 sodium hydroxide for 2 to 15 minutes reported throat irritation and watery eyes (NIOSH 1975). Based on the observations of the irritant effects on workers exposed to 1 to 40 mg/m^3 sodium hydroxide, it was concluded that 2 mg/m^3 represented a concentration that is 'noticeably but not extensively irritant' (NIOSH 1975). Obstructive airway disease has been reported following chronic occupational exposure to sodium hydroxide mist (IPCS 1996). The patient developed cough, dyspnoea and tachypnoea after a 20-year exposure to sodium hydroxide.
Carcinogenicity	IARC Category 3 - not classifiable as to human carcinogenicity
Mutagenicity/ Genotoxicity	In vitro and vivo genetic toxicity testing reported no evidence of mutagenic activity.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No valid studies were identified regarding reproduction toxicity after oral, dermal or inhalation exposure to NaOH. Sodium hydroxide is not expected to be systemically available to the body under normal handling and use conditions.
Acute Toxicity	Exposure to the solid or concentrated liquid can cause severe burns to the eyes, skin and gastrointestinal tract which may cause death. An oral LD50 of a 1-10% solution of NaOH in rabbits was 325 mg/kg bw (as 100% NaOH). An oral LD50 of 140 to 340 mg/kg in rats has also been reported (National Research Council 2011), however details of the study are not available. In an acute dermal study, mice were treated dermally with 50% sodium hydroxide, and the treated area was irrigated with water at various intervals (OECD 2002). The mortality of mice was 20, 40, 80 and 71% when they were irrigated at 30 minutes, one hour, two hours or not at all after the application. All animals developed rapidly progressive burns. No mortality or burns were observed when the treated area was irrigated immediately after the application. A 5% aqueous solution of sodium hydroxide produced severe necrosis when applied to the skin of rabbits for four hours (Clayton and Clayton 1993). A dermal LD50 of 1350 mg/kg has been reported in rabbits (National Research Council 2011), however details of the study are not available. Caustic dusts are irritating to the upper respiratory system. Prolonged exposure to high concentrations may cause discomfort and ulceration of nasal passages. Cases of fatality due to ingestion of liquid sodium hydroxide have been reported in humans.
Irritation	Sodium hydroxide is a corrosive irritant to skin, eyes and mucous membranes. A NaOH solution of 8% can be considered corrosive based on animal data. Human data indicate that concentrations of 0.5 to 4% were irritating.
Sensitisation	Sodium hydroxide has no skin sensitisation potential.

Health Effects Summary	An oral LD50 of 325 mg/kg in rats and a dermal LD50 of 1350 mg/kg in rabbits were reported for sodium hydroxide. Lethality has been reported in animals at oral doses of 240 mg/kg bw. Inhalational LC50 is not available. Sodium hydroxide is corrosive to skin, eyes and gastrointestinal and respiratory tracts. Based on human data, concentrations of 0.5 to 4.0% are irritating to the skin, while a concentration of 8.0% is corrosive. Sodium hydroxide is not a skin sensitiser. No animal data were available on repeated dose toxicity by oral or dermal routes for sodium hydroxide. In the single reported repeat dose inhalation study, a NOAEL could not be established. Both in vitro and in vivo genetic toxicity tests indicated no evidence of a mutagenic activity. Information is not available on reproductive and developmental toxicity and carcinogenicity of sodium hydroxide. Due to dissociation into ions which are subject to homeostatic controls in the human body, systemic effects from repeated exposures to sodium hydroxide are not expected. The critical health effect of sodium hydroxide is its corrosive effect.
Key Study/Critical Effect for Screening Criteria	No oral TRV apply. Acute toxicity only (irritant and corrosive), not systemically available in body. The Australian drinking water guideline value for pH may apply to sodium hydroxide.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Measured acute endpoints were available for fish (196 mg/L). Measured chronic endpoint were available for Daphnia (240 mg/L)
Determination of PNEC aquatic	An assessment factor of 10 has been applied to the lowest reported NOEC of 240 mg/L for Daphnia. The PNECaquatic is 24 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	C: R35 (Corrosive, causes severe burns)
Australian Occupational Exposure Standards	Sodium hydroxide has an exposure standard of 2 mg/m³, Time Weighted Average (Safe Work Australia 2013).
International Occupational Exposure Standards	Occupational Exposure Limit (OEL) or limit values in working environment of 2 mg/m³ [Argentina, Belgium, Bulgaria, Canada, China, India, Japan and the US (NIOSH 1975)]. Occupational exposure standard: 2 mg/m³ [Korea] Occupational exposure limit values: 0.5 mg/m³ [Latvia] Short Term Exposure Limit (STEL): 2 mg/m³ [UK] US Department of Energy Temporary Emergency Exposure Limits (TEELs) = 0.5 mg/m³ (TEEL-0 and TEEL-1), 5 mg/m³ (TEEL-2) and 50 mg/m³ (TEEL-3).
Australian Food Standards	Processing aids - Generally permitted - permitted for use as acidity regulator (FSANZ 2013). Sodium hydroxide is allotted an International Numbering System (INS) of food additives number: INS 524 (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found. However, since sodium hydroxide readily dissociates in water into sodium and hydroxyl ions, the Australian Drinking Water Guidelines for sodium state that, based on aesthetic considerations (taste), the concentration of sodium in drinking water should not exceed 180 mg/L (National Health and Medical Research Council (NHMRC) 2011). No health-based guideline value is proposed for sodium.
Aquatic Toxicity Guidelines	No data found.
Occupational Exposure Limits	Peak limitation – 2 mg/m^3
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and hydroxide ions are ubiquitous and are present in most water, soil and sediment.

T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

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3. European Commission (EC) Joint Research Centre (JRC) Institute for Health and Consumer Protection - European Chemical Substances Information System (ESIS), Sodium Hydroxide, Summary Risk Assessment Report, 2008
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Toxicity Summary - Sodium iodide

Chemical and Physical Properties [1,2,3]	
CAS number	7681-82-5
Molecular formula	INa
Molecular weight	149.92
Solubility in water	165 – 1,800 g/L @ 25 °C
Melting point	651 - 659 °C at 101.3 kPa
Boiling point	1,304 °C at 101.3 kPa
Vapour pressure	-1.301 @ 25 °C
Henrys law constant	0.015 Pa.m³.mol-1 @ 25 °C
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Solid, colourless cubic crystals, odourless
Overview	Iodides are used by the thyroid gland in hormone production. Iodides have been utilized to treat iodine disorders, hyperthyroidism, bacterial, fungal or protozoal infections and also were traditionally as expectorants because of their stimulatory effects on bronchial secretions. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate [2]	
Soil/Water/Air	Sodium iodide is very stable under ordinary conditions of use and storage. The phototransformation in air is irrelevant to sodium iodide, because few sodium iodide can be distributed in air for the low vapour pressure and high water solubility. Hydrolysis is not a concern to such inorganic substance which can be completely ionized in water phase. sodium iodide will completely dissociate in water giving sodium ion and iodide anion. The sodium iodide is readily absorbed by organisms as Na+ and I-, which are both small (an)ions and well known to not likely to be bioaccumulative. Based on the intrinsic prosperities of sodium iodide, the substance can be expected to have a low potential for adsorption (completely ionized to small ions in water phase). The sodium ion and iodide anion are uniformly distributed in water phase. In the air, these two basic (an)ions is negligible, due to high water solubility and low vapour pressure. To sediment and soil phases, these two (an)ions are mostly distributed in the pore water.
Human Health Toxicity Summary [1]	

Chronic Repeated Dose Toxicity	The most likely route for human exposure is via digestion, so the dermal and inhalation route are irrelevant in the repeated toxicity assessment. Boyages et al. (1989) compared thyroid status in groups of children 7–15 years of age who resided in two areas of China where drinking-water iodide concentrations were either 462.5 µg/l (n = 120) or 54 µg/l (n =51). Urinary iodine concentrations were 1236 µg/g creatinine in the high-iodine group and 428 µg/g creatinine in the low-iodine group. Although the subjects were all euthyroid, with normal values for serum thyroid hormones and TSH concentrations, TSH concentrations were significantly higher ($P < 0.05$) in the high-iodine group. The high-iodine group had a 65% prevalence of goitre and a 15% prevalence of Grade 2 goitre compared with 15% for goitre and 0% for Grade 2 goitre in the low-iodine group. To transform the measured urinary iodine levels into estimates of iodine intakes, steady state baseline dietary intakes of iodide were assumed to be equivalent to the reported 24 h urinary iodine excretion rates. Assuming a body weight of 40 kg and lean body mass of 85% of body weight, the urinary iodine/creatinine ratios reported by Boyages et al. (1989) can be converted to approximate equivalent intake rates of 1150 µg/day (0.029 mg/kg body weight per day) and 400 µg/day (0.01 mg/kg body weight per day) for the high- and low-iodine groups, respectively. Thus, the NOAEL for this study is considered to be 0.01 mg/kg body weight per day. From the Boyages et al. (1989) study, supported by the studies of Gardner et al. (1988), Paul et al. (1988), and others, a TDI of 0.01 mg/kg body weight, based upon reversible subclinical hypothyroidism, can be established by dividing the NOAEL of 0.01 mg/kg body weight per day by an uncertainty factor of 1.
Carcinogenicity	A chronic toxicity and carcinogenicity study, in which male and female F344/DuCrj rats were administrated iodide (KI) in the drinking water at concentrations of 0, 10, 100 or 1000 ppm for 104 weeks was conducted. In the test, neither focal hyperplasias, adenomas nor carcinomas derived from the follicular epithelium were increased, despite the fact that iodide was administered for 2 yr. It was therefore concluded that long-term treatment of iodide per se does not result in thyroid tumour induction in rats. In contrast, SCCs were observed in the submandibular gland in the 1000 ppm groups of both sexes, along with focal acinar atrophy and/or ductular proliferation, frequently accompanied by squamous metaplasia. Based on the fact that the cell proliferation of these proliferating ductules was higher in cases with metaplasia, and the evidence of a morphological continuum from meta-plasias to squamous cell carcinomas, a histogenetic relationship is suspected, which was also described in previous investigation (Takegawa et al., 1998). Based on these findings, it suggests that excess iodide has a thyroid tumour-promoting effect, but iodide per se does not induce thyroid tumours in rats. In the salivary gland, iodide was suggested to have carcinogenic potential via an epigenetic mechanism, only active at a high dose (1000 ppm in drinking water). The default value of volume of drinking water for rat is well accepted of 10 ml/100g bw·day, and the average body weight for rat is 250g. Based on these the LOAEL for salivary glands for carcinogenicity is proposed to be 100 mg/kg bw·day of iodide by drinking water

Mutagenicity/ Genotoxicity	The mutagenic potential for iodide (in potassium iodide) was studied using the L5178Y mouse (TK+/-) lymphoma assay (Kessler et al., 1980), The established mutagens ethylmethanesulphonate (EMS) and dimethylnitrosamine (DMN)were highly active in this assay, whereas iodide (KI) was inactive. Using the BALB/c 3T3 transformation assay well assessed the transformational capacities of these same agents and the positive mutagen N-ethyl-N-nitro-N-nitrosoguanidine (MNNG). All concentrations of the iodide tested were inactive in this assay it can be concluded that KI did not possess any biologically significant mutagenic cell transforming ability. Another study (J.M. Poul, and P. Sanders, 2004) on genotoxic effects of potassium iodide was conducted in vitro using the alkaline comet assay at concentration of 0.625, 1.25, 2.5, 5 and 10 mM. Additionally in the test cell viability was also measured using the Trypan blue exclusion method and expressed as proportion of total cells. The test results showed that potassium iodide did not induced DNA damage or cytotoxicity in the alkaline comet assay for doses up to 10 mM. In the same study, the chromosome damage effects of potassium iodide were evaluated in vitro using cytokinesis-block micronucleus test at concentration of 0.625, 1.25, 2.5, 5 and 10 mM. Additionally in the test cytotoxicity was also measured by the binucleated (BN) cell ratio between treated and control slides. The test results showed that potassium iodide did not induce chromosome damage or cytotoxicity in the alkaline comet assay for doses up to 10 mM. In an in vivo chromosome aberration test on embryonic hepatocytes, Stable iodine of 10 mg/kg is administered to the rats 7 days after fertilization. Then the embryonic liver was homogenated and the cells in metaphase were stained and checked under metaphase. The chromosome aberration cells were counted respectively for the concentration group and control group. The chromosome aberration rate in the concentration group was compared with that in the control group. The result showed there was no significant difference between iodide dosed group with the control group. Therefore, it can be concluded that the iodide has neither genetic toxicity nor cytotoxicity to mammalian cells.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Iodide (KI) was fed to male and female rats before and during breeding, to females only during gestation and lactation, and to their offspring after weaning (day 21 after birth) through to day 90, at levels of 0, 0.025, 0.05 or 0.1% (w/w) of the diet. There was no evidence suggesting that potassium iodide was embryotoxic. Litter size was significantly reduced, but birth weights and external morphology among those born alive were not significantly altered. No change in thyroid weight was observed indicating that these doses were not overtly thyrotoxic. Thyroid hormones were not assessed, however, and it is possible that thyroid function could have been altered in these animals. Nevertheless, the data are consistent with a picture of impaired thyroid function. Several tests of post-weaning behaviour showed effects at the lowest dose, 0.025 % potassium iodide. M-maze errors were increased at this dose and rotorod performance decreased. However, because these effects were not found at the higher doses it appears unlikely that they were related to potassium iodide. At present, these effects can only described as 'false positives'. The only effect on post-weaning behaviour that appeared to be consistently related to potassium iodide exposure was the reduction in nocturnal running-wheel activity found among the tested females. It may be that female cyclicity makes them more sensitive to the influence of chronic moderate iodide exposure than males and this could explain the contrast with the results of an acute test of activity and exploration, the open-field test, on which no consistent iodide-related effects were found. According to REACH guidance “R 10.8 of Guidance on information requirements and chemical safety assessment Chapter R.10: Characterisation of dose [concentration]-response for environment” The NOAEL can be calculated with the equation R 10-7:NOAEL(mg/kg bw day) = NOEC (mg/kg food)/CONV Where NOEC (mg/kg food) is 0.1, and CONV for Rattus norvegicus (> 6 weeks) is 20, and 10 for Rattus norvegicus (≤6 weeks). Therefore under this study the NOAEL for rats is 50 mg/kg bw day (developmental). In another study, twenty-five thyroiditis-prone BB/W rats were prenatally and postnatally exposed to iodine in drinking-water at dosages equivalent to 0, 0.059, or 59 mg/kg body weight per day for about 12 weeks. An increase in the number of lysosomes and lipid droplets was observed in the treated animals, especially in the higher exposure group. However, the test organism is not healty, as well as not enough information in the study, the effects cannot be considered to be dose related. Additionally, old studies were conducted with rabbits hamsters, rats and swine (Arrington LR, et al., 1965) to determine the effects of excess iodine intake. Females were bred to normal males, potassium or sodium iodide was added to the diet during the latter portion of gestation and the females were permitted to litter normally. Observations were made for length of gestation, parturition time, lactation and survival of young. 250 to 1000 ppm iodide fed for 2 to 5 days caused increasing mortality of new born rabbits. Hamsters were not affected by 2500 ppm iodine except for slightly re duced feed intake and decreased weaning weight of the young. Gestation time for rats and hamsters was not affected by iodine. Female rats and rabbits re-bred after removal from dietary iodine produced and nursed litters normally. Swine were not affected by dietary levels of iodine which were toxic to rabbits and rats. In conclusion, the iodide is not reproductive, embryonic toxicity, but the developmental toxicity was showed under concentration of 0.1% in diet, corresponding NOAEL as 50 mg/kg bw day (developmental).

Acute Toxicity	The most relevant study on vertebrates by oral route is a company study (A. Hausner, G. Weise, and A. Hofmann, 1980). In the test the effects of iodide were studied in male and female Wistar rats. 10 male and 10 female in each dose and control groups were administrated with potassium iodide for 14 days at dose of 0 (control), 2000, 2500, 2800 3200, 3600, and 4000 mg/kg body weight mg/kg bw respectively. The key value of LD50 was calculated by Probit-analysis (Fink und Hund 1965). It shows the 24 hour and 7-14 days of LD50 to rats (male/female) was respectively 3118 and 2779 mg/kg bw under test conditions. Therefore the key value which is used in the hazard classification and chemical safety assessment is 3118 mg/kg bw.
Irritation	Iodine has been used for dermal application in human as disinfectant (as Iodine and Povidine Iodine) for long time. The mechanism of disinfecting is oxidizing bactericide by iodine; meanwhile the iodine is reduced to iodide. It means after application of iodine on skin, the iodide is left on skin. In addition, based on information from assessment report of WHO, in a human assay, five patients were applied with potassium iodide in concentrations ranging from 5% to 20% in petrolatum, the reactions were negative. With such evidence, it can be concluded that iodide has no effect to the human skin.
Sensitisation	No adverse effect observed (not sensitising) for skin and respiratory sensitisation.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health
Key Study/Critical Effect for Screening Criteria	TDI of iodide is 0.01 mg/kg body weight.
Ecological Toxicity [2]	
Aquatic Toxicity	The 96 hours acute toxicity test to Rainbow Trout (Laverock, M.J., M. Stephenson, and C.R. MacDonald, 1995) was conducted according to Protocol to determine the acute lethality of liquid effluents to fish, which was established by Ontario Ministry of the Environment. The results showed that the 96 hour LC50 is over 860 mg/l. The acute toxicity to daphnia of iodide was determined (INERIS Parc Technologique ALATA, 2012) according to OECD test guideline 202 following GLP procedure to give a result of 48hrs-EC50 as 1.27 mg/L (95%CL, 1.19 -1.38 mg/L). There is another data on daphnia acute toxiciy (Laboratoire d'Ecotoxicologie Parc technologique ALATA, 1996) of KI according to method of “French standard”, which was similar to OECD test guideline 202, which is 48 hrs- EC50 as 7.5 mg/l. As the study for NaI gives lower tolerance value for daphnia and the test itself is more reliable (Klimisch score 1), the 48 hrs- EC50 of 1.27 mg/l is taken as the key value. One study of acute toxicity of iodide to algae was published in well-known journal “water research” (Bringmann, G., and R. Kuhn, 1980). It was not a standard test and without declaration of GLP compliance, and in the test the 7 days cell multiplication inhibition test was applied to the model organism, Scenedesmus quadricauda (green algae) for iodide, but fulfilled basically scientific principles. The results showed the toxicity threshold (≥3% inhibition of the biomass of green algae) of iodide to green algae is 2370 mg/l.
Determination of PNEC aquatic	PNECaquatic: On the basis of the acute results for Daphnia, an assessment factor of 100 has been applied to the lowest reported effect concentration of 1.27 mg/L. The PNECaquatic is determined to be 1.27 µg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.

International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [2]	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment).
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and iodide ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Acute toxicity data >0.01 mg/L in invertebrates, thus sodium iodide does not meet the screening criteria for toxicity.
Overall conclusion	Not applicable.
Revised	January 2019

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Toxicity Summary - Sodium Persulfate

Chemical and Physical Properties[1,2,3,4]	
CAS number	7775-27-1
Molecular formula	Na2O8S2
Molecular weight	238
Solubility in water	730 g/l at 25 °C
Melting point	Decomposes at > 180°C
Boiling point	No data available
Vapour pressure	0 Pa at 25 °C (negligible)
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	White crystals or powder
Overview	The persulfates category includes molecules with similar chemical structure and similar physical-chemical properties. Substances of the persulfate category are inorganic salts sharing the persulfate anion moiety. The inorganic substances differ only by the cationic portion of the salt, which is not expected to influence the hazardous properties of the molecule. The anionic part is identical and is expected to display the same environmental, ecotoxicological and toxicological behaviour based on the available data.
Environmental Fate[1,3]	
Soil/Water/Air	Substances of the persulfate category are not stable in the environment. Persulfates are not expected to adsorb to soil due to their dissociation properties, instability (hydrolysis) and high water solubility. They should behave as free ions or decompose into sulfate ions. In soils, upon decomposition, the cation could form more stable sulfate or bisulfate salts. Persulfates are not expected to bioaccumulate in the soil or in aqueous solution. They will decompose into inorganic sulfate or bisulfate.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	The persulfates have low repeat dose toxicity. Twenty-eight-day repeated dose oral (dietary) toxicity studies were conducted in rats with three persulfate salts. The oral doses for the three salts were 0, 100, 316, 1000 ppm (equivalent to 0, 12.6, 41.2, 131.5 mg/kg bw/day for the potasium salt). Tests were performed in male rats only. The no observed adverse effect levels (NOAEL) for sodium and potassium salts were 137 and 131.5 mg /kg bw/day, respectively (the highest doses tested), while the NOAEL for ammonium persulfate was 41 mg/kg bw/day, based on decreased relative adrenal weight at the highest dose (FMC, 1979a; FMC, 1979b; FMC1979c). Another oral (dietary) subchronic toxicity study using sodium persulfate was conducted in rats. Rats (20/sex/group; strain not provided) were fed rodent chow containing 0, 300, 1000 or 3000 ppm sodium persulfate (0, 23, 100 or 225 mg/kg bw/day) for 90 days. On day 48 of the study, the concentration of the group receiving 1000 ppm was increased to 5000 ppm for the remainder of the study. At the two high dose levels body weight was decreased during the last 6 weeks of treatment (FMC 1979e).
Carcinogenicity	Based on the limited data available, there is no evidence of carcinogenicity of any of the persulfate salt. In a non-guideline study, female SENCAR mice were exposed dermally twice weekly to 0.2 mL of a 200 mg/mL solution of ammonium persulfate for 51 weeks. The investigators concluded that ammonium persulfate is neither a tumour promoter nor a complete carcinogen when applied to the skin (Kurokawa et al., 1984).

Mutagenicity/ Genotoxicity	Based on the limited available data, sodium persulfate was not mutagenic. An in vitro unscheduled DNA synthesis test was also negative for sodium persulfate (FMC, 1990d). The ammonium salt was not clastogenic in Chinese hamster fibroblasts in the absence of metabolic activation in a chromosome aberration test (Ishidate et al., 1988). Sodium persulfate was negative in two in vivo genotoxicity studies. Doses of sodium persulfate up to 338 mg/kg injected into mice intraperitoneally did not increase the incidence of micronuclei in bone marrow polychromatic erythrocytes (FMC, 1990c). Sodium persulfate was found to be non-genotoxic when tested up to 820 mg/kg in an in vivo unscheduled DNA synthesis test in rats (FMC, 1991c).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the limited data available for ammonium persulfate, the sodium persulfate is not toxic to reproduction or development. In a well conducted fertility/developmental study (OECD 421), groups of rats (Crl:CD (SD)IGS BR, 12/sex/group) were administered ammonium persulfate in the diet at doses of 0, 40, 100 and 250 mg/kg bw/day (Weaver, 2004). Animals (both sexes) were dosed two weeks prior to and during mating. Females were administered the substance following mating, throughout gestation and until lactation day 4. In the parental generation group, there were no treatment related clinical signs, effects on body and organ weights or gross lesions. There were no significant adverse effects on the gonads and progression of spermatogenesis, although a non-significant decrease in pregnancy rates was reported at = 100 mg /kg bw/day. On this basis, it was concluded that the NOAEL for fertility indices and reproductive performance was the top dose of 250 mg /kg bw/day. There were no treatment-related clinical signs, mortality or necropsy findings among pups (live birth and viability indices were similar across all groups). There was a slight transient depression in mean pup body weight; however it was not considered adverse. The developmental toxicity NOAEL determined was the highest dose of 250 mg /kg bw/day (Weaver, 2004).
Acute Toxicity	Persulfate salts are considered to have moderate acute toxicity by the oral route. The acute oral median lethal dose (LD50) values for soidum persulfate (in rats) was reported as 895-930 mg/kg bw (Degussa AG, 1979). Clinical signs were ocular and oral discharge, irregular breathing and loss of muscle control. Persulfate salts have low acute dermal toxicity. The acute dermal LD50 was greater than 10,000 mg/kg bw (rabbits) for sodium persulfates (FMC, 1979c). Ocular and nasal discharge and slight irritation were reported in animals dermally exposed to high levels of persulfates (FMC, 1979b). Persulfates have low acute inhalation toxicity. Acute inhalation studies with sodium persulfates performed according to OECD guidelines in rats, indicated median lethal concentration (LC50) values of greater than the maximum attainable concentrations, 5.1 mg/L. Following exposure to high concentrations of persulfates, animals exhibited dyspnoea, respiratory distress and increased nasal, ocular and oral secretion (FMC 1987, FMC, 1979b; FMC 1995).

Irritation	The chemicals are classified as hazardous with the risk phrase 'Irritating to Respiratory system' (Xi; R37) in the HSIS (Safe Work Australia). Groups of male ND4 Swiss Webster mice were exposed, head-only, to sodium persulfate dust for 30 minutes at concentrations of 0.26 to 3.22 mg/L. Mortality was observed in all except the lowest exposure group during the 7-day post-exposure period with clinical signs that included ocular and nasal discharge and decreased respiratory rate. Abnormal gait and whole body tremors were observed in animals exposed to the highest concentration of dust. The concentration of dust which produced a 50 % decrease in respiratory rate (RD50) was 2.25 mg/L, indicating that sodium persulfate was a respiratory system irritant (FMC, 1994). Sodium persulfates were not found to be skin irritants in animal studies. However human observations support the existing classification as skin irritants. Three brief study reports submitted by industry on sodium persulfate showed at most a slight skin irritant potential in rabbits (FMC, 1979d; FMC, 1980). The chemicals are classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in the HSIS (Safe Work Australia). In a single unpublished study, sodium persulfate was instilled into the eyes of 8 rabbits. Eye irritation was scored by the Draize method at 24, 48 and 72 h. Slight conjunctivitis was noted at 48 h (FMC, 1979c).
Sensitisation	There was evidence of delayed contact hypersensitivity in two maximisation tests (OECD TG 406) using ammonium and sodium persulfate in guinea pigs. All test animals reacted positively following challenge by intradermal injection of 0.1 % ammonium persulfate and 80 % of animals were positive following dermal challenge with 1 % ammonium persulfate 14 days later. The corresponding figures for sodium persulfate were 90 % positive for test animals positive following an (non-standard) intracutaneous challenge and 60 % of the test animals were positive following topical challenge (CIR, 2001; BIBRA International, 1997). Sodium persulfate was not sensitising when applied to the skin of guinea pigs in an unpublished Buehler Test, conducted to guideline standards (FMC, 1990b). In a murine local lymph node assay (LLNA), investigators concluded that both ammonium and sodium persulfate were moderate to strong sensitisers with EC3 values (amount of chemical required to elicit a stimulation index of 3) calculated to be 1.9 % and 0.9 % respectively (Cruz et al., 2009 cited in HSDB).
Health Effects Summary	Although the persulfate salts are harmful by the oral route, potential for acute toxicity was generally not demonstrated via the dermal or inhalation routes. The persulfate salts were irritating to eyes and respiratory system but not skin irritants in animal studies, while studies in humans indicate that persulfates can cause skin irritation. The persulfates are capable of inducing skin and respiratory sensitisation in animals and these are also the major chronic effects observed in humans. Mouse LLNA results for ammonium and sodium persulfate suggest that persulfates are moderate to strong sensitisers. Overall, the main critical effects to human health are skin and respiratory sensitisation and irritation.
Key Study/Critical Effect for Screening Criteria	
Ecological Toxicity [2]	
Aquatic Toxicity	The LC50 values for acute toxicity to fish ranged between 163 to 771 mg/L for sodium persulfate. The acute toxicity EC50 values for invertebrates were between 133 and 519 mg/L for sodium persulfate. In algae, the EC50 for sodium persulfate 116 mg/L.
Determination of PNEC aquatic	A PNECaquatic of 116 µg/L was calculated using the lowest endpoint of EC50 of 116 mg/L for algae. An assessment factor of 1000 was used.
Current Regulatory Controls	

Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Biodegradation is not applicable to substances of the Persulfate Category, as the substances are inorganic. Upon contact with water or water vapour substances of the persulfate category hydrolyse into cation and persulfate anion. The persulfate anion, independent of the cation, undergoes further decomposition in normal water or acid conditions, readily oxidizing water to oxygen, producing sulphate and hydrogen ions. All final persulfate degradation products are ubiquitous to the environment.
B/vB criteria fulfilled?	No. Persulfates are very soluble in water and are not expected to bioaccumulate in soil or aqueous solutions.
T criteria fulfilled?	Based on measured acute toxicity endpoints of greater than 1 mg/L, sodium persulfate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. NICNAS (2017) Human Health Tier II Assessment for Persulfates
2. OECD (2005) SIDS Initial Assessment Profile on Persulfates
3. ECHA REACH, Disodium peroxodisulphate, Retrieved 2017: https://echa.europa.eu/information-on-chemicals/registered-substances
4. ICSC Sodium Persulfates, Retrieved 2017: http://www.inchem.org

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Toxicity Summary - Sodium sulphate

Chemical and Physical Properties[1,3,4,5]	
CAS number	7757-82-6
Molecular formula	Na2SO4
Product name	142.04 g/mol
Molecular weight	161 g/l at 20 °C
Solubility in water	No data found.
Melting point	884 °C
Boiling point	Decomposition occurs above 884°C.
Vapour pressure	Solid
Henrys law constant	Expected to be extremely low
Explosive potential	No data found.
Flammability potential	No data found.
Colour/Form	Not combustible. Gives off irritating or toxic fumes/gases in a fire.
Overview	Sodium sulfate is widely distributed in nature; it occurs as mineral salts (e.g. thenardite, mirabilite), it is present in almost all fresh and salt waters and sulfate as such is normally present in almost all natural foodstuffs. Both sodium and sulfate ions are among the most common ions found in all living organisms. In mammals, sulfate is an normal metabolite of sulfur-containing amino-acids, it is normally incorporated in a variety of body compounds and it plays an important role in detoxification/ excretion processes due to sulfoconjugation Sodium sulfate has been produced for many years in high volumes for use in detergents, glass and paper manufacture and a variety of smaller industrial uses National Industrial Chemicals Notification and Assessment Scheme (NICNAS) has performed an IMAP environment Tier 1 summary which concluded that sodium sulphate is an inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
Environmental Fate[1,4,5]	
Soil/Water/Air	Sodium sulphate is a solid inorganic salt well soluble in water. In water solutions it is fully dissociated to sodium and sulfate ions. In anaerobic environments sulfate is biologically reduced to (hydrogen) sulphide by sulfate reducing bacteria, or incorporated into living organisms as source of sulphur, and thereby included in the sulphur cycle. The BCF of sodium sulfate is very low (0.5) and therefore bioconcentration is not expected. Sodium and sulfate ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. However some plants (e.g. corn and *Kochia Scoparia*), are capable of accumulating sulfate to concentrations that are potentially toxic to ruminants.
Human Health Toxicity Summary [1,2,4,5]	
Chronic Repeated Dose Toxicity	Valid oral repeated dose toxicity studies with 21, 28 and 35 day studies in hens and pigs are available. Toxicity was confined to changes in bodyweight, water and feed intake and diarrhoea. These changes occurred only at very high doses of sodium sulfate. In ruminants, high concentrations of sulfate in food may result in the formation of toxic amounts of sulfites by bacterial reduction the rumen, leading to poly-encephalomalacia. The available data do not allow the derivation of a NOAEL. Based on available consumer data, a daily dose of around 25 mg/kg/day is well tolerated by humans

Carcinogenicity	There is no valid oral carcinogenicity study. Limited data from experimental studies support the notion that a substance that is abundantly present in and essential to the body is unlikely to be carcinogenic.
Mutagenicity/ Genotoxicity	Sodium sulfate has been shown to be without effect in the Ames test using various strains of *S. typhimurium* (TA1535, TA1537, TA100, TA98) both with and without S9 activation in a GLP standardised test Based on the natural intra- and extracellular occurrence of the substance it can be concluded that sodium sulfate is highly unlikely to be mutagenic
Reproductive Toxicity	Limited data of poor validity did not provide an indication of toxicity to reproduction.
Developmental Toxicity/Teratogenicity	No data were found.
Acute Toxicity	The acute toxicity (LD50) of sodium sulfate has not been reliably established but is probably far in excess of 5000 mg/kg. In an inhalation study with an aerosol, no adverse effects were found at 10 mg/m3. Also human data indicate a very low acute toxicity of sodium sulfate. Human clinical experience indicates that very high oral doses of sodium sulfate, 300 mg/kg bw up to 20 grams for an adult, are well tolerated, except from (intentionally) causing severe diarrhoea. WHO/FAO did not set an ADI for sodium sulfate. There is no data on acute dermal toxicity, but this is probably of no concern because of total ionisation in solution.
Irritation	Sodium sulfate is not irritating to the skin and slightly irritating to the eyes. Respiratory irritation has never been reported.
Sensitisation	Sodium sulphate is not a skin or respiratory sensitiser
Key Study/Critical Effect for Screening Criteria	The Australian Drinking Water Guidelines for sodium and sulphate may apply to sodium sulphate.
Ecological Toxicity [3,4,5]	
Aquatic Toxicity	Algae were shown to be the most sensitive to sodium sulfate; EC50 120h = 1,900 mg/l. For invertebrates *(Daphnia magna)* the EC50 48h = 4,580 mg/l and fish appeared to be the least sensitive with a LC50 96h = 7,960 mg/l for *Pimephales promelas*. No data were found for long term toxicity. The acute studies all show a toxicity of sodium sulfate higher than 100 mg/l, no bioaccumulation is expected
Determination of PNEC aquatic	An assessment factor of 1000 has been applied to the lowest reported effect concentration of 1900 mg/L for Daphnia. The PNEC aquatic is 1.9 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substance Information System (HSIS) (Safe Work Australia 2013).
Australian Occupational Exposure Standards	No data found
International Occupational Exposure Standards	No data found
Australian Food Standards	No data found
Australian Drinking Water Guidelines	The Australian Drinking Water Guideline for sulphate is 250 mg/L (aesthetic) and sodium is 180 mg/L (aesthetic).
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	Sodium sulphate is an inorganic salt that dissociates completely to sodium and sulphate ions in aqueous solutions. The persistent criterion is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	The BCF of sodium sulfate is very low (0.5) and therefore bioconcentration is not

	expected.
T criteria fulfilled?	The acute aquatic toxicity of sodium sulfate is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).

References

1. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2017, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. National Health and Medical Research Council, Natural Resources Management Ministerial Council, national Water Quality Management Strategy, Australian Drinking Water Guidelines 6, 2011, Version 3.3 Updated November 2016.
3. National Industrial Chemicals Notification and Assessment Scheme (NICNAS), IMAP Environment Tier I Summary all tranches, 2016.
4. OECD (2005a) Screening Information Dataset (SIDS) Initial Assessment Report for Sodium Sulfate, CAS Number 7757-82-6, UNEP Publications
5. OECD (2005b) SIDS Initial Assessment Profile for Sodium Sulfate, CAS Number 7757-82-6, UNEP Publications

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Toxicity Summary - Tributyl tetradecyl (TTPC)

Chemical and Physical Properties	
CAS number	81741-28-8
Molecular formula	C26-H56P.Cl
Product name	BE9
Molecular weight	435.15 g/mol
Solubility in water	miscible
Melting point	45 °C
Boiling point	439 °C (estimated)
Vapour pressure	Solid
Henrys law constant	1.04 x 10-8 kPa at 25 °C (estimated)
Explosive potential	No data found
Flammability potential	No data found
Colour/Form	No data found
Overview	Limited toxicity information was located for this alkyl phosphonium salt.
Environmental Fate[1]	
Soil/Water/Air	No data found
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	No data were found.
Carcinogenicity	No data were found.
Mutagenicity/ Genotoxicity	No data were available for TTPC. A brief report for TBPB noted that the chemical tested negative in an Ames bacterial mutagenicity assay, a Chinese hamster ovary (CHO) chromosome aberration test and a cell transformation test using Hamster Embryo Cells (HEC) although further details were not provided (Dunn et al. 1982). Therefore, TBPB is not mutagenic under the conditions tested and, on the basis of this limited evidence; it is assumed that TTPC is not genotoxic.
Reproductive Toxicity	No data were found.
Developmental Toxicity/Teratogenicity	No data were found.
Acute Toxicity	An inhalation study (EPA Office of Prevention, Pesticides and Toxic Substances (OPPTS) 870.1300) in rats exposed nose-only to TTPC (particle size 1.7 to 2.1 µm) reported hypoactivity, gasping, irregular respiration, red nasal discharge, ano-genital staining and abdominal distension at 0.05 mg/L (US EPA 2012b). Six of the 10 animals died within three days of a four-hour exposure. Gross necropsy revealed red coloured lungs, distension of stomach and / or intestines and / or mottled liver. The single exposure acute inhalation LC50 for this study was identified as <0.05 mg/L. This study shows that TTPC is highly toxic by the inhalation route in rats. No oral or dermal information was available for TTPC. However, based on analogue data available for THPB, TBPC and TBPB from animal studies, acute toxicity of TTPC by oral and dermal route is likely to be moderate

Irritation	No information was available for TTPC but data were available for the analogues THPB and TBPC.for skin irritation. Overall, the effects observed with the analogues THPB and TBPC, albeit after a 24-hour exposure period compared with the four-hour exposure specified by the equivalent OECD TG, demonstrate the likely corrosive potential of TTPC to the skin. No information was available for TTPC but data were available for the analogues THPB, TBPC and TBPB for eye irritation. The effects observed in all tests with the analogues THPB, TBPC and TBPB demonstrate the likely corrosive potential of TTPC to the eyes. In an inhalation study with TTPC in rats, a red nasal discharge and facial staining was noted (US EPA 2012b). While the information in the study is limited based on the analogues being corrosive to the skin it is likely that the chemicals are also irritant to the respiratory mucosa. TTPC is therefore likely to be a respiratory irritant.
Sensitisation	No data were available for TTPC. TBPC at 0.1% concentration in normal saline solution was determined as not sensitising to the skin following dermal applications (undisclosed induction and one challenge treatment) in guinea pigs (US EPA 1978). TBPC is not a skin sensitiser in guinea pigs and therefore a sensitisation potential for TTPC is not expected. No data were available for respiratory sensitisation.
Health Effects Summary	TTPC demonstrates high acute toxicity by the inhalation route. Based on read across data available from THPB, TBPC and TBPB, the chemical has moderate acute toxicity by oral and dermal routes and is corrosive to the skin and eye and is a respiratory irritant. Data available for TBPC and TBPB indicate that the chemical is not a skin sensitiser or genotoxic, respectively. No repeat dose, carcinogenicity or reproductive toxicity data were available for the chemical or suitable analogues. Chronic exposure may be considered as inappropriate given the nature of TTPC and analogues as direct acting corrosives mediating severe adverse effects at the site of contact. In conclusion, the critical health effect of TTPC is its acute inhalation toxicity.
Key Study/Critical Effect for Screening Criteria	No data are available for determining the critical effect and the LOAEL/NOAEL for an oral reference dose.
Ecological Toxicity [1,2]	
Aquatic Toxicity	The modelled acute endpoint for Daphnia is 16.788 mg/L and Fish is 1059.2530 mg/L.
Determination of PNEC aquatic	PNECaquatic: On the basis that the modelled data consists of short-term results from two trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 16.788 mg/L for Daphnia. The PNECaquatic is calculated to be 0.0168 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substance Information System (HSIS) (Safe Work Australia 2013).
Australian Occupational Exposure Standards	No data found
International Occupational Exposure Standards	No data found
Australian Food Standards	No data found

Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	No information is available on biodegradation.
B/vB criteria fulfilled?	Not Bioaccumulative (Based on an estimated log Kow value of 6.26)
T criteria fulfilled?	No chronic toxicity data are available for TTPC. The lowest modelled acute endpoint of TTPC is 16.788 mg/L in invertebrates. Since this value is >0.1 mg/L, TTPC does not meet the screening criteria for toxicity.
Overall conclusion	Inconclusive.

References

1. Material Safety Data Sheet for Bellacide 350, BWA Water Additives, SDS No. 10794
2. National Information System of the Regional Integrated Pest Management (IPM) Centers, U.S. Department of Agriculture and National Institutes of Food and Agriculture (www.ipmcenters.org).

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Toxicity Summary - 2,2`,2"- Nitrilotriethanol

Chemical and Physical Properties [1,2, 3,6]	
CAS number	102-71-6
Molecular formula	C6H15NO3
Molecular weight	149.19 g/mol
Solubility in water	Miscible with water.
pH	10.5
Melting point	17-21.6 °C
Boiling point	153 °C at 0.1007 kPa 192.87 °C at 0.7996 kPa 236.69 °C at 5.01 kPa 320 °C at 101 kPa
Vapour pressure	$3.59x10^{-6}$ mm Hg at 25 °C
Henrys law constant	$7.05x10^{-13}$ atm-cu m/mole at 25 °C
Explosive potential	No data found.
Flammability potential	Combustible, when exposed to heat or flame. Gives off irritating or toxic fumes (or gases) in a fire.
Colour/Form	Pale yellow to colourless viscous liquid with a slight ammonia odour.
Overview	Triethanolamine is a member of the ethanolamines family that combines the properties of amines and alcohols. Triethanolamine is typically supplied as a pale colourless to yellow liquid with an ammonia-like odor. Triethanolamine is primarily used in detergents, personal-care products, and textile finishing. Triethanolamine may also be used as in other applications including adhesives, agricultural products, concrete additives, gas treating processes, rubber, surfactants, photographic chemicals, and urethane foams. Contact with triethanolamine may cause slight to severe eye irritation. Brief contact is essentially nonirritating to the skin, but repeated exposure may cause irritation and burns. Skin contact may cause an allergic skin reaction. At room temperature, exposure to vapour is minimal due to low volatility; single exposure is not likely to be hazardous. This product has very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts, but swallowing larger amounts may cause injury. This product has been toxic to the fetus in laboratory animals at doses toxic to the mother. Findings from a study by the National Toxicology Program suggest an increased incidence of liver tumors in mice, but their relevant to humans is not clear. Triethanolamine is water soluable and biodegradable according to the OECD 301A test for biodegradation. It is not expected to bioaccumulate or persist in the environment. Triethanolimine is practically non-toxic to aquatic organisms on an acute basis. However large releases may increase the pH of aquatic systems to levels that may be toxic to aquatic organisms.

Environmental Fate [1,3,4,6]	
Soil/Water/Air	If released to soil, triethanolamine is expected to have very high mobility based upon an estimated Koc of 7. However, the pKa of triethanolamine is 7.8, indicating that this compound will primarily exist in cation form; and cations generally adsorb to organic carbon and clay more strongly than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 7.1X10-13 atm-cu m/mole. If released into water, triethanolamine is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Triethanolamine biodegraded in a biochemical oxygen demand (BOD) test at an initial concn 50 ppm. After 10 days, the ThOD (theoretical oxygen demand) was 70% using acclimated water as seed and sewage as inoculum. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions

Human Health Toxicity Summary [1,2,3,4,5,6]	
Chronic Repeated Dose Toxicity	Fischer 344 rats and B6C3F1 mice were administered 0, 500, 1000, 2000, 4000 or 8000 mg/100 mL triethanolamine in drinking water (NTP 1990). Water consumption was reduced at the top two doses. No other details were provided. In a 91-day study conducted in accordance with OECD TG 408, Cox CD rats were administered 88.5% triethanolamine in the diet at doses of 0, 250, 500 or 1000 mg/kg bw/day (REACH 2013). There were no significant dose-dependent changes in bodyweight, organ weight, histopathology, pathology and haematology. No Lowest Observed Adverse Effect Level (LOAEL) or No Observed Adverse Effect Level (NOAEL) can be established for this study. In a 90-day study, rats (strain not specified) were administered doses of 5 to 2610 mg/kg bw/day triethanolamine in the diet (Smyth et al. 1951). The study reported microscopic lesions and mortality at doses of 730 mg/kg bw/day and above. The authors indicated the NOAEL as 80 mg/kg bw/day. No other details were provided. In 60- and 120-day studies in rats (strain not specified) given 200 to 1800 mg/kg bw/day triethanolamine, effects observed included liver changes at all treatment doses after 60 and 120 days administration, kidney changes at 400 mg/kg bw/day after 60 and 120 days administration, and kidney damage at >800 mg/kg bw/day after 60 and 120 days administration (Kindsvatter 1940). The specific changes in the liver and kidney were not described. No other details were provided. The LOAEL for this study was 200 mg/kg bw/day. Repeated dermal dose toxicity with triethanolamine application was consistently associated with inflammation at the treatment site. Systemic effects included changes in bodyweight and organ to bodyweight ratios. The critical study for determining the effects of repeated dermal exposures to the chemical is the 90-day study cited in REACH (2013) conducted similarly to OECD TG 411. The NOAELs for this study are 125 mg/kg bw/day for males and 250 mg/kg bw/day for females. In an inhalation study, Fischer 344 rats were exposed to 0, 125, 250, 500, 1000 or 2000 mg/m3 triethanolamine for 16 days (NTP 1985b). The effects observed included decreased bodyweight at 2000 mg/m3 for both sexes, increased liver weight in males at 2000 mg/m3, increased kidney weight in males at concentrations ≥500 mg/m3, and increased kidney weight in females at concentrations ≥250 mg/m3. Minimal to slight acute inflammation of the larynx was reportedbut the doses for which this effect was seen were not specified. The LOAECs are 500 mg/m3 in males and 250 mg/m3 in females. The NOAECs are 250 and 125 mg/m3 in males and females, respectively. Wistar rats were exposed through the head and nose to 0, 0.02, 0.1 or 0.5 mg/L aerosolised triethanolamine in a 28-day study conducted in accordance with OECD TG 412 (Gamer et al., 2008). There were no treatment-related effects seen on bodyweight, haematology, clinical chemistry and neurobehavioural parameters. Local effects, such as minimal to moderate focal inflammation in the submucosa of the larynx region, were reported at all treatment concentrations. The LOAEC and NOAEC for systemic effects cannot be established. The LOAEC for local effects is 0.02 mg/L. B6C3F1 mice exposed to 0, 125, 250, 500, 1000 or 2000 mg/m3 triethanolamine for 14 days showed minimal acute inflammation of the laryngeal submucosa (NTP 1985a). The doses for which this effect was seen were not specified.
Carcinogenicity	The International Agency for Research on Cancer (IARC) has classified the chemical as ‘not classifiable as to its carcinogenicity to humans’ (Group 3), based on inadequate evidence for carcinogenicity in humans and experimental animals (IARC, 2000). There was no evidence of carcinogenicity by oral (up to 1000 mg/kg/day for 104 weeks, and up to 3334 mg/kg/day for 82 weeks amongst rats and mice respectively) or dermal routes (dose unknown) in studies of 14-18 months duration using rats and mice. No inhalation data were available.

Mutagenicity/ Genotoxicity	Triethanolamine was not genotoxic in a number of in vitro studies (bacterial reverse mutation, mammalian cell cytogenetics, and unscheduled DNA synthesis). On the basis of the negative results observed in a range of in vitro studies, in vivo genotoxicity is not anticipated.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	Triethanolamine is not considered to be toxic to fertility and not considered to be a developmental toxicant. There were no effects observed in the reproductive organs of the animals treated with the chemical from repeated oral, dermal and inhalation toxicity studies. In a reproduction/developmental toxicity screening test conducted in accordance with OECD TG 421, Wistar rats were administered 0, 100, 300 or 1000 mg/kg bw/day triethanolamine by gavage (REACH 2013). The animals were treated during pre-mating (two weeks for both sexes), mating (maximum of two weeks for both sexes), post-mating (one week in males), and the entire gestation period and four days of lactation in females. There were no parental systemic effects reported in all of the treated animals. Most of the animals treated at the top dose showed transient salivation, which could be attributed to the unpalatability of the chemical or local irritation of the upper digestive tract. There were no effects on fertility observed in any of the treated animals. The parental LOAEL and NOAEL for local effects are 1000 and 300 mg/kg bw/day, respectively. The developmental LOAEL and NOAEL are 1000 and 300 mg/kg bw/day, respectively. The LOAEL and NOAEL for fertility cannot be established. A dye formulation containing 0.15, 1.5 or 2% triethanolamine was applied to the shaved skin of CD-1 rats (Burnett et al. 1976). The application occurred seven times during the gestation period. There were no systemic or local effects observed. No developmental effects were reported.
Acute Toxicity	The chemical was of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in experimental rats studies ranged from is 4190–11300 mg/kg bw triethanolamine. Two studies in mice (strain not specified), two studies in rabbits (strain not specified), and three studies in guinea pigs (strain not specified) reported acute oral LD50s of 5400 to 7800, 2200 to 5200, and 2200 to 8000 mg/kg bw, respectively.Observed sub-lethal effects included agitation, elevated respiration and reduced grooming (NIWL, 2003; CIR, 2011). The chemical was of low acute toxicity in animal tests following dermal exposure. The median lethal dose (LD50) in rabbits is greater than 2000 mg/kg bw. Observed sublethal effects included mild erythema 24 hours after exposure, resolving after 6 –10 days (REACH; CIR, 2011). Due to the low vapour pressure of the chemical, the highest attainable vapour concentration is 1.8 mg/m³. In a study conducted in rats (strain not specified) exposed to the chemical (1.8 mg/m³), no deaths were reported. One out of 12 rats exposed showed signs of chronic bronchitis (REACH).
Irritation	Based on the available data, the chemical is considered a respiratory and eye irritant. In two studies conducted similarly to OECD TG 405 the average Draize scores for corneal opacity, redness of the conjunctivae and chemosis were 1, 2 and 1.75 respectively (REACH). In one study, the corneal opacity in one animal had not fully resolved by day eight of the observation period. However, based on the results seen in the other animals, it is expected that the corneal opacity would fully resolve had the observation period continued for 21 days. The chemical was not irritating to skin in studies that were performed in accordance with OECD Test Guideline (TG) 404 (REACH). In one study, three Vienna White Rabbits were dermally exposed to the chemical (85 % concentration of triethanolamine and 15 % diethanolamine) through a occlusive patch for four hours. Neither oedema nor erythema was observed throughout the observation period (REACH). In animal studies with repeated exposures, the chemical was applied to rabbit ears over 10 open applications, with 10 unoccluded applications to abdominal intact skin, or with three semi-occluded 24-hour applications to abraded skin. These exposures resulted in slight to moderate irritation (CIR, 2013). In a two-year repeated dose dermal study, the chemical caused lesions consisting of acanthosis (thickened skin), ulceration and chronic active inflammation at the application site. In the repeated dose inhalation studies, minimal to slight acute inflammation of the larynx was observed in rats and mice (NTP 1985a, 1985b). In a more recent 28-day inhalation study, minimal to moderate focal inflammation in the submucosa of the larynx was observed in rats (Gamer et al. 2008).

Sensitisation	Triethanolamine is not a skin sensitizer in animals. The negative results observed for the chemical in several guinea pig maximisation tests and one local lymph node assay support a conclusion that the chemical is not a skin sensitiser (REACH; CIR, 2013).
Health Effects Summary	Triethanolamine has low acute oral and dermal toxicity but may cause eye and respiratory irritation. Triethanolamine was non-irritating to the skin in rabbit studies, whilst studies in humans indicate that the chemical can cause skin irritation. The chemical is not a skin sensitiser. The chemical is neither genotoxic, carcinogenic nor a reproductive toxicant.
Key Study/Critical Effect for Screening Criteria	The most appropriate NOAELs for risk assessment, determined from the 90-day repeat dermal dose toxicity study cited in REACH (2013) are 125 (males) and 250 (females) mg/kg bw/day based on systemic effects. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability); 10 (subchronic to chronic) Oral RfD = 125/1000 = 0.125 mg/kg/day Drinking water guideline value = 0.49 ppm

Ecological Toxicity [1,3, 4,6]	
Aquatic Toxicity	Triethanolamine is of low acute toxicity to fish and aquatic invertebrates. The most sensitive fish species tested was the fathead minnow Pimephales promelas for which a 96h-LC50 of 11,800 mg/l was determined. Triethanolamine was slightly more toxic to Daphnia, which had a 24h-EC50 of 1,390 mg/l. In a 21 day reproduction test with Daphnia magna, a NOEC of 16 mg/l and an EC50 of 2,038 mg/l were determined in a semi-static test (concentrations measured twice during the test). Triethanolamine appears to be more toxic to algal species. Toxicity tests have been carried out at both constant pH and allowing the pH to increase with increasing triethanolamine concentration. In two cases triethanolamine appears to be more toxic when the test is carried out allowing the pH to increase. In one case, using the green algae Scenedesmus quadricauda, the 7-8 day toxicity threshold (defined as the concentration which just caused an effect of cell multiplication of around 3% compared with controls - can be considered as a NOEC) for triethanolamine was found to be much lower at constant pH (toxicity threshold = 1.8 mg/l) than when the pH was allowed to vary (toxicity threshold = 715 mg/l). The EC50 was reported as 910 mg/l for Scenedesmus subspicatus (algae) for 96 hour exposure under test conditions where the test media was neutralised.
Determination of PNEC aquatic	PNECaquatic: On the basis that the data consists of short-term and long-term results from three trophic levels, an assessment factor of 10 has been applied to the lowest reported NOEC of1.8 mg/L for Scenedesmus quadricauda mg/L for invertebrates. The PNECaquatic is 0.18 mg/L.
Current Regulatory Controls [2]	
Australian Hazard Classification	Triethanolamine is listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013) with a recommended Exposure Standard.
Australian Occupational Exposure Standards	Time Weighted Average (TWA) of 5 mg/m^3 (Safe Work Australia 2013).
International Occupational Exposure Standards	TWA: 5 mg/m^3 [Belgium, Finland, Iceland, New Zealand, Peru] 0.5 mg/m^3 [Denmark].
Australian Food Standards	Triethanolamine is listed as a permitted processing aid in bleaching agents, washing and peeling agents, water used as an ingredient in other foods, and miscellaneous functions under the conditions of Good Manufacturing Practice (GMP) (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment [1,3,4,6]	
P/vP Criteria fulfilled?	There are conflicting findings from standard ready biodegradability tests regarding the rate of biodegradation of triethanolamine. Some studies indicate relative rapid biodegradation, whereas some closed bottle studies indicate slow biodegradation under the test conditions (OECD 1995). However, the chemical is inherently biodegradable. The results of a test using OECD test guideline 302B showed that 89% of the chemical is degraded after 14 days (OECD 1995). Thus, Triethanolamine is categorised as Persistent.
B/vB criteria fulfilled?	Based on the measured log Kow of -1.0 and a measured BCF of <3.9 L/kg in fish, triethanolamine has low bioaccummulation potential and is considered not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of triethanolamine is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data). Further assessment of the environmental risks from the use of this chemical is not required as identified by DoEE.
Revised	April 2018

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Toxicity Summary - Sodium perborate tetrahydrate

Chemical and Physical Properties	
CAS number	10486-00-7
Molecular formula	NaBO3. 4H2O / NaBO2. H2O2. 3H2O
Molecular weight	153.9
Solubility in water	g/100ml at 20°C: 2.3
Melting point	ca. 60-65.5°C
Boiling point	Decomposes.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Perborates are salts of perboric acid. Sodium perborate degrades into sodium metaborate and water with the generation of hydrogen peroxide and oxygen. Sodium metaborate is the salt of a strong base (sodium hydroxide) and a weak acid (boric acid). Undissociated boric acid is the main species present in the blood of mammals following exposure to these chemicals. Sodium perborate tetrahydrate (CAS No. 10486-00-7) have reported domestic use as bleaching agents.
Environmental Fate[1]	
Soil/Water/Air	Perborates have high water solubility. Perborates dissociate to borates and hydrogen peroxide in aqueous environments. The most important borate species, which will be formed in aqueous solutions, is boric acid (H3BO3). At relevant environmental pH values of ≤ 7 no significant adsorption of boron compounds in soil and the aquatic compartments are to be expected (EPA, 1975; Koehnlein, 1972).
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a repeated dose toxicity study, sodium perborate tetrahydrate (CAS No. 10486-00-7) was administered (by gavage) to rats at 1000 mg/kg bw/day (70 mg boron/kg bw/day) for 28 days. Acanthosis and hyperkeratosis in the forestomach, and hyperplasia of the fundic mucosa were noted. At the end of the study, the red blood cell count, haemoglobin, haematocrit and number of lymphocytes were significantly decreased; the number of platelets was significantly increased. The spleen size and splenic parenchyma were reduced. Although a significant (18 %) decrease in absolute testicular weights was recorded, the authors attributed this to a generalised weight reduction of 15 %; histological examination of the testes revealed no adverse effects. The lowest observed adverse effect level (LOAEL) was 1000 mg/kg bw/day (70 mg boron/kg bw/day), based on effects on the stomach, spleen and the haematopoietic system. It was concluded that the no observed adverse effect level (NOAEL) for males or females was below 1000 mg/kg bw/day (EU RAR, 2007; SCCS, 2010; REACH). In a repeated dose toxicity study, sodium perborate tetrahydrate (CAS No. 10486-00-7) was applied at 200 mg/kg bw/day (as a 10 % aqueous solution) to the abraded skin of New Zealand White rabbits for three weeks. After exposure, the skin was near normal (signs of mild irritation in some cases) and there were no adverse microscopic findings in different organs. A NOAEL of 200 mg/kg bw/day was established, being the highest tested dose (EU RAR, 2007; SCCS, 2010; REACH). In another repeated dose toxicity study, sodium perborate tetrahydrate (CAS No. 10486-00-7) was applied at 50 mg/kg bw (as a 2.5 % aqueous solution) to the

	intact skin of New Zealand White rabbits (three/sex), five days/week for 13 weeks. The treatment caused no skin irritation and there were no adverse effects on blood parameters or on the gross histopathology of selected organs. An NOAEL of 50 mg/kg bw/day was established, being the highest tested dose (EU RAR, 2007; SCCS, 2010; REACH).
Carcinogenicity	Not likely to have any carcinogenic potential.
Mutagenicity/ Genotoxicity	Not considered to have mutagenic or genotoxic potential.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a repeated dose toxicity study, sodium perborate tetrahydrate (CAS No. 10486-00-7) was administered (by gavage) to rats at 1000 mg/kg bw/day (70 mg boron/kg bw/day) for 28 days. The authors recorded a significant (18 %) decrease in absolute testicular weights but this was attributed to a generalised weight reduction of 15 %. A histological examination of the testes revealed no adverse effects. It has also been argued that more sensitive methods of histopathology than used in this study (fixed with formalin) could have revealed more subtle effects. Therefore, using reduced testes weights as early signs of testicular toxicity cannot be dismissed in view of the known testicular toxicity of the borates. It was concluded that the NOAEL for males or females was below 1000 mg/kg bw/day (EU RAR, 2007; SCCS, 2010; REACH). In a developmental toxicity study, sodium perborate tetrahydrate (CAS No. 10486-00-7) was administered (by gavage) to 25 pregnant Crl:Cd (SD) rats on gestation days (GD) 6–15 at doses of 0, 100, 300 and 1000 mg/kg bw/day. The NOAEL for maternal toxicity was established as 100 mg/kg bw/day (7 mg boron/kg bw/day), based on significant reductions in body weight gain at the two highest doses. It is also noted that even though reduced maternal weight gain might partly be due to an increased number of resumptions and reduced foetal weights, other toxicological studies have supported the view that doses above 100 mg/kg bw/day administered via gavage are toxic to the dams. A dose-related effect was found on the ossification and bone system. While various incomplete ossifications and wavy ribs occurred at 300 mg/kg bw/day, malformations (fused ribs) were observed at 1000 mg/kg bw/day. The NOAEL for developmental toxicity was established as 100 mg/kg bw/day (7 mg boron/kg bw/day) (EU RAR, 2007; SCCS, 2010; REACH).
Acute Toxicity	The reported oral LD50 for sodium perborate tetrahydrate is 2567 mg/kg bw (CAS No. 10486-00-7). The chemical is likely to have low acute toxicity following dermal exposure. It is also noted that the dermal absorption through intact skin is very low. The available data (median lethal concentration—LC50, inhalation) for sodium perborate tetrahydrate is 1.65 mg/L. Reported signs of toxicity included gasping, red nasal discharge, and compound-covered faeces (EU RAR, 2007; SCCS, 2010; REACH).
Irritation	The chemicals in the group are classified as hazardous, with hazard category Specific Target Organ Toxicity (Single Exposure) – Category 3 and hazard statement 'May cause respiratory irritation' (H335) in the HCIS (Safe Work Australia). Although slight skin irritant effects were reported in animal studies, the effects were not sufficient to warrant a hazard classification for the chemicals in this group. The sodium perborates are classified as hazardous with hazard category 'Eye Damage – Category 1' and the hazard statement 'Causes serious eye damage' (H318) in the HCIS (Safe Work Australia). In an eye irritation study conducted according to Federal Hazardous Substances Act Regulations 191.12 (1964-09) of the USA, 0.1 mL of sodium perborate tetrahydrate (CAS No. 10486-00-7) was placed once into the right eyes of six albino rabbits. The chemical was judged to be corrosive as severe corneal damage, severe iritis and severe conjunctivitis were observed in all animals (EU RAR, 2007; SCCS, 2010; REACH).
Sensitisation	Not likely to be skin and respiratory sensitisers.
Health Effects Summary	The critical health effects for risk characterisation include systemic long-term effects (reproductive toxicity, developmental toxicity), systemic acute effects

	(acute toxicity from oral/inhalation exposure) and local effects (respiratory and eye irritation).
Key Study/Critical Effect for Screening Criteria	The lowest NOAEL of 50 mg/kg bw/day from the repeated dose dermal study will be used for risk assessment.
Ecological Toxicity[3]	
Aquatic Toxicity	The following aquatic toxicity endpoints are based on modelled estimates of sodium perborate (CAS 7632-04-4) from ECOSAR: The 96hr LC50 for fish is estimated to be 2610 mg/L The 48 hr LC50 for daphnids is estimated to be 1241 mg/L The 14 day LC50 for earthworms is estimated to be 164.5 mg/L The 96 hr EC50 for algae is estimated to be 444 mg/L
Determination of PNEC aquatic	In a recent publication Dyer (2001) used a probabilistic approach to derive a PNEC0.05 (Predicted No Effect Concentration for 95% of the species) from chronic studies that were available for boron for all trophic levels. Mean toxicity levels per taxa were determined and then converted to a cumulative probability term and curve-fit assuming a log-logistic distribution. The PNEC 0.05 derived from this analysis was 3.45 mg B/l when all species data with uniform chronic toxicity endpoints (NOEC, LC10) were considered.
Current Regulatory Controls[4]	
Australian Hazard Classification	Reproductive toxicity – category 1B Acute toxicity – category 4 Specific target organ toxicity (single exposure) – category 3 Eye damage – category 1
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be biodegradable based on Ecosar prediction using sodium perborate.
B/vB criteria fulfilled?	No. Estimated log Kow for sodium perborate: 0.08 (Log Kow < 4.5)
T criteria fulfilled?	No. Acute toxicity values > 1 mg/L.
Overall conclusion	Not PBT
Revised	October 2019

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Colour/Form	Boric Acid: Colourless, transparent crystals or white granules or powder. Sodium Tetraborate: Colourless, monoclinic crystalline salt; also occurs as a white powder. Boronatrocalcite: Silky white rounded crystalline masses or parallel fibres. Borax: White crystalline solid. Odourless.
Overview	Limited toxicity data is available for sodium tetraborate (Borax anhydrous) and boronatrocalcite (Ulexite) as such; this toxicity profile includes data on boron and boric acid. In physiological conditions, aqueous solutions of simple borates will exist predominantly as un-dissociated boric acid. Therefore, the chemical and toxicological properties of simple borates such as boric acid, boric acid disodium salt and borax are expected to be similar on a mol boron/L equivalent basis when dissolved in water or biological fluids at the same pH and low concentration. Accordingly, read-across of toxicity testing results between these borate species and from other similar borate species differing only in extent of hydration was applied and testing results were expressed as boron equivalents. Boric acid and borate salts exist naturally in rocks, soil, plants and water as forms of the naturally occurring element boron. Anhydrous Borax is a free flowing mixture of clear, glass-like particles and white granules formed by the crushing of relatively large masses of fused materials. Borax is a salt of boric acid. Borax occurs naturally in evaporite deposits produced by the repeated evaporation of seasonal lakes and has many applications in chemistry, mining and pharmaceuticals. Ulexite is a sodium-calcium-hydroborate and, like other borates, is a structurally complex mineral. It is composed of hydrogen (3.98 %), sodium (5.67 %), calcium (9.89 %), boron (13.34 %), and oxygen (67.12 %). There is a lack of data available in the literature to directly assess the toxicity of the chemical. The major component of the chemical is a borate ion, which is likely to be associated with human health hazards of the chemical. The other constituents are considered to be of low concern to human health (NICNAS, 2013). As the chemical will readily break down in the stomach pH to boric acid (H_3BO_3) following ingestion, the toxicokinetics and toxicity of the chemical will be driven predominantly by borate ions. Boron is a naturally occurring element that is found in the form of borates in the oceans, sedimentary rocks, coal, shale, and some soils. Boron is widely distributed in nature, with concentrations of about 10 mg/kg in the earth's crust (range 5 mg/kg in basalts to 100 mg/kg in shales) and about 4.5 mg/L in the ocean. Borates are used in glass, ceramics, detergents, wood treatment and insulation fiberglass industries. Boric acid and other borates are also used in a range of consumer products including cosmetic and personal care products and also in detergents. Moreover, borates are essential for all plants – their use as fertilizers increases crop yields (including grapes, potatoes, sugar beets, alfalfa and olives) and quality. Boron occurs in foods as borate and boric acid. Boron has not been established to be an essential nutrient for humans and no specific biochemical function for boron has been identified in higher animals or man. There is some evidence that, in humans, boron intake within the usual dietary range may influence the metabolism and utilisation of other nutrients, particularly calcium, and may have a beneficial effect on bone calcification and maintenance.
Environmental Fate[2,4]	
Soil/Water/Air	These forms of boron are highly soluble and not easily removed from solution by natural mechanisms. Borate and boric acid are in equilibrium depending on the pH of the water. At an acidic pH, boron exists in solution mainly as undissociated boric acid, whereas at alkaline pH it is present as borate ions. Boric acid is a persistent molecule, mobile in soil and sediment, not subject to hydrolysis, photodegradation or biodegradation. Other borates yield boric acid upon dissolution in water (or borate anion in higher pH conditions).

Human Health Toxicity Summary [2,3,4,8,9]	
Chronic Repeated Dose Toxicity	The haematological system and the testes have been identified as the major targets after oral repeat dose exposure to Boric acid. Studies after repeated dermal or inhalation exposure to boric acid are not available. A NOAEL for effects on testes and the blood system of 17.5 mg boron/kg bw/day can be derived (with a LOAEL of 58.5 mg boron/kg bw/day) from two 2-year studies in rats on boric acid. This NOAEL was the equivalent of 155 mg borax/kg bw/day. Results obtained with boric acid can be supported by findings obtained from other borates thus indicating that the boron ion is the toxicologically relevant species
Carcinogenicity	In two-year dietary studies on boric acid and borax in rats (Weir 1966a; Weir 1966b) (described under Section A1.6.5) no signs of carcinogenicity were observed. It has been noted that less than one third of treated animals (10 animals per sex) were used for macroscopic and histopathological examination in these studies (ECHA 2009; RIVM 2013). In a subsequent two-year dietary carcinogenicity study of boric acid in mice, animals received 0, 446 or 1150 mg boric acid (0, 75 or 200 mg boron)/kg bw /day (NTP 1987). High dose males showed testicular atrophy and interstitial cell hyperplasia. No signs of carcinogenicity were observed.
Mutagenicity/ Genotoxicity	Boric acid is not mutagenic either in vitro or in vivo. Overall, it was concluded that boric acid is unlikely to be genotoxic.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	Results from animal experiments demonstrate that boric acid adversely effects fertility and development. Feeding studies in different animal species (rats, mice and dogs) have consistently demonstrated that the male reproductive system is the principle target in experimental animals, although effects on the female reproductive system have also been reported. Testicular damage ranging from mildly inhibited spermiation to complete atrophy has been demonstrated following oral administration of boric acid. Effects on fertility were observed at lower dose levels compared to dose levels, where signs of general toxicity appeared. Based on data from the two-year feeding studies with boric acid and borax in rats, 17.5 mg boron /kg bw/day (equivalent to 100 mg boric acid/kg bw/day)_was derived as a NOAEL for male and female fertility. Developmental effects have been observed in three species, rats, mice and rabbits. The most sensitive species appears to be rats, in which the effects observed at non maternally toxic doses include a reduction in foetal body weight and minor skeletal variations which, with the exception of short rib XIII, had reversed by 21 days post-natal. The NOAEL for developmental effects is 9.6 mg boron/kg bw/day (55 mg boric acid/kg/day).

Acute Toxicity	Borates are of low acute toxicity in mammals, including rats and mice. For boric acid, an oral median lethal dose (LD50) of 3765 mg/kg bw (659 mg boron/kg bw) was reported in Sprague-Dawley rats (Keller 1962; Weir and Fisher 1972). An acute oral toxicity study in rats conducted according to the Organisation for Economic Cooperation and Development (OECD) Test Guideline (TG) 401 of disodium octaborate tetrahydrate reported an LD50 of 2550 mg/kg bw (535 mg boron/kg bw) (Doyle 1988). In an acute dermal toxicity study in rats performed with disodium octaborate tetrahydrate the LD50 value was >2000 mg/kg bw (European Commission 2000). The other borates also appear to have low acute dermal toxicity. In a study in rabbits, the dermal LD50 value for boric acid was >2000 mg/kg bw/day (Weiner et al. 1982). Acute dermal toxicity studies with disodium tetraborate decahydrate (borax) and disodium tetraborate pentahydrate revealed no deaths at a limit dose of 2000 mg/kg bw/day (Reagan and Becci 1985a,c). It was noted that these studies may be flawed since the test material was not moistened, so good contact with the skin was not ensured. The four-hour acute median lethal concentration (LC50) for boric acid, borax and disodium borates is reported to be >2 mg boron/m3 (Hubbard 1998). An inhalation study in rats conducted to OECD TG 403 with boric acid reported an oralmedian lethal concentration (LC50) of ≥2.03 mg/L (Wnorowski 1994a). A similar study with disodium octaborate anhydrate reported an LC50 of ≥2.01 mg/L (Wnorowski 1994b).
Irritation	Borates have low skin irritation potential. In rabbits, boric acid caused no/mild skin irritation, induced reversible conjunctival redness and chemosis with minor effects on the iris. In rats and mice, boric acid acts as a sensory irritant. The substance may irritate the eyes, nasal mucous membranes, skin and the respiratory tract, and may cause effects on the gastrointestinal tract, liver and kidneys.
Sensitisation	Boric acid and borax were tested in a Buehler skin sensitisation test conducted according to OECD TG 406 (Wnorowski 1994c, 1994d). Test substances were applied at a concentration of 95% in water during both induction and challenge. No signs of skin sensitisation were seen.
Health Effects Summary	Borates are of low acute toxicity and low skin irritation potential. It may cause sensory irritant effects on animals and humans with acute exposure. Borates were shown not to be skin sensitisers, genotoxic or carcinogenic. Repeated exposures to boron as boric acid induced effects on fertility (testes), development and the blood system.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 9.6 mg boron/kg bw/day. This NOAEL was the equivalent of 55 mg boric acid/kg bw/day; 38 mg disodium octaborate anhydrate/kg bw/day and 85 mg borax/kg bw/day), from feeding (dietary intake) studies based on developmental effects. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability); 10 (subacute to chronic). Drinking water guideline for boron: 3.5 ppm
Ecological Toxicity [3,9]	
Aquatic Toxicity	The most sensitive tests report that acute effects on fish are in the range of 10-20 mg-B/L although the quality of these studies was rated low. The lowest daphnid acute value is 133 mg-B/L. Algal and microbial inhibition studies suggest less toxicity: Selenastrum growth was not affected at 93 mg-B/L and activated sludge respiration showed minimal effects at 683 mg/L boric acid (119 mg-B/L). Chronic endpoints for Boric acid were available for Daphnia (6 mg/L) and Fish (2.1 mg/L).
Determination of PNEC aquatic	Canadian Water Quality Guidelines for the Protection of Aquatic Life: Long–term Exposure to Boron is 1.5 mg/L (2009). An assessment factor of 100 has been applied to the lowest reported chronic effect concentration of 2.1 mg/L for Fish. The PNECaquatic is 0.021 mg/L.
Current Regulatory Controls[9]	

Australian Hazard Classification	Boric acid and borax are classified as hazardous for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013) with the following risk phrases: - Toxic to reproduction (Repr.) Cat. 2; R60 (May impair fertility) - Repr. Cat. 2; R61 (May cause harm to the unborn child) Mixtures containing boric acid and borax are classified as hazardous with the following risk phrases based on the concentration (conc) of the chemicals in the mixtures. - Boric acid: Conc ≥5.5%: Toxic (T); R60; R61 - Borax: Conc ≥8.5%: T; R60; R61.
Australian Occupational Exposure Standards	There are no specific exposure standards for boric acid. However, the permissible exposure limits (as the time weighted average (TWA)) for dusts apply (10 mg/m^3 measured as inspirable dust) (Safe Work Australia 2013b). The exposure standard for borax is 5 mg/m^3 TWA (Safe Work Australia 2013a).
International Occupational Exposure Standards	Boric Acid: Canada 2 mg/m^3 TWA, 6 mg/m^3 Short-term exposure limit (STEL) (borate compounds) Germany 10 mg/m^3 TWA; 1 mg/m^3 STEL Spain 10 mg/m^3 TWA (insoluble particles) US 2 mg/m^3 TWA; 6 mg/m^3 STEL (borate compounds), 5 mg/m^3 TWA (particulates, respirable fraction) Disodium octaborate anhydrate: Canada 10 mg/m^3 TWA, (insoluble particles) Spain 10 mg/m^3 TWA (particulates, inhalable fraction) US 5 mg/m^3 TWA (particulates, respirable fraction) Borax: Canada 1 to 5 mg/m^3 TWA, 6 mg/m3 STEL (inorganic borate compounds) Denmark 1 to 2 mg/m^3 TWA Germany 0.5 mg/m^3 TWA Spain 5 mg/m^3 TWA Sweden and UK 2 mg/m^3 TWA US 2 mg/m^3 TWA (inorganic borate compounds); 5 to 10 mg/m3 TWA.
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	No data found. However, boron in the environment is likely to be predominantly in the form of boric acid and that based on health considerations, the concentration of boron in drinking water should not exceed 4 mg/L (NHMRC 2011).
Aquatic Toxicity Guidelines	For boron: 90 µg/L (ANZECC 2000 99% Freshwater)
PBT Assessment[9]	
P/vP Criteria fulfilled?	For the purposes of this PBT assessment, the persistent criteria is not considered applicable to this inorganic substance.
B/vB criteria fulfilled?	For the purposes of this PBT assessment, the bioaccumulation criteria is not considered applicable to this inorganic substance.
T criteria fulfilled?	No. The chronic toxicity data is >1 mg/L.
Overall conclusion	Not PBT

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Appendix H

Toxicity Profiles for Chemical Tracers

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Toxicity Summary - Water Flow Assurance Tracer (WFT)

Chemical and Physical Properties[1,2,3,4]	
CAS number	One chemical (proprietary)
Molecular formula	Proprietary
Molecular weight	534.36
Solubility in water	167.05 g/L at 20 °C and pH 7
Melting point	347.1 °C
Boiling point	909.54 °C at 101.325 kPa
Vapour pressure	7.43 X 10-22 mm Hg at 25°C (calculated)
Henrys law constant	10-15 atm-m^3/mol (estimated)
Explosive potential	Non-explosive (100%)
Flammability potential	Non-flammable (100%)
Colour/Form	Bright, odourless, orange-yellow powder
Overview	This chemical is used as a food, drug, and cosmetic colorant. It is used to colour confectionary, bakery goods, animal feeds, aqueous drug solutions, toothpastes, bath salts, hair rinses, and printing inks for use in and on foods, drugs, and cosmetics and on food, drug, and cosmetic packaging materials. This chemical is an azo dye. Azo compounds are formed from arenediazonium ions reacting with highly reactive aromatic compounds, in what is called a diazo coupling reaction. Azo compounds are generally deeply coloured because the azo linkage brings the two aromatic rings into conjugation (Solomon, 1996).
Environmental Fate[2]	
Soil/Water/Air	This chemical's production as a dye for wool, silks and as a colorant in food, drugs and cosmetics may result in its release to the environment through various waste streams. If released to air, this chemical will exist solely in the particulate phase in the atmosphere since it is a salt and will be non-volatile. Particulate-phase this chemical will be removed from the atmosphere by wet or dry deposition. This chemical may be susceptible to direct photolysis by sunlight; after exposure to sunlight, This chemical in distilled water exhibited a first order rate constant of $2.31X10^{-3}$ per day, corresponding to a half-life of 300 days. If released to soil, this chemical is expected to be mobile since this compound is expected to exist almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process because the compound exists as an anion and anions do not volatilize. If released into water, this chemical is not expected to adsorb to suspended solids and sediment based upon this compound's ionic nature in the environment. This chemical passed through pilot scale treatment activated sludge processes relatively unchanged, indicating that biodegradation is not expected to be an important environmental fate process. This chemical will exist almost entirely in the anion form at pH values of 5 to 9 and therefore volatilization from water surfaces is not expected to be an important fate process. Measured BCF values of <0.29 and <3.0 in carp suggests bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyse under environmental conditions.

Human Health Toxicity Summary [1,2,3,4]	
Chronic Repeated Dose Toxicity	Two separate but concurrent studies in rats given 0%, 0.1%, 1% or 2% in the diet or 0% or 5% in the diet for between 113 and 125 weeks showed decreases in body weight in females at 1% in the diet and in males (12.2% decrease) and females (16.9% decrease) at 5% in the diet, but there were no effects at 2% in the diet. The FAO/WHO Expert Committee on Food Additives concluded that 2% in the diet, equal to 984 mg/kg bw per day, was the NOAEL for this study. During a 2-year study in Fischer 344 rats given This chemical in the drinking water at a concentration of 0%, 1% or 2%, statistically significant increases in mesothelioma in the abdominal cavity in males and endometrial stromal polyps in females in the 1% concentration groups were reported. The incidences of these tumours were not dose dependent, and the authors noted that the incidences were within the historical control range for these tumours in this rat strain.
Carcinogenicity	A 104-week carcinogenicity study in mice given 0%, 0.5%, 1.5% or 5% This chemical in the diet showed no effects other than reductions in body weight at various time points in both sexes at 5% in the diet and slight, but statistically significant, increases in feed consumption in males at 5% in the diet. Although the authors considered the NOAEL to be the highest dose tested, the FAO/WHO Expert Committee on Food Additives concluded that 1.5% in the diet, equal to 2173 mg/kg bw per day, was the NOAEL for this study, on the basis of a body weight reduction concurrent with an increase in feed consumption at the higher dose in males.
Mutagenicity/ Genotoxicity	The FAO/WHO Expert Committee on Food Additives concluded that the overall weight of evidence indicates that this chemical is not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Reproductive and developmental parameters were assessed in the rat chronic toxicity studies that included an in utero exposure phase. No significant effects on reproduction or body weights of the offspring were observed. The FAO/WHO Expert Committee on Food Additives concluded that 5% in the diet, equal to 2641 mg/kg bw per day, the highest dose tested, was the NOAEL for reproductive end-points in this study. No reproductive effects were observed in two developmental neurotoxicity studies. Also, no effects on reproductive parameters were observed in several other developmental neurotoxicity studies in rats using a mixture of colours, including This chemical, as the test substance. Two developmental toxicity studies were available in rats, one with dietary administration and one with drinking-water administration of This chemical during gestation days 0–19; these showed no adverse effects at doses up to 1000 mg/kg bw per day.
Acute Toxicity	In reports submitted to the World Health Organization, the acute oral LD50 in mice was reported to be 12,750 mg/kg bw [National Institute of Hygienic Sciences of Japan, 1964]. In rats, the LD50 by intraperitoneal injection was reported to be 2,000 mg/kg bw and the LD50 by intravenous injection was reported to be 1,000 mg/kg bw [Deutsche Forschungsgemeinschaft, 1957].
Irritation	No irritating effects were observed both for skin and for eye.
Sensitisation	The results of the available tests about the evaluation of dermal effects on human showed no sensitizing effects.
Health Effects Summary	A number of case reports have been published showing intolerance or hypersensitivity reactions to This chemical. Although some of these reactions have been shown to be quite severe, their prevalence appears to be very low (0.12% in the general population).
Key Study/Critical Effect for Screening Criteria	An average daily intake (ADI) of 0-10 mg/kg bw per day was assigned by JECFA in 2016.

Ecological Toxicity [1]	
Aquatic Toxicity	Acute short-term administration on fish: LC50 fish (96 h) > 120 mg/L Acute short-term administration on invertebrates: Both of the acute toxicity to Daphnia magna studies does not show any toxic effects. EC50(48h) > 125 mg/L Acute short-term administration on aquatic plants: Both of the acute toxicity to aquatic plants studies does not show any toxic effects. EC50(48h) > 125 mg/L
Determination of PNEC aquatic	On the basis of the three acute toxicity data points, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 120 mg/L. The PNECaquatic is determined to be 0.12 mg/L.
Current Regulatory Controls[3,4]	
Australian Hazard Classification	This chemical is a permitted food colour in both Australia and New Zealand.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	This chemical is a certified colour additive approved by the FDA in the United States to colour food, drugs and cosmetics.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not readily biodegradable. Thus, it is expected to meet the screening criteria for persistence.
B/vB criteria fulfilled?	As the estimated Log Pow is -10.7 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

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Toxicity Summary - Water Flow Assurance Tracer (WFT)

Chemical and Physical Properties[3,4,8,9]	
CAS number	One chemical (proprietary)
Molecular formula	Proprietary
Product name	--
Molecular weight	194.19
Solubility in water	$2.16x10^{4}$ mg/L at 25 deg C
pH	6.9
Melting point	236.2 deg C
Boiling point	178 deg C
Vapour pressure	Odourless white crystals or crystalline powder
Henrys law constant	$9.0x10^{-7}$ mm Hg at 25 deg C
Explosive potential	$1.1X10^{-11}$ atm-cu m/mole at 25 deg C
Flammability potential	Combustible. Gives off irritating of toxic fumes in a fire.
Colour/Form	No data found
Overview	This WFT is a naturally occurring substance in various plant species. The use in food is the predominant way of human exposure and of exposure of the environment. It is generally recognised as safe (GRAS) as a food additive by the US FDA.
Environmental Fate[4,8,9]	
Soil/Water/Air	If released to air, a vapor pressure of 9.0X10-7 mm Hg at 25 deg C indicates this chemical will exist in both the vapor and particulate phases in the atmosphere. In vapor-phase the chemical will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 20 hours. The Henry's law constant of 0.00000363 Pa m^3/mol indicates that the substance is non-volatile from water surfaces. If released to soil, this chemical is expected to have low to no mobility based upon Koc values of 741 and 7762 determined in silt and sandy loam soils. An approximated Koc of 71 suggests high mobility in sand which contains no clay and very low organic carbon content. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 1.1X10-11 atm-cu m/mole. Various biodegradation studies have found this chemical to be readily biodegradable. If released into water, this chemical is expected to adsorb to suspended solids and sediment based upon the Koc. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. An estimated BCF of 3 (log Kow of -0.07) suggests the potential for bioconcentration in aquatic organisms is low. The hydrolysis half-life of this chemical in water is reported to be >1 year. Degradation in natural water can occur through photodegradation and biodegradation.

Human Health Toxicity Summary [1,2,3,5,6,7,8,9]	
Chronic Repeated Dose Toxicity	This chemical was tested for carcinogenicity in five studies in rats by oral administration. In two of these studies, no significant difference in the incidence of tumours at any site was found. The other three studies were found to be inadequate for evaluation. Studies on oral and intraperitoneal administration of this chemical to mice were found to be inadequate for evaluation. In one study, decaffeinated coffee to which this chemical was added was tested by oral administration to rats; overall, no increase in tumours at any site was observed as compared to appropriate controls. Administration of this chemical in combination with known carcinogens resulted in decreased incidences of lung tumours in mice treated with urethane, of mammary tumours in rats treated with diethylstilboestrol and of skin tumours in mice treated with either ultra-violet light or cigarette-smoke condensate. This chemical did not influence the incidence of bladder tumours induced in rats by N-nitroso-N-butyl(4-hydroxybutyl)amine in three experiments or of pancreatic tumours induced in rats by 4-hydroxyaminoquinoline-1-oxide in another study. Nawrot et al. (2003) concluded in their review of the effects of this chemical on human health that “for the healthy adult population, moderate daily this chemical intake at a dose level up to 400 mg/day (equivalent to 6 mg/kg body weight/day in a 65-kg person) is not associated with adverse effects such as general toxicity, cardiovascular effects, effects on bone status and calcium balance (with consumption of adequate calcium), changes in adult behaviour, increased incidence of cancer and effects on male fertility.” It was indicated that habitual daily use of this chemical at greater than 500-600 mg/day (8.3 - 10 mg/kg) could be considered a health risk. For women, this chemical intake greater than 400 mg/day (6.7 mg/kg) “may increase the risk of detrusor instability (unstable bladder) development in women”. The EFSA’s panel on dietetic products, nutrition and allergies concluded that single doses of caffeine up to 200 mg (3 mg/kg/bw) from all sources do not raise safety concerns for the general healthy adult population. Intakes up to 400 mg per day (5.7 mg/kg bw) consumed throughout the day do not raise safety concerns for healthy adults in the general population, except pregnant women. A safety level of 3 mg/kg bw per day is also proposed for habitual caffeine consumption by children and adolescents.
Carcinogenicity	IARC evaluates that this chemical is not classifiable as to its carcinogenicity to humans (group 3).
Mutagenicity/ Genotoxicity	The potential for this chemical to induce genotoxicity has been evaluated in both in vitro an in vivo studies, with in vitro studies indicating both genotoxic and non-genotoxic results; in vivo studies have shown that, overall, this chemical is not genotoxic .
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	This chemical has been shown to cause adverse reproductive and developmental effects in mice, rats, rabbits and monkeys. Testicular atrophy was observed at high dose levels in rats. Reproductive studies in mice showed no effect on pregnancy but there was a decrease in litter size at birth. Teratogenic effects were usually associated with high, single, daily doses that were also associated with other signs of maternal toxicity. High daily levels given as divided doses were less toxic to the conceptus that when given as a single dose. Reduced fetal body weight was observed in rats. A reversible delay in ossification of the sternum was observed in rats at a relative low dose given by gavage. With administration in drinking-water, similar effects were seen, but at higher doses. One epidemiological study revealed no effect of this chemical on the sex ratio of their children. In lymphocytes of normal, this chemical-exposed people, chromosomal aberrations were not observed. An increased frequency of micronucleated blood cells was observed in otherwise healthy splenectomized people exposed to this chemical. Urine of this chemical-exposed persons was not mutagenic to Salmonella typhimurium.

Acute Toxicity	After oral application the LD50 for rats (10 animals/group/sex) was found to be 261-383 mg/kg bw; as clinical symptoms of toxicity, dyspnoea and staggering were seen after oral intake. In further reports the oral LD50 for rats was reported to be 200-400 mg/kg bw and for mice 185 mg/kg bw. The inhalation of the substance by rats as an aerosol for a period of 4 h resulted in an LC50-value of ca. 4.94 mg/l. Irregular and accelerated respiration were noted in this study. The LD50 for dermal application was >2000 mg/kg bw; no clinical symptoms of toxicity were observed. In animals studies this chemical showed moderate toxicity after oral uptake and inhalation and a low acute toxicity after dermal treatment .
Irritation	The undiluted substance was not irritating to the eyes of rabbits. Mean irritation indices were 0.9 (corneal opacity), 0 (iritis), 1.6 (conjunctival erythema) and 0.6 (conjunctival edema). The strongest signs of irritation were observed in 3/3 animals within the first 24h. By day 8 only one animal showed slight corneal opacity and conjunctival redness. The substance in a 50% aqueous dilution was not irritating to the skin of rabbits (Irritation index was 0) (OECD guideline 404 and 405). This chemical is not irritating to skin and eyes.
Sensitisation	No data available.
Key Study/Critical Effect for Screening Criteria	The American College of Obstetricians and Gynaecologists (2010) concluded that moderate chemical consumption (<200 mg/day) does not appear to be a major contributing factor in miscarriage or preterm birth. The EFSA's panel on dietetic products, nutrition and allergies concluded that single doses of caffeine up to 200 mg (3 mg/kg/bw) from all sources do not raise safety concerns for the general healthy adult population Thus, the acceptable daily intake of this chemical will be set at 200 mg/person/day for the derivation of a drinking water guidance value. Assuming that humans consume 2 litres of water a day, the drinking water guidance value for this chemical is determined to be 100 mg/L.
Ecological Toxicity [8,9]	
Aquatic Toxicity	Acute toxicity guideline studies have been conducted in fish, invertebrates and algae (OECD, 2002a,b; ECHA REACH database). A 96-hour LC50 in Leuciscus idus was reported to be 87 mg/L; the 48-hour EC50 in Daphnia magna was reported to be 182 mg/L. and the ErC50 in Scenedesmus subspicatus was reported to be >100 mg/L. .
Determination of PNEC aquatic	Based on the lowest acute toxicity value of 87 mg/L in fish and an assessment factor of 1,000, a PNECaquatic is determined to be 0.087 mg/L
Current Regulatory Controls	
Australian Hazard Classification	No data found
Australian Occupational Exposure Standards	No data found
International Occupational Exposure Standards	No data found
Australian Food Standards	No data found
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
Australian Hazard Classification	No data found
Australian Occupational Exposure Standards	No data found

PBT Assessment	
P/vP Criteria fulfilled?	This chemical is expected to be readily biodegradable and thus would not be expected to meet the screening criteria for persistence.
B/vB criteria fulfilled?	This chemical is water-soluble and bioaccumulation is not expected according to the log Kow (0.07). Thus, this chemical is not likely to meet the screening criteria for bioaccumulation.
T criteria fulfilled?	Long term data not available (acute data >0.1 mg/L); potentially not toxic.
Overall conclusion	Not a PBT substance (based on screening data).

References

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Toxicity Summary - Water SoluableTracers (CFTs) - Benzoic acid used as analogue data

Chemical and Physical Properties[1]	
CAS number	20 chemicals (proprietary)
Molecular formula	Proprietary
Molecular weight	140 – 260 (approximate)
Solubility in water	3.5 g/L at 25 °C
Melting point	122.4 °C
Boiling point	249.2 °C
Vapour pressure	0.11 Pa at 20 °C
Henrys law constant	No data available.
Explosive potential	Non-flammable
Flammability potential	Non explosive
Colour/Form	A white crystalline powder with a pleasant odour.
Overview	CFTs are organic compounds. Benzoic acid has been used as analogue data.
Environmental Fate[1,2,3]	
Soil/Water/Air	If released to air, a vapor pressure of 7.0X10-4 mm Hg at 25 deg C indicates benzoic acid will exist solely as a vapor in the atmosphere. Vapor-phase benzoic acid will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 9 days. Benzoic acid absorbs light at wavelengths >290 nm and, therefore, may be susceptible to direct photolysis by sunlight. If released to soil, benzoic acid is expected to have very high mobility based upon an estimated Koc of 15 (log Kow of 1.87). The pKa of benzoic acid is 4.20, indicating that this compound will exist almost entirely in the anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil is not expected because the compound exists as an anion and anions do not volatilize. Benzoic acid is not expected to volatilize from dry soil surfaces based upon its vapor pressure. If released into water, benzoic acid is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Biodegradation half-lives of 0.85 and 3.6 days using inoculum from a polluted river and a reservoir, respectively, suggest that biodegradation may be an important fate process in water. Measured BCF values of <10, 14, and 21 were reported for Golden ide (Leuciscus idus melanotus)(1), trout(2), and mosquito fish (Gambusia affinis)(3), respectively. This BCF range suggests the potential for bioconcentration in aquatic organisms is low.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Based on the weight of evidence the chemical is not considered to cause serious damage to health by repeated oral exposure (no observed adverse effect level (NOAEL) of 825 mg/kg bw/d). Effects observed at > 1000 mg/kg bw/d included increased mortality, reduced weight gain, and liver and kidney effects (OECD, 2004). Available animal data suggest that the chemical is not likely to cause serious damage to health via repeated dermal exposure. No treatment-related effects in rabbits at doses of up to 2500 mg/kg bw/d applied 5 d/wk for 3 weeks (OECD, 2004). Available animal data suggest that the chemical is not likely to cause serious damage to health via repeated inhalation exposure. The only available rat study for this chemical reported 2/20 mortalities at 1.2 mg/L 6 h/d (5 d/wk over 4 wk). Local reddish discharge around the nostrils and inflammatory cell infiltrates and interstitial fibrosis of the lung secondary to local irritant effects were also observed at ³ 0.25 mg/L. On the basis of systemic effects, the NOAEC is considered to be > 0.25 mg/L 6 h/d (ECHA, 2011).
Carcinogenicity	Based on the available data, the chemical is not considered carcinogenic. The chemical was not carcinogenic (NOAEL 500 mg/kg bw/d) in a lifetime 3-generation study in rats when given with the diet at doses up to 500 mg/kg bw/d. No increase in the lifetime tumour incidence, clinical abnormalities or histopathological changes were observed (OECD, 2004). A lifelong study using male/female Swiss Albino mice given the chemical (2 %) continuously in drinking water showed no carcinogenic effect (such as effect on survival or incidence of tumours) (CICAD, 2000).
Mutagenicity/ Genotoxicity	Based on the weight of the evidence of the in vitro and in vivo genotoxicity data, the chemical is not considered mutagenic or clastogenic. In vitro data using the reverse mutation assays with various strains of Salmonella typhimurium (with and without metabolic activation) and sister chromatid exchange assays (except one equivocal result) were negative. Weak genotoxic effects or equivocal results were observed in most of the chromosome aberration assays in three mammalian cell lines and two of the recombination assays in Bacillus subtilis (no further information available, only summary given) (REACH). No genotoxicity was observed in the in vivo cytogenetic, micronucleus, or other assays at either somatic or germ cell level (OECD, 2004).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No evidence of reproductive or developmental toxicity was observed for the chemical.

Acute Toxicity	The chemical is of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats and mice is greater than 2000 mg/kg bw/d. LD50 in rats ranged from 1700-3040 mg/kg bw/d and in mouse ranged from 1940-2370 mg/kg bw/d. However, the studies that reported the lower LD50s were all pre-guideline studies and no further information was available to critically assess the data. LD50s reported in two reliable studies were 2250 mg/kg bw/d (mice) and 2565 mg/kg bw/d (rats) (OECD, 2004). The chemical is of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats and mice is greater than 2000 mg/kg bw/d. LD50 in rats ranged from 1700-3040 mg/kg bw/d and in mouse ranged from 1940-2370 mg/kg bw/d. However, the studies that reported the lower LD50s were all pre-guideline studies and no further information was available to critically assess the data. LD50s reported in two reliable studies were 2250 mg/kg bw/d (mice) and 2565 mg/kg bw/d (rats) (OECD, 2004). The chemical exhibits low acute toxicity in animal tests as evidenced by reported dermal LD50 (median lethal concentration) in rats of greater than 2000 mg/kg bw (OECD, 2004). The chemical exhibits low acute toxicity in animal tests following inhalation exposure. No mortalities or toxic effects were observed in rats and mice with the reported median lethal concentration (LC50) > 12.2 mg/L/4-h (ECHA, 2011; OECD, 2004).
Irritation	Inhalation toxicity of the chemical was evaluated in one rat study (0, 0.025, 0.25 and 1.2 mg/L, 6 h/d 5 d/wk over 4 weeks) using fine benzoic acid dust (see Repeat dose toxicity - Inhalation). A reddish discharge around the nostrils was seen in the mid and high dose groups. An increased incidence and intensity of interstitial inflammatory cell infiltrate and interstitial fibrosis (indicating upper respiratory tract irritation) was noted at all doses. Observed histopathological changes were most likely due to a persistent irritating effect of the test substance on the lung. No changes in gross pathology were noted (REACH). The chemical was irritating (erythema and swelling of the ear lobe) in the guinea pig ear swelling test at ³ 1%, particularly when dissolved in ethanol, although it was not found irritating in the rabbit (OECD, 2004). The chemical was highly irritating in rabbit eyes, causing irreversible corneal opacity and chemosis in 2/3 animals, and increasing conjunctival redness severity with white/grey discoloration after 2-day observation. A Draize score of 35 was given based on the effects (REACH). In another rabbit study an irritation score of 65.0/110 was noted. No further details were available from this study (OECD, 2004).
Sensitisation	The negative results seen for the chemical from several skin sensitisation animal studies including guinea pig maximisation test (GPMT), Buehler test and local lymph node assay (LLNA) support a conclusion that the chemical is not a skin sensitiser (REACH). The chemical did not induce sensitisation in healthy volunteers although some allergic reactions were noted in 34/537 patients with suspected contact dermatitis (at 2 %) (SCCP, 2005) and 9/121 patients with dermatoses and 10/57 patients with chronic urticaria (at 5 %) (ECHA, 2011).
Health Effects Summary	The critical health effects associated with the chemical (but not the salts) are skin, eye and respiratory tract irritation. However, no systemic effects were seen with benzoic acid. The salts are expected to exist almost entirely as the benzoate ion under normal physiological conditions and will not have the local irritant properties that arise from the acidity of benzoic acid. Therefore, it is unlikely that any systemic effects will be observed with the salts of benzoic acid.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 825 mg/kg bw/day from the repeated chronic oral toxicity study.

Ecological Toxicity [2]	
Aquatic Toxicity	Studies on three trophic levels are available with the lowest EC50 found in algae (33.1 mg/L). In this study the concentrations decreased significantly over the exposure period of 72 hours. The LC50 for fish is 44.6 mg/L and for daphnia an EC50 of > 100 mg/L was derived. The EC10 from the algae study is 3.4 mg/L, which is much lower than the NOEC for fish (120 mg/L in a 28 day study) and daphnia (25 mg/L in 21 day reproduction test).
Determination of PNEC aquatic	Long-term data was available for a fish, invertebrate and algae. An assessment factor of 10 was used on the lowest NOEC of 3.4 mg/L for algae for a resulting PNEC of 0.34 mg/L.
Current Regulatory Controls[1]	
Australian Hazard Classification	The chemical is not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).
Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 5–10 mg/m^3 in different countries such as USA (California, Tennessee), Canada and England.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Benzoic acid is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on the measured BCF values of <10 to 21 and a log Kow of 1.87 benzoic acid is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

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Toxicity Summary - Gas Phase Frac Tracers (GFTs)

Chemical and Physical Properties[1,2,3]	
CAS number	15 chemicals (proprietary).
Molecular formula	Proprietary
Molecular weight	~300 – 500
Solubility in water	Insoluble
Melting point	~-37 °C
Boiling point	~76 °C
Vapour pressure	666 @ 25 °C
Henrys law constant	No data available
Explosive potential	Non explosive
Flammability potential	Non-flammable
Colour/Form	Colourless, odourless liquid
Overview	GFTs tracers are compounds that consist of a carbon and fluorine atoms joined by covalent bonds. GFTs are very stable because of the strength of the carbon–fluorine bond. GFTs are chemically inactive, nontoxic, and non-flammable compounds that are found in the atmosphere at very low levels. They are chemical inert, have no biological effects and are very safe. GFTs present no known danger to humans if inhaled or ingested. There are no regulatory restrictions on the use or emission of GFTs. Information for Perfluorocarbons (PFCs) used as analogue data.
Environmental Fate[1]	
Soil/Water/Air	GFTs as a class are extremely stable. They are not susceptible to hydrolysis, and not affected by light (including UV).
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Two-week repeat dose preliminary inhalation toxicity (rat at a target concentration of 10,000 ppm (10%), no treatment-related effects were noted for clinical signs, body weight, food consumption, water consumption, macroscopic pathology or organ weights. 90 day inhalation study in rats: no treatment-related effects were observed in this study in which rats were exposed to 5,000 ppm, 15,000 ppm, and 50,000 ppm of the test material for 6 hours per day, 5 days per week for a total of 13 weeks. These results indicate that the toxicity of the test material following repeated inhalation exposure is very low and suggest that the gas can be treated as a simple asphyxiant. In a short term repeated Dose 28 Day oral toxicity study in rodents conducted in accordance to the OECD Guideline 407, the test subjects showed no toxic effect at a dosage of 1000 mg/kg/day over 28 days. The NOEL was determined to be 1000 mg/kg/day.
Carcinogenicity	Chromosomal aberration test in cultured mammalian cells: non-clastogenic
Mutagenicity/ Genotoxicity	Bacterial mutation assay salmonella typhimurium (strains ta 1535, ta 1537, ta 1538, ta 98 and ta 100): negative.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.

Acute Toxicity	Inhalation 4-hour LC50 : > 800,000 ppm in rats Effects observed in animals by inhalation include decreased growth rate, pulmonary changes, irregular respiration, increased urine volume and creatinine, reversible pathological changes in the kidneys, and increased urinary fluoride concentration. One study showed no arrhythmogenic effects in dogs at a concentration of 20 %, while another study did show some arrhythmogenic effects in both guinea pigs and dogs. Long-term inhalation exposures resulted in an initial decrease in growth rate, but no other adverse changes were noted. No animal test reports are available to define carcinogenic, developmental, or reproductive hazards. The compound does not produce genetic damage in bacterial cell cultures but has not been tested in animals. Acute inhalation toxicity study (rat): the 4-hour LC50 is above 110,000 ppm. These results suggest that on an acute inhalation basis the test material can be considered as a simple asphyxiant.
Irritation	Non-irritating
Sensitisation	Not sensitising
Health Effects Summary	The chemicals have been used in various medical applications, both in trials and in routine use, in human subjects, for some forty years, indicating these materials have zero toxicity to humans.
Key Study/Critical Effect for Screening Criteria	The NOEL level for the purposes of risk assessment is 1000 mg/kg bw/day from the repeated short term oral toxicity study.
Ecological Toxicity [1]	
Aquatic Toxicity	Fish 96h LC50 > 100 mg/L Invertebrates 48h EC50 > 0.1 mg/L Microorganism 3h EC50 > 100 mg/L Pimephales promelas (fathead minnow) 96 h NOEC = 1000 mg/L
Determination of PNEC aquatic	$PNEC_{aquatic}$ has not been calculated. The substance exhibits no toxicity.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Yes, GFTs are not biodegradable. However, they are volatile and are quickly removed from the environment.
B/vB criteria fulfilled?	The estimated Log Kow is generally > 4.5 (EPI Suite), thus it is expected to be bioaccumulative.
T criteria fulfilled?	No. Fish 96 h NOEC = 1000 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT

Revised	April 2019

References

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Appendix I

Toxicological Profiles for Drilling and Packer Fluids

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Toxicity Summary - Sodium Erythorbate

Chemical and Physical Properties[1,2]	
CAS number	6381-77-7
Molecular formula	C6H7NaO6
Molecular weight	199.13
Solubility in water	Soluble; 146 g/L at 20 °C and pH 6
Melting point	160 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	Non-flammable (100%)
Colour/Form	White, free-flowing crystals
Overview	Sodium erythorbate is a synthetic antioxidant used in food and cosmetic formulations. Foliar application of sodium erythorbate sprays and dusts are used to control young tree decline in citrus trees and to reduce ozone damage to Thompson seedless grapes. It is also used in hydraulic fracturing mixtures to prevent precipitation of metal oxides (iron control). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1]	
Soil/Water/Air	The chemical is not expected to be readily biodegradable. The chemical achieved 56% degradation in 28 days according to test guidelines OECD 301E. However, the degradation after 28 d was not yet finished as a plateau is not yet visible in the degradation curve; thus, a further degradation of the product seems to be possible.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	Male 6-week-old F344 rats were given doses of 5% Sodium Erythorbate in feed for 168 days. Parameters of urinary excretion were investigated and the urinary bladder epithelium was examined using light and scanning electron microscopy at weeks 8, 16, and 24. The urine of rats fed Sodium Erythorbate had increased pH, elevated content of crystals and sodium, and decreased osmolality; however, no morphological alterations such as hyperplasia were detected in the mucosa. The urine values and urinary bladder mucosa were similar to controls at doses below 5 g/kg/day.

Carcinogenicity	F344/DuCrj rats of both sexes (6-week-old) were given 1.25% or 2.5% Sodium Erythorbate in drinking water for 104 weeks and untreated water for 8 additional weeks. Rats of the control group were given untreated water only. Each group consisted of 52 male and 50 female rats. Cumulative consumption of Sodium Erythorbate by male rats was 217 g/rat (1.25%) and 430 g/rat (2.5%). Consumption by females was 206 g/rat (1.25%) and 583 g/rat (2.5%). Body weight of rats given 2.5% Sodium Erythorbate was reduced by 8.5% for males and 15.5% for females at weeks 88 and 85, respectively, compared to controls. Body weight gain was normal in rats of the low dose group. All male treated and control rats (except two of the high-dose group) had testicular interstitial cell tumours. Various tumours occurred in 80% of control males, 69% of males given the low dose, and 78% of males given the high dose. A 6-18% incidence of leukaemia, pheochromocytoma, mammary fibroadenoma, and mesothelioma was observed. Of the females of the control, 1.25%, and 2.5% dose groups, 94%, 88%, and 78% had tumours, respectively. Twenty to 43% of females (all groups) had leukaemia, mammary fibroadenoma, endometrial stromal polyp and/or pituitary adenoma. Females given 2.5% Sodium Erythorbate had significantly fewer tumours than control females. The pattern of occurrence of the various types of tumours was similar among the groups. Sodium Erythorbate did not enhance the development of rare spontaneous tumours or transform benign tumours (e.g., solid adenoma of the thyroid) to carcinomas. The investigators concluded that Sodium Erythorbate was not carcinogenic in F344 rats.
Mutagenicity/ Genotoxicity	Sodium Erythorbate (99.8% pure; 5.0 mg/plate) was non-mutagenic in S. typhimurium strains TA92, TA94, TA98, TA100, TA1535, and TA1537 with and without S9 activation. Sodium Erythorbate (0.25 mg/mL plate) was also negative in the chromosomal aberration assay using Chinese hamster fibroblasts; Sodium Erythorbate did not induce the formation of polyploid cells after 48 hours, and caused 1 % chromosomal breaks after 24 hours.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Sodium erythorbate did not cause maternal or fetal toxicity when administered to female rats and mice during gestation by oral intubation at dosages up to 1,030 mg/kg/day. Developmental toxicity did not occur after pregnant rats were given up to 5% sodium erythorbate in feed during a 13-week teratogenesis study. It produced negative results in the Ames test, the host-mediated assay using S. typhimurium, chromosomal aberration tests using Chinese hamster ovary fibroblasts, the dominant lethal test using rats, and the B. subtilis rec assay.
Acute Toxicity	Sodium erythorbate powder was applied to the intact and abraded skin of six rabbits as a single 2 g/kg dose. A substantial amount of residual compound was observed 24 hours after dosing. No erythema, edema, or other signs of dermal irritation were observed at five of six test sites. One rabbit (abraded skin) had slight (1+) erythema at 24 hours that cleared by 48 hours.
Irritation	Sodium erythorbate powder did not cause signs of dermal irritation when applied to the intact and abraded skin of rabbits. Instillation of sodium erythorbate powder to the conjunctival sac of rabbits caused slight and transient reddening of the conjunctiva that cleared within 24 hours.
Sensitisation	In a dermal sensitization study (according to OECD 429) with Sodium erythorbate (5, 10, 25% w/w in propylene glycol), young adult female CBA/Ca (CBA/CaOlaHsd) mice (4/group) were tested using the local lymph node assay (LLNA). In this study, Sodium erythorbate was not considered a potential skin sensitizer.
Health Effects Summary	Sodium erythorbate did not show signs of toxicity, carcinogenicity, mutagenicity, irritation and sensitisation in the studies reported. This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water guideline value for sodium may apply.

Ecological Toxicity [1,2]	
Aquatic Toxicity	The acute toxicity of the sodium erythorbate to the freshwater fish rainbow trout (Oncorhynchus myldss) has been investigated and gave a 96-Hour LC50 of greater than 100 mg/L (semi-static). The acute toxicity of sodium erythorbate to Daphnia magna gave an EC50 (48 h) of 84 - 100 mg/L. The effect of the test item on the growth of Pseudokirchneriella subcapitata has been investigated over a 72-Hour period. The EC50 (72 h) was 160 mg/L while the NOEC (72 h) was 20 mg/L.
Determination of PNEC aquatic	A PNECaquatic of 84 µg/L was calculated using the lowest endpoint of EC50 of 84 mg/L for Daphnia magna. An assessment factor of 1000 was used.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Could potentially be persistent as it is not readily biodegradable.
B/vB criteria fulfilled?	No. The Log Pow is -3.29 (Log Pow < 4.5) which does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. Based on measured acute toxicity endpoints of greater than 1 mg/L Sodium erythorbate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

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Toxicity Summary - Starch

Chemical and Physical Properties[1,2,4,6]	
CAS number	9005-25-8
Molecular formula	(C6H10O5)n
Molecular weight	UVCB
Solubility in water	In cold water, starch absorbs water reversibly and swells slightly. In hot water, irreversible swelling occurs, producing gelatisation.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Combustible
Flammability potential	No data available.
Colour/Form	White powder, tasteless and has no smell
Overview	Starch is a high –polymeric carbohydrate material primarily composed of amylopectin and amylose. It is usually derived from cereal grains such as corn, wheat and sorghum and from roots and tubers such as potatoes and tapioca. It includes starch which has been pregelatinized by heating in the presence of water. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[7]	
Soil/Water/Air	Based on information from NICNAS (2006): In a ready biodegradation test, the notified polymer (Potato Starch Modified) showed an 86.87% degradation during a Modified Sturm Test (OECD Test Guideline 301B) indicating that it was readily biodegradable. The test was verified using a sodium benzoate standard which showed 93.77% degradation at the end of the study. In addition a toxicity control consisting of a mixture of the test substance and sodium benzoate showed 83.49% degradation at the end of the study period, indicating that the test material did not inhibit the microbial activity. The notified polymer does potentially contain cationic and anionic functional groups, however based on the typical dissociation constants for the functionalities and their ratio within the polymer it is expected to have a net anionic charge throughout most of the environmental pH range, becoming slightly cationic only at the low end of the range. In landfill and the sewer, the notified chemical is expected to be relatively readily degraded by biotic and abiotic pathways to ultimately yield water and oxides of carbon and nitrogen and salts of chlorine and sodium. Any incineration of the notified polymer would result in its destruction and the formation of carbon dioxide and water and ash containing salts of chlorine and sodium. The notified polymer has a high molecular weight not expected to bioaccumulate.

Human Health Toxicity Summary[2,3]	
Chronic Repeated Dose Toxicity	A long-term study was carried out on the effects of inoculating 1.5 g of starch powder into the peritoneal cavity of rats. After an initial considerable inflammatory reaction, the intense vascular reaction subsided, leaving firm adhesions that were still present in animals sacrificed at 18 months (Ell90). Feeding of unmodified cornstarch and potato starch to groups of rats at dietary levels up to 30% (equivalent to 27.4-33.6 g/kg bw/d) in a 2-year test and 10% (food intake not indicated) in a 3-generation test did not result in distinct toxicologically significant effects (Gro74). Rats fed a cooked diet containing 62% unmodified maize starch (equivalent to 51.1 g/kg bw/d*) for 2 years also did not show significant toxicological effects, including reproductive effects over 3 generations (Tru79). Slight growth retardation was seen in rats exposed for 4 weeks to raw potato starch at a dietary level of 40% (equivalent to 46.0-52.8 g/kg bw/d) (Fer73).
Carcinogenicity	Not classifiable as a human carcinogen (A4)
Mutagenicity/ Genotoxicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Acute Toxicity	Toxicity of starch given orally to albino rats were studied. Experiments were performed upon CBL albino rats weighing 140 ± 15 (mean ± S.D.). Starch was given daily for 14 consecutive days in total daily oral doses of 36, 72, 120 and 168 g/kg and in animals which did not succumb to gastric rupture in doses gradually increasing to 204, 240 and 288 g/kg. Gastric rupture appeared in 50 – 75% of rats given starch in amounts of 168 g/kg and over. Of the survivors of gastric rupture, 5% died of pneumonia and 20% from bowel obstruction during the 14 days of starch administration. Doses of one tenth body weight and above produced some inhibition of growth, doses of one fifth body weight and above increased the susceptibility to pneumonia and bowel obstruction owing to the inability of the animal to evacuate the starch calculi. It was noted that doses of this order could not readily be taken by humans and smaller doses had insignificant toxicity. Acute respiratory effects after exposure to dust from the refining process of potato starch have been described (personal sampling: 3.9-56.0 mg/m^3, total dust). The responsible agent could not be identified although the authors suspected endotoxin to be the causative agent (Hol94). Millers and bakers occupationally exposed to grain and flour dusts (personal sampling: 1.1-14.3 mg/m^3, total dust) showed significantly higher incidences of coughing and chronic bronchitis compared to a non-exposed reference group (Mas95, Mas96). A dose-response relationship was observed between dust exposure levels and chronic respiratory symptoms (Mas95). Although flour is a complex product that is mainly made up of starch (70%) and gluten (12%), it may also contain mite dust and endotoxins. The causative role of starch in the observed respiratory symptoms is therefore not clear. The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).
Irritation	Skin contact with a total dose of 300 µg of starch, intermittently applied over a 3-day period, resulted in a mild erythema and slight oedema of the skin in humans (ACG99).
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).

Ecological Toxicity[7]	
Aquatic Toxicity	Based on QSAR modelling: Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L
Determination of PNEC aquatic	Based on the lack of ecotoxicity data, PNECaquatic was not determined.
Current Regulatory Controls[2,4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	TWA = 10 mg/m^3
International Occupational Exposure Standards	TLV: 10 mg/m^3, as TWA The current administrative occupational exposure limit (MAC) for starch in the Netherlands is 10 mg/m^3, 8-hour TWA, equal to the occupational exposure limit for nuisance dust.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. This substance is expected to be readily biodegradable.
B/vB criteria fulfilled?	No. This substance is not expected to be bioaccumulative.
T criteria fulfilled?	Based on QSAR modelling, this substance is not expected to meet the toxicity criteria.
Overall conclusion	Not PBT
Revised	April 2019

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Toxicity Summary - Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione

Chemical and Physical Properties[1,2,3,5]	
CAS number	533-74-4
Molecular formula	C5H10N2S2
Molecular weight	162.28
Solubility in water	3.5 g/l at 20 °C at pH 5, pH 7and pH 9
Melting point	103.2 – 105.2 °C
Boiling point	No data available.
Vapour pressure	5.8 x 10-6 Pa at 20 °C (extrapolated)
Henrys law constant	2.66X10-10 atm-cu m/mole
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Off-white to yellowish solid of sulphurous odour
Overview	Dazomet (Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione) is a soil fumigant effective for the control of nematodes, insects, germinating weeds and soil fungi. Dazomet is strongly phytotoxic, acting by virtue of the chemical release of methylisothiocyanate (MITC).
Environmental Fate[1]	
Soil/Water/Air	Dazomet's production may result in its release to the environment through various waste streams; its use as a soil sterilant, nematicide, fungicide, slimicide in pulp and paper manufacture, and as a preservative in adhesives and glues will result in its direct release to the environment. If released to air, a vapour pressure of 2.80X10-6 mm Hg at 20 deg C indicates dazomet will exist in both the vapour and particulate phases in the atmosphere. Vapour-phase dazomet will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 1.4 hours. Particulate-phase dazomet will be removed from the atmosphere by wet or dry deposition; hydrolysis of this compound during rain events or in clouds may occur. It has been suggested that dazomet may also undergo direct photolytic degradation and this process may contribute to atmospheric removal. If released to soil, dazomet is expected to have high mobility based upon an estimated Koc of 52; however it is expected to hydrolyse before extensive leaching occurs. Volatilization from moist soil surfaces is not expected to be an important fate process based upon a Henry's Law constant of 2.66X10-10 atm-cu m/mole. When dazomet is applied to soil, either to the surface or incorporated, it quickly hydrolyzes in the presence of moisture. The major degradate is methyl isothiocyanate, but formaldehyde, monomethylamine, hydrogen sulfide and (in acid soils) carbon disulfide, are also formed. The half-life of dazomet in soil has been reported as less than 1 day (pH >5). The rate of disappearance was found to be the same in both unamended and sterilized soils and in different soil types, indicating that chemical hydrolysis and not biodegradation is the primary removal process. Dazomet is not expected to volatilize from dry soil surfaces based upon its vapour pressure. If released into water, dazomet is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's Henry's Law constant. In water, dazomet is expected to undergo hydrolysis rapidly, forming methyl isothiocyanate and formaldehyde. Half-lives of 3.6, 2.4, 2.8, and 4.0 hours have been reported at pH values of 4.4, 5.7, 7.0, and 8.0, respectively. In salt water (0.15 M), a half-life of 6.1 hours was reported. An estimated BCF of 2.4 suggests the potential for bioconcentration in aquatic organisms is low.

Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	In a 78 week study, mice were given dazomet in the diet at 0, 20, 80 and 320 ppm. Compound intakes were estimated as follows: males - 0, 4, 16 and 68 mg/kg/d; females - 0, 6, 22 and 93 mg/kg/d. Survival was not affected and there were no noteworthy clinical signs, or bodyweight or food consumption changes. There was a significant elevation of liver weight at the high dose and an increased number of mid-dose and high dose animals with liver discolouration, liver masses and centrilobular lipid deposition. At the high dose, females showed a slightly increased incidence of hepatocellular adenomas (3, 0, 1 and 7 females, out of 50, in the control, low dose, mid dose and high dose groups, respectively) and a significantly increased incidence of basophilic foci. Increased splenic haemosiderin deposition and extramedullary haematopoiesis were noted at the mid dose (males) and high dose. Three/60 females from each dose group had malignant lymphoma at one or more sites; because of the low incidence, lack of a dose-response, and lack of any effect in males, it was not considered to be directly compound-related. The NOEL was 20 ppm (about 4 mg/kg/d in males, 6 mg/kg/d in females).
Carcinogenicity	Rat studies showed no clear evidence of any carcinogenic effect of dazomet. In mice, there was a slight increase in hepatocellular adenomas (not carcinomas) following 78 weeks of treatment at the high dose (320 ppm). There was also an increase in malignant lymphoma in females, but because of the low incidence, the lack of effect in males and the lack of any dose-response, it was not considered to be directly compound-related. The lack of a carcinogenic effect of dazomet is consistent with the data for MITC.
Mutagenicity/ Genotoxicity	An acceptable package of mutagenicity tests has been conducted covering all three end points. The results are the genotoxicity tests are not clear cut. While the majority of tests gave negative results, there were sufficient positive results to indicate some genotoxic potential of dazomet. In summary, there were positive results in one gene mutation assay (HGPRT locus in Chinese hamster ovary cells), equivocal results in another gene mutation assay (TK locus in mouse lymphoma L5178Y cells), and positive results in two chromosome aberration assays (both in vitro assays in mouse lymphoma L5178Y cells), in one in vitro assay for of unscheduled DNA synthesis in primary rat hepatocytes and in one in vitro assay of sister chromatid exchange. In all cases, the positive findings were relatively weak. There were no positive in vivo studies and there was a trend for results to only be positive (or to be stronger) in the absence of metabolic activation than in its presence. This suggests that unchanged dazomet has greater genotoxic potential than the metabolites of dazomet. The unscheduled DNA synthesis assay was the only assay which gave results suggesting that the metabolites of dazomet may have some genotoxic potential, even if only weak.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Dazomet was fed to rats at 0, 5, 30 and 180 ppm for at least 70 days prior to mating, throughout mating and lactation, during production of F_1a and F_1b litters. Selected F_1a pups were maintained on compound-containing diets post-weaning to produce F_2 litters. Hepatotoxicity was observed in both generations, mainly at the high dose, but to some extent at the mid dose. Liver weights were increased and there was an increased severity of liver fatty change. Some serum enzyme and serum protein changes also indicated effects on the liver. There was no impairment of mating or reproductive performance and no adverse effect on reproductive organs or pup development. The NOEL with respect to reproductive function in rats was 180 ppm (about 18 mg/kg/d), while that for systemic toxicity was 5 ppm (about 0.5 mg/kg/d). An oral (gavage) developmental study was conducted in rats at dazomet doses of 0, 3, 10 and 30 mg/kg/d. Food intake and body weight and also uterine weights were reduced at the high dose and to a lesser extent at the mid dose. There was a higher incidence of runts at 10 mg/kg and above, however, without a clear dose-response relationship. There was no evidence of teratogenic effects. The NOEL for maternal and foetal effects was 3 mg/kg/d.
Acute Toxicity	Dazomet is of moderate acute oral toxicity. The oral LD50 values for dazomet from two different studies in rats were about 600 - 900 mg/kg for males and 400 - 550 mg/kg for females. The LD50 of dazomet, given subcutaneously to mice, was 248 mg/kg. The LD50 of dazomet, given subcutaneously to rats, was 470 and 550 mg/kg in males and females, respectively. The dermal LD50 of dazomet in rats was greater than 2000 mg/kg. Symptoms associated with acute dazomet toxicity were shaking, salivation, tonic convulsions, trembling, dyspnoea and lassitude.

Irritation	In two studies, the introduction of 39 or 50 mg dazomet into the eye of rabbits caused slight irritation (moderate conjunctival erythema and slight oedema). Results of two acute dermal irritation studies employing 50% aqueous preparations of dazomet in rabbits were reported. No irritation was observed in the study employing a 4 h exposure period. After a 20 h exposure period, moderate erythema and oedema were observed. Application of the EUP, Basamid Granular (2 g coated on a cottonwool carrier), to the rabbit ear for 20 h caused slight inflammation.
Sensitisation	Skin sensitisation was not observed in two studies following the application of dazomet or Basamid Granular to the guinea pig. No justification was given for the doses / concentrations used in one of these studies and positive control compounds were not tested in these studies.
Health Effects Summary	Dazomet has moderate to low acute oral, dermal and inhalational toxicity. It appears that the toxicity of dazomet is somewhat greater by the oral route than by the dermal and inhalational routes. Dazomet is only a slight dermal and ocular irritant.
Key Study/Critical Effect for Screening Criteria	An ADI of 0.005 mg/kg/d is calculated based on a NOEL of 0.5 mg/kg (established in a 1-year dietary dog study and a 2-year dietary rat reproductive study) and a safety factor of 100.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Daphnia magna (Water flea), 48 h, static, EC50 = 0.3 mg/L Salmo gairdneri (Rainbow trout), 96 h, static, LC50 = 0.16 mg/L Ankistrodesmus bribaianus (Green alga), 72 h, static, EC50 = 1.08 mg/L Colinus virginianus (Bobwhite quail), 21 d, LD50 = 415 mg/kg bw Colinus virginianus (Bobwhite quail), 25 weeks, NOEL = 100 mg/kg food
Determination of PNEC aquatic	An assessment factor of 10 has been applied to the lowest reported LC50 of 0.16 mg/L for Rainbow trout. The PNECaquatic is 0.016 mg/L.
Current Regulatory Controls [4]	
Australian Hazard Classification	Acute toxicity – category 4 Eye irritation – category 2 Hazardous to the aquatic environment (acute) – category 1 Hazardous to the aquatic environment (chronic) – category 1
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1,3,5]	
P/vP Criteria fulfilled?	The half-life of dazomet in soil has been reported as less than 1 day (half-life in soil < 6 months). Thus, it is not expected to be persistent.
B/vB criteria fulfilled?	As the Log Pow is 0.63 at 20 °C (Log Pow < 4.5) and estimated BCF is 2.4, it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

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Toxicity Summary - Trisodium Nitrilotriacetate

Chemical and Physical Properties[1,2,3]	
CAS number	5064-31-3
Molecular formula	C6H9NO6.3Na
Molecular weight	257.0
Solubility in water	640 g/l at 20 °C
Melting point	410 °C with decomposition above 200 °C
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	Non-explosive (100%)
Flammability potential	Non-flammable (100%)
Colour/Form	colourless crystalline powder
Overview	The chemicals in this group are known as nitrilotriacetic acid (NTA) and its trisodium and tripotassium salts, trisodium nitrilotriacetate (trisodium NTA) and tripotassium nitrilotriacetate (tripotassium NTA). The trisodium salt also occurs as its monohydrate form (trisodium nitrilotriacetate monohydrate; CAS No. 18662-53-8). The chemical NTA is an aminocarboxylic acid with three functional carboxylate groups. The chemical forms water-soluble complexes with multivalent metal ions. The chemical NTA and trisodium NTA dissociate to form a common moiety, nitrilotriacetate ion. Thus the systemic toxicity of these chemicals is similar (Health Canada, 2010; SCCS 2010). Tripotassium NTA is considered to be functionally similar to trisodium NTA. The chemicals, NTA and trisodium NTA are used to soften water and to remove traces of heavy metals. These chemicals are commonly used as chelating and sequestering agents, and as builders in detergent and cleaning formulations for domestic and commercial use (EU RAR, 2008; SCCS, 2010).
Environmental Fate[1]	
Soil/Water/Air	Trisodium NTA was tested for ready biodegradability according to OECD 301 E (BASF, 1983b,c), OECD 301 F (in addition to a combined CO2/DOC test, see Strotmann et al., 1995), and Sturm Test (BASF, 1983d), and in a die away test (Takahashi et al, 1997) as well as for inherent biodegradability according to OECD 302 B (BASF, 1983a). These tests resulted in 75 -100 % degradation after 7 to 28 days with lag phases ranging between 1 and 16 days. According to results from ready biodegradation tests, trisodium NTA can be regarded as readily biodegradable. In accordance with column 2 of REACH Annex IX, trisodium NTA has a log octanol-water partition coefficient of -13.2 at pH 7, is highly water-soluble, and is unlikely, due to its polar nature, to be taken up by fish gills or across other biological membranes. Due to the ionic structure of the substance a relevant adsorption of trisodium NTA onto the organic fraction of soils, sediments or suspended solids is not expected. However, interaction with the mineral phase may be possible. This assumption is in line with available study results (Dunlap et al., 1971; Bolton et al., 1993) which demonstrate that trisodium NTA is neither strongly sorbed by loam, clay-loam and sandy soils or marine surface sediments (Kp sediment-water = 1.6 l/kg).

Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	The available data suggest that the chemicals have harmful effects following repeated oral dosing, based on results from animal tests. However, the effects were not sufficient to warrant hazard classification. In a 4-week study, Charles River and Fischer 344 (F344/N) (five or ten animals/group) rats were fed either 0 % or 1.5 % NTA in the diet. Effects observed included reduced growth, increased relative kidney weight, urinary calcium, haematuria and hydronephrosis. A lowest observed adverse effect level (LOAEL) of 1.5 % NTA (equivalent to 750 mg/kg bw/day) was reported (EU RAR, 2008; Health Canada, 2010). In a 10-week study in male Sprague Dawley (SD) rats, trisodium NTA was administered to the rats in drinking water at 0 %, 0.01 %, 0.1 % or 1 % (equivalent to 0, 10, 100 or 1000 mg/kg bw/day). Increased kidney weights were observed in the rats treated at 0.1 % (100 mg/kg bw/day) and marked vacuolisation of the renal tubules was observed at 1 % trisodium NTA (1000 mg/kg bw/day dose) group. A LOAEL of 100 mg/kg bw/day (0.1 % trisodium NTA) was reported (EU RAR, 2008; Health Canada, 2010; SCCS, 2010). Trisodium NTA was administered to male SD rats by gavage at 0, 0.73 or 7.3 mmol/day (equivalent to 0, 187 or 1876 mg/kg bw/day) for 30 days. Cytoplasmic vacuolisation, focal haemorrhage, necrosis, erosion and hyperplasia of the epithelium of the proximal convoluted tubules were observed in all treated animals. An oral LOAEL of 0.73 mmol/day (187 mg/kg bw/day) was reported (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHb). In a 90-day study in rats (strain not reported), NTA was administered to male rats at 0, 100, 1000 or 5000 mg/L in drinking water. All treated animals showed reduced serum potassium levels (EU RAR, 2008; Health Canada, 2010). In two different studies (28-days and 91-days), New Zealand White (NZW) rabbits (six/group) were treated with either 0 or 2.5 % trisodium NTA on intact or abraded skin. No treatment-related effects were observed with or without abrasion (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHa & b). In a 4-week repeated dose inhalation toxicity study, NTA was administered in SD rats, trueblood albino guinea pigs and cynomolgus monkeys at 0, 10, 213 or 343 mg/m^3 concentrations for 6 hours/day by whole body exposure. No respiratory irritation or discomfort was observed at the highest tested concentration. The only treatment-related effects included diarrhoea in monkeys and dyspnoea in rats and guinea pigs. The no observed adverse effect concentration (NOAEC) of 213 mg/m^3 and the lowest observed adverse effect concentration (LOAEC) of 343 mg/m^3 were reported (EU RAR, 2008; Health Canada, 2010; REACHa & b). In another study, male albino rats were treated with NTA at 0, 2, 20, 200 or 2000 mg/m^3 concentrations for 6 hours/day for four consecutive days by inhalation exposure. All animals in the 2000 mg/m^3 showed signs of nasal, respiratory and eye irritation, which were fully reversed on day 14 (EU RAR, 2008; Health Canada, 2010).

Carcinogenicity	Trisodium NTA is classified as hazardous with hazard catergory 'Carcinogenicity – Category 2' and hazard statement 'Suspected of causing cancer' (H351) in the HCIS (Safe Work Australia). The available data support the classification for trisodium NTA. Additionally, the classification for carcinogenicity is considered appropriate for NTA. The International Agency for Research on Cancer (IARC) has classified NTA and its salts as 'Possibly carcinogenic to humans' (Group 2B), based on inadequate evidence for carcinogenicity in humans, but sufficient evidence for carcinogenicity in animal tests (IARC, 1990; IARC, 1995). In two-year carcinogenicity studies in Charles River (CD) rats and B6C3F1 mice, oral administration of Na3NTA induced benign and malignant tumours of the urinary system in both male and female rats at 80–100 mg/kg bw/day and haematopoietic tumours in male mice at 500–600 mg/kg bw. Trisodium NTA was reported to induce renal tubular adenomas and adenocarcinomas in male rats when administered orally (IARC, 1990; IARC, 1995; EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHa & b).
Mutagenicity/ Genotoxicity	Based on the weight of evidence from the available in vitro and in vivo genotoxicity studies, the chemicals are not considered to be genotoxic. Several in vitro and in vivo micronucleus tests for gene mutation and clastogenicity were negative, although several positive results were reported (IARC, 1990; IARC, 1995; EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHa & b).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the available information, the chemicals do not cause specific reproductive or developmental toxicity. In different two-generation reproductive and developmental toxicity studies, oral administration of up to 0.5 % trisodium NTA (equivalent to 450 mg/kg bw/day) in the diet of Charles River rats, up to 250 mg/kg bw/day trisodium NTA by gavage in pregnant NZW rabbits, and up to 0.2 % NTA (equivalent to 570 mg/kg bw/day) in drinking water in Naval Medical Research Institute (NMRI) mice, caused no significant maternal, embryonic or foetal effects. No effect on neonatal development was seen in any of the above studies (NTP, 1977; IARC, 1995; EU RAR, 2008; Health Canada, 2010; SCCS, 2010; HSDB; REACHa & b). In a developmental study, female NZW rabbits (groups of 20) were treated by gavage with trisodium NTA in drinking water at 0, 2.5, 25, 100 or 250 mg/kg bw/day during gestation days 7–16. All animals were sacrificed on day 28 of gestation. No treatment-related effects were observed (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHa & b). A study was conducted in pregnant NMRI albino mice (10 animals/group) treated with 0 or 0.2 % trisodium NTA (equivalent to 0 or 570 mg/kg bw/day) in drinking water on 6–18 days of gestation. No significant differences in maternal weight gains and no developmental effects were observed (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHa & b).

Acute Toxicity	Trisodium NTA is classified as hazardous with hazard category 'Acute Toxicity – category 4' and hazard statement 'Harmful if swallowed' (H302) in the HCIS (Safe Work Australia). The available data (median lethal dose—LD50 of 1470 mg/kg bw in female rats and 750 mg/kg bw in monkeys) support this classification. Reported signs of toxicity include ataxia, tremors, hypopnoea, hypothermia, hypoactivity, prostration, staggering, twitching, opisthotonus, tonic convulsion, apathy, salivation and dyspnoea. Available data for NTA indicate an LD50 >6400 mg/kg in rats. The chemicals have low acute toxicity based on results from an animal test in rabbits following dermal exposure. In an acute dermal toxicity study, a 25 % aqueous solution of trisodium NTA monohydrate was applied occlusively to intact skin of rabbits (one animal/sex/dose) at 1000, 1580, 2510, 3980, 6310 or 10000 mg/kg bw. Mild muscle weakness and reduction in activity and appetite were seen in the higher dose groups. No local symptoms or muscular uncoordination were reported. An LD50 of >10,000 mg/kg bw was reported (EU RAR, 2008; REACHa & b). The chemicals have low acute toxicity based on results from animal tests following inhalation exposure. A median lethal concentration (LC50) in rats of >5.0 mg/L was reported for NTA (EU RAR, 2008; Health Canada, 2010; SCCS, 2010).
Irritation	Trisodium NTA is slightly irritating to the animal skin. The effects were not sufficient to warrant a hazard classification. Trisodium NTA is classified as hazardous with hazard category 'Eye Irritation – category 2A' and hazard statement 'Causes serious eye irritation' (H319) in HCIS (Safe Work Australia). The available data support this classification. In an eye irritation study in rabbits, trisodium NTA was found to be irritating. Conjunctivitis and marked corneal effects were observed at 24, 48 and 72 hours after application (ECHA, 2006). Effects were not reversible within the 7-day period. In a study, albino rabbits had considerable discomfort immediately after application of 100 mg of trisodium NTA monohydrate. Effects observed one hour after application included copious discharge, oedema with partial eversion of the lids, moderate redness and congestion with obscure iris. Discharge and oedema reduced on washing the eyes with saline solution after 24 hours. Complete reversal oedema occurred but mild redness and slight corneal dullness were observed on days 5 to 7 (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHb). In another study conducted according to OECD Test Guideline (TG) 405, trisodium NTA (0.1 mL of 38 % solution) applied to the conjunctival sac of three albino rabbits caused slight eye irritation. The average scores for conjunctival redness and chemosis after 24 hours were 2.0 and 0.7, respectively. The conjunctival redness score was 0.1 after 48 hours and no chemosis was present. The conjunctival redness was reversible within 8 days after application. No effects on the cornea and iris were reported (EU RAR, 2008; Health Canada, 2010; SCCS, 2010; REACHb).
Sensitisation	Based on the available data, the chemicals are not considered to be skin sensitisers.
Health Effects Summary	The critical health effects for risk characterisation include systemic long-term effects (carcinogenicity) for all three chemicals, and systemic acute effects (acute toxicity from oral exposure) and local effects (eye irritation) for trisodium NTA and tripotassium NTA only.
Key Study/Critical Effect for Screening Criteria	The Australian Drinking Water Guideline for NTA is 0.2 mg/L.

Ecological Toxicity[4]	
Aquatic Toxicity	Tests on acute toxicity to fish resulted in 96-hour LC50 values in the range of 98 – 487 mg/l. In a generation-cycle test over 224 days on Pimephales promelas (Arthur et al., 1974), there were no observable differences in survival, spawning activity, and egg hatchability at the highest tested concentration of 54 mg/l trisodium NTA (the active test substance was Ca- or Mg-NTA). Based in this study, the NOEC for fish is determined to 54 mg/L. All tests on acute toxicity to invertebrates showed effects only when the trisodium NTA concentration exceeded the stoichiometric metal levels of the medium. It is expected that effects are caused by the uncomplexed agent. This is supported by the increased effect values in hard water. In long-term tests, the most sensitive organism was the amphipod Gammarus pseudo limnaeus. In a generation-cycle test over 21 weeks exposure, the lowest tested concentration without significant effects was 9.3 mg/l trisodium NTA. Based in this study, the NOEC for invertebrates is determined to 9.3 mg/l. At this concentration, NTA is mainly complexed with Ca and Mg.
Determination of PNEC aquatic	Reliable long-term data was available for a fish, invertebrate and algae. The lowest NOEC of 9.3 mg/L was a result for testing with Gammarus pseudolimnaeus (Arthur et al. 1974). An assessment factor of 10 was used for a resulting PNEC for intermittent releases of 0.93 mg/L.
Current Regulatory Controls[1]	
Australian Hazard Classification	Trisodium NTA is classified as hazardous, with the following risk phrases for human health in the Hazardous Chemicals Information System (HCIS) (Safe Work Australia): Acute toxicity – category 4; H302 (Harmful if swallowed) Eye irritation – category 2; H319 (Causes serious eye irritation) Carcinogenicity – category 2; H351 (Suspected of causing cancer).
Australian Occupational Exposure Standards	The chemical NTA has an Australian drinking water guideline value of 0.2 mg/L (NHMRC, 2011; FSANZ).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica; Protective Action Criteria (PAC)): Temporary Emergency exposure limits (TEELs) defined by the US Department of Energy (DOE): TEEL-1= 3.7 - 9.2 mg/m^3; TEEL-2= 40 - 100 mg/m^3; TEEL-3= 220 - 110 mg/m^3.
Australian Food Standards	The chemical NTA has an Australian drinking water guideline value of 0.2 mg/L (NHMRC, 2011; FSANZ).
Australian Drinking Water Guidelines	The chemical NTA has an Australian drinking water guideline value of 0.2 mg/L (NHMRC, 2011; FSANZ).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	NTA is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Trisodium NTA has a log octanol-water partition coefficient of -13.2 at pH 7, is highly water-soluble. Thus, it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of NTA is > 0.01 mg/L. Hence the substance does not fulfil the screening criteria for toxic (T)

Overall conclusion	Not PBT
Revised	March 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier II Assessment for Nitrilotriacetic acid and salts: Retrieved 2019: https://www.nicnas.gov.au
2. ECHA REACH, Trisodium nitrilotriacetate, Retrieved 2019: https://echa.europa.eu/
3. HSDB (n.d.). Hazardous Substances Data Bank. Retrieved 2019, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB

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Toxicity Summary - Xanthan Gum

Chemical and Physical Properties[1,3]	
CAS number	11138-66-2
Molecular formula	Unspecified
Molecular weight	high-molecular weight (of the order of 1000 kDa)
Solubility in water	Water-soluble
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Xanthan gum is a high molecular weight anionic polysaccharide secreted by the bacteria *Xanthomonas compestris*. It is used as a stabilizer and thickener for foods, pharmaceuticals, and cosmetics, for rheology control in water-based systems, and in oil and gas drilling. Xanthan gum is used for controlling the viscosity of drilling muds (DoE 2014). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1]	
Soil/Water/Air	Xanthan gum is expected to exhibit similar behaviour to that of guar gum because the two compounds are chemically similar. Thus, it is expected to adsorb strongly to soil and sediment and there is limited potential for it to reach surface waters via dissolved runoff and / or to leach into ground water. Volatilisation from soils and water is not considered to be a likely transport process in the environment (US EPA 2005). Xanthan gum is expected to readily undergo microbial biodegradation in the environment (on the bases that it is polysaccharide and expected to be readily biodegradable), and the potential to bioaccumulate in organisms is considered to be low.

Human Health Toxicity Summary[2]	
Chronic Repeated Dose Toxicity	Groups of 30 male and 30 female Charles River CD strain rats were fed diets for 104 weeks supplying O, 0.25, 0.5, or 1.0 g/kg b.w./day xanthan gum. No abnormalities which could be attributed to ingestion of these experimental diets were found with regard to survival, body-weight gain, food consumption, behaviour, or appearance. Ophthalmic and haematologic examination yielded normal results. Analysis of blood for glucose, SGOT, and prothrombin time showed no abnormalities in test groups. Organ weights were within normal limits and no lesions attributable to xanthan gum were found on gross and histopathological examination (Woodard et al., 1973). Xanthan gum was administered in the diet at levels supplying 0, 0.25, 0.37, or 1.0 g/kg b.w./day to groups of 4 male and 4 female beagle dogs for 107 weeks. No effects attributable to administration of the gum were seen in the treated animals with regard to survival, food intake, body-weight gain, electrocardiograms, blood pressure, heart rate, body temperature, or ophthalmic and neurological examinations. Haemoglobin, total and differential white cell counts, coagulation and prothrombin times, thrombocyte counts, serum alkaline phosphatase, blood urea nitrogen, blood glucose, SGOT, and SPGT were the same in control and treated animals. Urine pH, glucose concentrations, and sediment contents were comparable between test and control groups, but there was a dose-related increase in urine SG and a more frequent appearance of urinary albumin in dogs consuming 1.0 g/kg b.w./day of gum than in the other groups. Stool consistency was normal at the 0.37 g/kg level, but stools were loose at the top-dose level. The weight of the faeces showed a dose-related increase, as would be expected from feeding a non-absorbed hydrophilic gum at high-dose levels. The increased urinary SG is consistent with physiological adjustment for the extra water excreted in the faeces. Examination of the appearance and weights of organs and histopathological examinations failed to detect any adverse effects of treatment with xanthan gum at any dose level (Woodward et al.,1973).
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A three-generation reproduction study was carried out using groups of 10 male and 20 female rats in the first generation and 20 male and 20 female rats in subsequent generations. Dosage levels of 0, 0.25, and 0.5 g/kg/day were administered in the diet. Criteria evaluated were survival, body weight, general appearance, behaviour, the number of litters produced, number of live births and still births, physical condition of the young, weight at birth and weaning, and survival of the young. Females that had fewer than two litters were examined to determine whether there was foetal resorption. Malformations in offspring were recorded and gross and micropathological examinations were made on the offspring of the second and third generations. No adverse effects attributable to xanthan gum were found in this study (Woodard et al., 1973).
Acute Toxicity	A study was carried out on an unspecified number of rats fed diets containing 7.5 or 10% xanthan gum for 99-110 days. No adverse effects were observed in extensive investigatins on these animals (Booth et al., 1963). In a 91-day feeding study, a reduced rate of weight gain was found in groups of rats receiving 7.5 or 15% xanthan gum in the diet. Diets containing 3 or 6% gum did not reduce weight gain. No significant alterations in haemoglobin, red or white cell counts, or organ weights were observed in these rats. Histological examination of tissues from rats at the 15% level showed no pathological effects. At the highest-dose level the animals produced abnormally large faecal pellets, but diarrhoea did not occur. A paired-feeding test was used to compare the growth of rats ingesting a diet containing 7.5% xanthan gum and comparable rats restricted to the same intake of control diet. No differences in weight gain were found at the end of 18 days, indicating the absence of a growth-inhibiting factor (Booth et al.,1963). Groups of 3 male and 3 female beagle dogs were fed diets supplying 0, 0.25, or 0.5 g/kg b.w./day xanthan gum for 12 weeks. Animals in the high-dose group had softer stools than normal, but no diarrhoea. Growth was slightly retarded in the males and the serum cholesterol level was lowered in both sexes of the high-dose group. No other adverse effects were seen. The no-adverse-effect-level in this test was considered to be 0.25 g/kg b.w./day (USDA, 1964).

Irritation	Daily application of a 1% solution for 15 days to rat skin produced no signs of irritation. Daily application of a 1% solution for five days to rabbit conjunctiva produced no signs of irritation.
Sensitisation	Intradermal challenge tests in guinea-pigs did not produce evidence of sensitization (Hendrickson & Booth, sine data).
Health Effects Summary	A mild skin and eye irritant
Key Study/Critical Effect for Screening Criteria	The Joint FAO/WHO Expert Committee on Food Additives allocated an Acceptable Daily Intake (ADI) of "not specified".
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Acute Fish (measured) = 420 mg/L
Determination of PNEC aquatic	Based on acute fish toxicity of 420 mg/L, an assessment factor of 1000 was used for a resulting PNEC of 0.42 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No biodegradation information was found on xanthan gum. However, xantham gum is a naturally occurring polysaccharide which would be expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence
B/vB criteria fulfilled?	Xantham gum is not expected to meet the criteria for bioaccumulation.
T criteria fulfilled?	Not applicable. Acute toxicity data >1 mg/L in fish, thus xanthan gum does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	March 2019

References

1. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
2. IPCS INCHEM, Xanthan Gum, Retrieved 2019: http://www.inchem.org/
3. Food and Agriculture Organization of the United Nations (FAO) 2016, 82nd JECFA - Chemical and Technical Assessment (CTA),XANTHAN GUM

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Toxicity Summary - Acrylamide polymers: Acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, sodium salt polymer and Polymer of 2-acrylamido-2- ethylpropanesulfonic acid sodium salt and methyl acrylate

Chemical and Physical Properties [2, 3, 4]	
CAS number	38193-60-1 and 136793-29-8
Molecular formula	38193-60-1: $(C_7H_{13}NO_4S.C_3H_5NO.Na)_x$ 136793-29-8: $C_{11}H_{18}NNaO_6S$
Molecular weight	Likely >1000 MW
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	No studies are available for the Acrylamide polymers. Information for 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt will be referenced in the following sections. 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salts are generally incorporated into polymers. As such, the fate of the monomer is tied to the polymer and no hydrolysis, movement, biodegradation or bioaccumulation of the polymer is expected. A Tier 1 Human Health Assessment for Acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, sodium salt polymer has been conducted by NICNAS which concluded that this chemical was identified as low concern to human health.
Environmental Fate [2]	
Soil/Water/Air	The polymers are not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weights and the low water solubilities of the polymers. Due to their high molecular weight, the polymers are not expected to bioaccumulate.
Human Health Toxicity Summary [2]	
Chronic Repeated Dose Toxicity	A repeat dose 28 day oral toxicity study carried out in rats with a 50% aqueous solution of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt indicated no treatment related toxic effects.
Carcinogenicity	No information available.
Mutagenicity/ Genotoxicity	2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt did not induce a mutagenic response in bacteria and no clastogenicity was observed when a 50% solution of the notified chemical was tested in albino mice cells in vitro.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.

Acute Toxicity	Aqueous solutions containing 50% of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt exhibited low acute oral and dermal toxicity in rats (LD50 > 5 000 mg/kg, and 2 000 mg/kg respectively).
Irritation	2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt was non-irritant to rabbit skin and a slight eye irritant in rabbits.
Sensitisation	A 50% aqueous solution of 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt showed minimal sensitisation potential when tested in guinea pigs.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	No data available
Ecological Toxicity [2]	
Aquatic Toxicity	Limited information is available. The polymers are expected to be a low concern for toxicity to aquatic organisms. Due to their poor solubility and high molecular weights, they are not expected to be bioavailable. The polymers do not contain any reactive functional groups. Ecotoxicity data for 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt indicate that it is practically non-toxic to fish, water fleas and algae.
Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls[5]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	Based on health considerations, the concentration of acrylamide in drinking water should not exceed 0.0002 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1, 2]	
P/vP Criteria fulfilled?	The polymers are not readily biodegradable, hence they meet the screening criteria for persistence.
B/vB criteria fulfilled?	The polymers are expected to have very high molecular weights and poor water solubility. They are not expected to be bioavailable, hence the polymers do not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on the polymers. They are expected to have low aquatic toxicity because of their very high molecular weights and poor water solubility. As such, the polymers do not meet the criteria for toxicity.
Overall conclusion	Not PBT substances
Revised	December 2018

References

1. Categorization Results from the Canadian Domestic Substance List, CAS# 38193-60-1

2. National Industry Chemicals Notification and Assessment Scheme. 2-Acrylamido-2-methylpropanesulfonic acid, ammonium salt, July 1997.
3. U.S National Library of Medicine, Toxicology Data Network, ChemIDplus, CAS#38193-60-1. Accessed 2017 at https://chem.nlm.nih.gov/chemidplus/rn/38193-60-1
4. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2018: https://www.nicnas.gov.au
5. National Health and Medical Research Council, Natural Resources Management Ministerial Council, national Water Quality Management Strategy, Australian Drinking Water Guidelines 6, 2011, Version 3.3 Updated November 2016.

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Toxicity Summary - Potassium chloride

Chemical and Physical Properties [1,2,3,8,9,10]	
CAS number	7447-40-7
Molecular formula	KCl
Molecular weight	74.55 g/mol
Solubility in water	34.20 at 20 ◦C
pH	7
Melting point	771.00 ◦C
Boiling point	1500 ◦C
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	White crystals or crystalline powder
Overview	Potassium is an essential element in the body. It is the main intracellular cation with 98% of total body potassium located within the cells. It is mainly used in fertilisers, medicine, lethal injections, scientific applications, feedstock, food processing and as a sodium substitute in table salt. Potassium chloride is an essential element with homeostatic physiological processes regulating levels in the body. In cases of increased exposure to high levels of potassium significant health effects in people with kidney disease or other conditions, such as heart disease may result. Potassium chloride as an inorganic salt is not subjected to further degradation processes in the environment once it dissociates into its respective ions. In water, potassium chloride is highly water soluble, and readily undergoes dissociation. In soil, transport and leaching of potassium and chloride ions is affected by the clay minerals (type and content), pH, and organic matter. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate [1,3,8,9]	
Soil/Water/Air	KCl is a solid inorganic salt that is highly soluble in water (342 g/L at 20º C). Potassium chloride fully dissociates in aqueous solutions to K+ and Cl- ions. Cl, either as an inorganic salt or as K+ and Cl- ions, is ubiquitous in the environment. There is no potential for bioaccumulation or bioconcentration. Potassium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated.

Human Health Toxicity Summary [1,3,8,9]	
Chronic Repeated Dose Toxicity	Fourteen female rats were given KCl in their drinking water (approximately 5,250 mg/kg/day) for 105 days. Ten rats were sacrificed after 105 days of exposure for examination of the heart, kidneys and the adrenals; four rats (recovery group) were kept for an additional month. KCl exposure resulted in decreased heart weight, increased kidney weight, and enlargement of part of the adrenals. All changes were reversible within one month of exposure (Bacchus, 1951).F344/Slc male rats were given 0, 110, 450 or 1,820 mg/kg/day KCl in feed for two years. At the end of the study, survival rates were 48%, 64%, 58% and 84% in the controls, 110, 45 and 1,820 mg/kg/day groups. Nephritis was reported to be predominant in all groups, including the controls. The only treatment-related effect observed was gastritis(inflammation of the stomach lining). The incidence of gastritis and ulcers were 6%, 18%, 18% and 30% in the controls, 110, 450 and 1,820 mg/kg/day groups (Imai *et al.*, 1968). Male and female Wistar rats were fed diets containing 0 or 3% KCl over a total period of 30 months: Examination after 13 weeks (10 rats/sex/group), after 18 months (15 rats/sex/group) and after 30 months (50 rats/sex /group). Due to the reduction of feed intake the mean test substance intake and mean body weight decreased in time. After 30 months of treatment, there was hypertrophy of the zona glomerulosa in the adrenals (24/50 treated rats versus 4/50 in controls); and cystitis in the urinary bladder (males: 3/59; females 3/50) and single epithelial hyperplasia of the bladder (males 3/50; females 2/50) (Lina *et al.*, 1994; Lina and Kuijpers, 2004)**.**
Carcinogenicity	Potassium chloride has not been evaluated and is not listed by the IARC as a carcinogen. In a long-term study, male rats (50 per group) were fed potassium chloride in the diet at levels of 110, 450 or 1820 mg/kg bw/day for 2 years. No carcinogenic effects were observed in male rats.
Mutagenicity/ Genotoxicity	No gene mutation ns were reported in bacterial tests, with and without metabolic activation. However, high concentrations of potassium chloride showed positive results in a range of genotoxic screening assays using mammalian cells in culture. The action of potassium chloride in culture seems to be an indirect effect therefore further *in vivo* studies were not considered necessary.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	A developmental study revealed no foetotoxic or teratogenic effects of potassium chloridel in doses up to 235 mg/kg/day (mice) and 310 mg/kg/day (rats). No fertility study has been located. Further human and ecological assessment was not recommended by the OECD SIDS.
Acute Toxicity	Potassium chloride is an essential element with homeostatic physiological processes regulating levels in the body. In cases of increased exposure to high levels of potassium significant health effects in people with kidney disease or other conditions, such as heart disease may result. Adverse health effects due to consumption of potassium from drinking water are unlikely to occur in healthy individuals. Acute effects are rare in humans although under particular circumstances severe effects may occur. Lethal effects were observed in a 2 month old baby fed 15,000 mg potassium chloride for 2 days and in another case report where an adult woman had ingested slow released potassium chloride tablets (35, 000 mg). The most common form of ingestion is through drinking water. It is not considered necessary to establish a health-based guideline value for potassium in drinking water due to its lack of toxicity.
Irritation	Slight skin and eye irritant. A threshold concentration for skin irritancy of 60% was seen when potassium chloride in aqueous solution was in contact with skin of human volunteers. The threshold concentration when applied to broken skin was 5%.
Sensitisation	No data found.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health and it is listed by the US Food and Drug Administration (FDA) as a Generally Recognised as Safe (GRAS) substance.

Key Study/Critical Effect for Screening Criteria	In a two-year rat feeding study, there was an increased incidence of gastritis and ulcers at dose levels of >110 mg/kg/day (Imai *et al.*, 1968). There was no NOAEL. Thus, the LOAEL for this study is 110 mg/kgday. Since the gastritis and ulcers are the result of a localized irritation effect of the test substance (site of contact) in the gastrointestinal tract, an uncertainty factor for interspecies variability is deemed unnecessary. For systemic effects, the NOAEL for the two-year rat feeding study is considered to be 1,820 mg/kg/day, the highest dose tested. Uncertainty factors: 10 (intraspecies variability); 10 (interspecies variability); 1 (intraspecies variability) Oral Reference Dose = 1,820/100 = 18.2 mg/kg/day Drinking water guideline: 71 ppm
Ecological Toxicity [1,3,8,9,10]	
Aquatic Toxicity	In a guideline study, the 96-hour LC50 in *Pimephales promelas* was reported to be 880 mg/L (Mount *et al.*, 1997). The 48-hour LC50 values from two studies on *Lepomis macrochirus* (Patrick *et al.*, 1968; Trama, 1954), and one study each on *Oncorhyncusmykiss* and *Ictalurus punctatus* (Waller *et al.*, 1993) ranged from 720 to 2,010 mg/L. In a guideline study, the 48-hour EC50s in *Daphnia magna* and *Ceriodaphnia dubia* were 660 and 630 mg/L, respectively (Mount *et al.*, 1997; ECHA REACH database). The 48-hour EC50 in *Daphnia magna* in another study was also reported to be 177 mg/L (Biesinger and Christensen, 1972).The toxicity of KCl has been investigated in one algae species (*Nitzschia linearis*), showing 120 hour-EC50 (growth rate) of 1,337 mg/L (Patrick *et al.*, 1968). The 72-hour EC50 to *Scenedesmus subspicatus* is >100 mg/L (growth rate), with a NOEC of >100 mg/L (ECHA REACH database). In a fish early-life-stage test with the fathead minnow (*Pimephales promelas*), the 7-day NOEC is 500 mg/L (ECHA REACH database). A long term (21-day) study has been performed on *Daphnia magna* where effects on reproduction were investigated for several metals. A 16% impairment of reproduction (LOEC) was observed at a concentration of 53 mg/L of K +, equal to KCl concentration of 101 mg/L (Biesinger and Christensen, 1972). The measured NOEC for Daphnia is 373 mg/L
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 100 has been applied to the lowest reported effect concentration of 373 mg/L. The PNECaquatic is determined to be 3.73 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1,8,9,10]	
P/vP Criteria fulfilled?	Potassium chloride is an organic salt that dissociates completely to potassium and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both potassium and chloride ions are also ubiquitous and are present in most water, soil and sediment. For the purposes of this PBT assessment, the persistent criteria is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Potassium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, potassium chloride is not expected to bioaccumulate.

T criteria fulfilled?	The measured chronic toxicity data for potassium chloride was 373 mg/L for Daphnia. Thus, potassium chloride does not meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	April 2018

References

1. WHO (2009). Potassium in drinking-water. Background document for development of Guidelines for Drinking-water Quality. World Health Organization WHO/HSE/WSH/09.01/7.
2. HSDB Hazardous Substance Databank (HSDB) Potassium Chloride. Toxnet http://toxnet.nlm.nih.gov U.S. National Library of Medicine.
3. IARC, 2009: IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. International Agency for Research on Cancer. World Health Organisation.
4. Material Safety Data Sheet Potassium chloride. ScienceLabs.com Inc. http://www.sciencelab.com/msds.php?msdsId=9927402
5. WHO Poisons Information Monograph for Potassium Chloride. Electronic record accessed from www.inchem.org World Health Organization.
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7. ECHA REACH database: http://apps.echa.europa.eu/registered/registered-sub.aspx
8. IUCLID Data Set for Potassium chloride (CAS No. 7447-40-7), UNEP Publications.
9. OECD (2001b). OECD-Screening Information Assessment Report (SIAR) for Potassium chloride (CAS No. 7447-40-7), UNEP Publications.
10. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

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Toxicity Summary - 2-Propenoic acid, polymer with sodium phosphinate and 2-Propenoic acid, sodium salt, polymer with 2-propenamide

Chemical and Physical Properties[1,2,3]	
CAS number	129898-01-7 25085-02-3
Molecular formula	(C3H4O2.H3O2P.Na)x.xNa (C3H5NO.C3H4O2.Na)x
Molecular weight	Likely >1000 MW
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	No studies are available. The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[2]	
Soil/Water/Air	The polymer is not expected to be readily biodegradable. Biodegradation is limited due to the very high molecular weight and the low water solubility of the polymer. Due to its high molecular weight, the polymer is not expected to bioaccumulate.
Human Health Toxicity Summary	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.

Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity[2]	
Aquatic Toxicity	Limited information is available. The polymer is expected to be a low concern for toxicity to aquatic organisms. Due to its poor solubility and high molecular weight, it is not expected to be bioavailable. It does not contain any reactive functional groups.
Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	The polymer is not readily biodegradable, hence it meets the screening criteria for persistence.
B/vB criteria fulfilled?	The polymer is expected to have a very high molecular weight and poor water solubility. It is not expected to be bioavailable, hence this polymer does not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on the polymer. It is expected to have low concern for aquatic toxicity because of its very high molecular weight and poor water solubility. As such, the polymer does not meet the critera for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
2. Categorization Results from the Canadian Domestic Substance List, 2-Propenoic acid, polymer with sodium phosphinate
3. U.S National Library of Medicine, Toxicology Data Network, ChemIDplus, CAS#38193-60-1. Accessed 2017 at https://chem.nlm.nih.gov/chemidplus/rn/38193-60-1

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Toxicity Summary - Calcium Carbonate

Chemical and Physical Properties[1,2]	
CAS number	1317-65-3
Molecular formula	Not applicable
Molecular weight	Not applicable
Solubility in water	No data available
Melting point	Approximately 900°C (Oates 1998).
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Solid
Overview	Limestone is the name given to a type of rock mostly composed of calcium carbonate. It also contains minor impurities of iron, magnesium, quartz, clay, pyrite, phosphate, and organic matter (Pohl 2011). It is used widely in agriculture to increase calcium concentrations and the pH of soils (Upjohn et al. 2005). Limestone is used industrially on a very large scale as an ingredient in concrete production and in metallurgy (Oates 1998; Pohl 2011). In the Australian coal seam gas industry, it is used as a bridging agent in drilling fluid formulations. A Tier 1 Human Health Assessment for these chemicals has been conducted by NICNAS which concluded that these chemicals were identified as low concern to human health by application of expert validated rules.
Environmental Fate[2]	
Soil/Water/Air	Limestone dissolves slowly in water, releasing calcium and carbonate ions as well as other trace elements, such as iron and magnesium (Deer et al. 1992; Clair and Hindar 2005; Pohl 2011). These trace elements are naturally ubiquitous in the environment and are subject to natural biogeochemical processes. Calcium oxide reacts immediately upon exposure to water, forming calcium hydroxide, which itself reacts with carbon dioxide to form calcium carbonate. The final reaction products of both limestone and calcium oxide in the environment are therefore essentially the same, although calcium oxide typically has lower concentrations of magnesium and other inorganic chemicals than limestone and produces a higher initial concentration of hydroxide ions (Upjohn et al. 2005). Calcium and carbonate ions occur naturally in all environmental compartments, and are important nutrients for various organisms. Calcium is mobile in soil (ANZECC and ARMCANZ 2000) and, if released to the environment, should be expected to experience significant partitioning to the water compartment. However, calcium ions may also form insoluble precipitates with anions present in the environment, such as carbonate ions, and settle out of the aqueous phase. Carbonate is an important component of the global carbon cycle (Wetzel 2001).
Human Health Toxicity Summary[3]	
Chronic Repeated Dose Toxicity	No systemic toxicological findings could be detected in rats after repeated administration of uncoated nano calcium carbonate by the oral route for a period of 90 days. The results of this study are read across to bulk calcium carbonate. Several potential adverse effects have been reported following calcium supplementation e.g. effects on kidney function, milk-alkali syndrome, kidney stones and interactions with minerals. However, these effects are more prevalent in those people suffering from renal insufficiency and following the ingestion of high doses of calcium.

	No systemic toxicity was observed in a 90-day inhalation study where rats were exposed to uncoated calcium carbonate at a maximum concentration of 0.399 mg/L, stated as the NOEC. The local effects observed at this level were limited to increased lung weights accompanied by increases in BAL-derived inflammation and cytotoxicity biomarkers, which were reversible in males but were not fully reversible in females within a 4-week recovery period. Hence the NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L. The results of this study are read across to bulk calcium carbonate.
Carcinogenicity	Uncoated nano calcium carbonate is not expected to pose a risk of carcinogenicity.
Mutagenicity/ Genotoxicity	Uncoated nano calcium carbonate was negative in the following assays: In vitro gene mutation study in bacteria (OECD TG 471) using Salmonella typhimurium strains TA 98, TA 100, TA 1535 and TA 1537 and Escherichia coli WP2 uvrA with and without metabolic activation (S9). In vitro chromosome aberration study in mammalian cells (OECD TG 473) using human lymphocytes in the presence and absence of metabolic activation. In vitro gene mutation study in mammalian cells (OECD TG 476) using mouse lymphoma L5178Y cells in the presence and absence of metabolic activation. The results of these studies are read across to bulk calcium carbonate.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of the OECD TG 422 study, uncoated nano calcium carbonate administered to male and female rats up to a dose level of 1000 mg/kg bw/day for a period of up to 48 days is not toxic to reproduction and has no effect on fertility or development. No treatment-related effects were observed for reproduction; hence, a NOEL for reproductive toxicity was considered to be 1000 mg/kg bw/day. The results of this study are read across to bulk calcium carbonate. The prenatal developmental toxicity study also demonstrated that calcium carbonate was neither foetotoxic nor teratogenic at the concentrations used. Since no adverse effects were noted at the highest dose level tested (1.25% Ca in diet), the NOAEL for teratogenic and maternal toxic effects in rats is in excess of 1.25% Ca, equivalent to approximately 1963 - 2188 mg/kg bw/day of calcium carbonate.
Acute Toxicity	Bulk calcium carbonate is not considered to be acutely harmful by the oral, dermal or inhalation routes.
Irritation	Bulk calcium carbonate is not considered to be irritating to the skin or eyes.
Sensitisation	Based on the results of an OECD TG 429 study performed using nano calcium carbonate and read across to bulk calcium carbonate, where the Stimulation Index was < 3, bulk calcium carbonate is considered to be a non-sensitiser
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	In the repeated dose toxicity study, NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L.
Ecological Toxicity[2]	
Aquatic Toxicity	Calcium carbonate has low toxicity to aquatic and terrestrial organisms. Ecotoxicological endpoint values for aquatic organisms generally greatly exceed 100 mg/L (LMC 2014), indicating very low toxicity.
Determination of PNEC aquatic	Experimental results are available for three trophic levels. Acute LC50 values are available for fish, invertebrates, and algae. On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 310 mg/L for invertebrates. The PNEC aquatic is 0.3 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.

International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic chemical, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	Not applicable. Expected to have low toxicity to aquatic organisms.
Overall conclusion	Not PBT
Revised	October 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
2. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
3. ECHA REACH, Calcium carbonate, Retrieved 2019: https://echa.europa.eu/

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Toxicity Summary - Cellulose, carboxymethyl ether, sodium salt

Chemical and Physical Properties[1,2]	
CAS number	9004-32-4
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	White odourless hygroscopic granules or powder.
Overview	Sodium carboxycellulose is the sodium salt of carboxymethylcellulose. Carboxymethyl cellulose is a cellulose derivative with carboxymethyl groups (-CH2COOH) bound to some of the hydroxyl groups of the glucopyranose monomers that make up the cellulose backbone. Sodium carboxycellulase is a listed as GRAS (Generally Regarded as Safe) by the U.S. Food and Drug Administration (FDA GRAS database). It is an approved food additive in the EU (EC, 1995) and may be added to all foodstuffs following quantum satis principle, except in products for the dietary management of metabolic disorders, where the limit of use is 10 g/L or kg (EC, 1999). Sodium carboxycellulase is also listed as an Inert Ingredient Eligible for US Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 25(b) pesticide products and US EPA List 4A. The Joint FAO/WHO Expert Committee on Food Additives has determined an Acceptable Daily Intake (ADI) for sodium carboxymethyl cellulose of “Not Specified” (no upper limit) (JECFA, 1989). A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	Carboxymethyl cellulose (DS 0.7) showed 25% biodegradation after 28 days in a OECD 301A test. Thus, sodium carboxymethyl cellulose is not readily biodegradable. Other studies have also shown partial degradation of carboxymethyl cellulose in ready and inherent biodegradability tests.
Human Health Toxicity Summary	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.

Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	No data available.
Key Study/Critical Effect for Screening Criteria	No data are available for determining the critical effect and the LOAEL/NOAEL for an oral reference dose.
Ecological Toxicity [1]	
Aquatic Toxicity	Carboxymethyl cellulose has been tested in several acute aquatic toxicity tests. The 96-hour LC50 for Brachydanio rerio is >2,500 mg/L; the 48-hour LC50 for Daphnia magna is >5,000 mg/L; and the 96-hour EC50 for Selenastrum capricornutum is 500 mg/L.
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (>2,500 mg/L), Daphnia (>5,000 mg/L), and algae (>500 mg/L). On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 500 mg/L for algae. The PNECaquatic is 0.5 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Sodium carboxymethyl cellulose is a water-soluble semisynthetic polymer and is not readily biodegradable. Thus, it meets the screening criteria for persistence.
B/vB criteria fulfilled?	Sodium carboxymethyl cellulose is a water-soluble semisynthetic polymer and is expected to have a molecular weight of >1,000 which limits its bioavailability to aquatic organisms. Thus, it is not expected to bioaccumulate.
T criteria fulfilled?	The acute EC(L)50 of sodium carboxymethylcellulose is >0.1 mg/L in fish, invertebrates and algae. Thus, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

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5. FDA GRAS Database: http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/SCOGS/ucm260737.htm
6. JECFA (1989). http://apps.who.int/ipsc/database/evaluations/chemical.aspx?chemID=3773

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Toxicity Summary - Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues

Chemical and Physical Properties[1]	
CAS number	68909-77-3
Molecular formula	C36H78N6O14
Molecular weight	UVCB
Solubility in water	100 g/L at 20 °C
Melting point	-20 °C at 101.3 kPa
Boiling point	223 °C at 101.3 kPa
Vapour pressure	0.55 - 20 Pa at 20 - 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified (50%), Non-flammable (50%)
Colour/Form	Liquid
Overview	The residuum from the reaction of diethylene glycol and ammonia. It consists predominantly of morpholine-based derivatives such as [(aminoethoxy)ethyl]morpholine, [(hydroxyethoxy)ethyl]morpholine, 3-morpholinone, and 4,4'-(oxydi-2,1-ethanediyl)bis[morpholine].
Environmental Fate[1]	
Soil/Water/Air	The substance is hydrolytically stable at pH 4, 7 and 9 at 25°C. Adsorption to solid soil phase is not to be expected. Based on the assessment of the components, it can be concluded that the mixture will not evaporate into the atmosphere. The substance is not readily biodegradable. Based on the low log Kow, the substance will have a low potential for bioaccumulation. Over time, the mixture will preferentially distribute into the compartment water.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	No adverse effects were observed in male and female rats in a 28 days and a 90 days repeated dose toxicity test conducted according to OECD 407 and OECD 408 respectively (Calvert Laboratories, Inc., 2011 and Envigo Research Limited, 2018) in which animals were exposed orally (gavage) to 0, 100, 500 or 1000 mg/kg bw/d (28 days study) and to 0, 10, 100 or 1000 mg/kg bw/d (90 days study). In both studies, an NOAEL of 1000 mg/kg bw was determined.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vivo micronucleus test on mouse bone marrow erythrocytes (BioReliance, 2010), performed according to OECD guideline 474, the animals were exposed orally (via gavage) with 500, 1000, 2000 mg/kg. This did not induce a statistically positive increase in micronuclei in the hemopoietic cells of the mouse bone marrow at the time intervals evaluated under the experimental condition of this assay. No toxicity was observed. Vehicle and positive controls were valid.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A Reproductive / Development Toxicity Screening Testing in Rats was performed according to OECD guideline 421 (Calvert Laboratories, Inc., 2011, Klimisch 1). In this GLP-compliant study, male and female Sprague-Dawley rats (10 animals/sex/dose) were exposed to 1000 mg/kg bw/day. Control animals received concurrent vehicle (water). The rats were exposed on a daily basis, starting two weeks prior to cohabitation until the day before the scheduled euthanasia (minimum of 4 weeks) for males and starting for a minimum of 15 days prior to cohabitation, during cohabitation and from presumed gestation days 0 through day 19 of gestation for females. One female animal was found dead on lactation day 2. All other females survived until scheduled sacrifice. No treatment-related effects were observed in clinical signs, mortality, body weight (gain), food consumption, gross pathology, organ weights or histopathology in the parental animals. There was no treatment-related effect on reproductive performance or in reproductive parameters like for instance number of gravid animals, corpora lutea per dam, total implantations, litter viability or foetal sex ratios. The incidence of neonates born alive/found dead, stillborn or missing between lactation days 0 -4 was comparable among study groups. No treatment-related malformations were observed for neonates. The body weight of neonates was statistically significantly increased with an unknown biological significance for this finding. A NOAEL of 1000 mg/kg bw/day was established.
Acute Toxicity	The oral LD50 in male and female Sprague-Dawley rats was determined to be 5000 mg/kg bw in a reliable, key study conducted similarly to OECD guideline 420 (Calvert Laboratories, Inc., 2010). Calvert Laboratories Inc (2010) determined acute dermal toxicity in 10 male / female rats following a GLP-compliant study performed equivalent to OECD guideline 402 (key study, Klimisch 1). Only one dose was tested (2000 mg/kg bw). No mortality was observed. Shortly after exposure, local erythema and oedema effects were observed in both males and females. The effects seemed to be reversible in males and 1 female. In the 4 other females, necrosis and slouching appeared.
Irritation	The skin irritation potential of the test substance is investigated in a key, reliable study performed according to OECD guideline 404 (Allen, 1994; Klimisch 2) in 3 rabbits. Semi-occlusive patches were removed from shaved test sites after exposure periods of 3 min, 1h, and 4h to 0.5mL of the test substance. The Draize scoring system was used to evaluate the results. No erythema/eschar formation and no oedema formation is observed after 3 min and 1 hour exposure. After 4 hours of exposure, very slight erythema in all 3 animals and very slight oedema in 2 animals was observed, but this was fully reversible within 24 - 48 hrs. Calvert Laboratories, Inc. (2010) investigated the eye irritation potential of the test substance in a key, reliable study performed according to EU method B.5 (Klimisch 1) in 3 rabbits. The treated eyes (with 0.1mL test substance) will remain unrinsed for at least 24 hours after instillation. The 24-, 48- and 72-hours scores will be added separately for each animal and each total divided by 3 to yield the individual mean scores for each animal. Based on the data and according to the criterial of the CLP regulation, the test substance is classified as irritant to the eyes (category 2).
Sensitisation	Based on a guinea pig maximization study, performed according to the OECD guideline 406 (Allen, 1996; Klimisch 2), the test substance is considered not sensitising to the skin.
Health Effects Summary	This chemical may cause skin and eye irritation.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 1000 mg/kg bw/day from the 90 day repeated oral toxicity study.
Ecological Toxicity [1]	

Aquatic Toxicity	In a static test following the procedures of the German national standard DIN 38412 using Leuciscus idus as test species a LC50 (96 h) of 681.2 mg/L (nominal) was determined [BASF AG, 1988; Study No. 10F0118/885140]. In conclusion, the substance is with high probability not acutely harmful to fish. The EC50 of the test item on daphnids was found to be greater than 122 mg/L (measured value) in a GLP guideline study according to OECD 202 [BASF SE, 2010; Study No. 50E0396/09E012]. Therefore, the test substance is with high probability acutely not harmful to aquatic invertebrates. A study was performed to assess the effect of the test item on the growth of the green alga Pseudokirchneriella subcapitata. The method followed that described in the OECD Guidelines for Testing of Chemicals (2006) No 201, "Freshwater Alga and Cyanobacteria, Growth Inhibition Test" referenced as Method C.3 of Commission Regulation (EC) No 440/2008. The effect of the test item on the growth of Pseudokirchneriella subcapitata has been investigated over a 72-Hour period. the ErC50(72h) of the test item is 45 mg/L for Pseudokirchneriella subcapitata. The toxicity to microorganisms was determined in a GLP short-term respiration test according to OECD guideline 209 using activated sludge from a municipal sewage treatment plant. After 180 minutes no inhibition effect on the respiration rate at the highest test concentration (1000 mg/L) was observed [BASF 2010; Study No. 08G0396/09G004]. Therefore, it can be concluded that inhibition of the degradation activity of activated sludge is not anticipated when introduced in appropriately low concentrations.
Determination of PNEC aquatic	The available short-term aquatic tests covering the three trophic levels (fish, daphnids, algae) showed the lowest L(E)C50 to be 45 mg/L in algae. An assessment factor of 1000 was used for a resulting PNEC for of 0.045 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not readily biodegradable. Thus, it is expected to meet the screening criteria for persistence.
B/vB criteria fulfilled?	As the Log Pow is 0.565 at 20 °C (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.1 mg/L. Thus, it is not expected to meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	March 2019

References

1. ECHA REACH, Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. residues, Retrieved 2019: https://echa.europa.eu/

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Toxicity Summary - Glyoxal (Ethanedial)

Chemical and Physical Properties[1,2,3]	
CAS number	107-22-2
Molecular formula	C2H2O2
Molecular weight	58.04
Solubility in water	600 g/L at 25 °C
Melting point	15 °C
Boiling point	50.4 °C
Vapour pressure	29.33 kPa at 20 °C
Henrys law constant	No data available.
Explosive potential	Non explosive
Flammability potential	Not classified
Colour/Form	Light yellow liquid with a mild odour at ambient temperatures; yellow crystals at 15 °C.
Overview	Glyoxal is generally available as an aqueous solution, typically containing 30-50% glyoxal in which hydrated oligomers are present. This chemical is used as a chemical intermediate in the production of pharmaceuticals and dyestuffs, as a cross-linking agent in the production of polymers, as a biocide, and as a disinfecting agent. Due to microbial activity as well as non-enzymatic autoxidation of oil or browning reactions of saccharides, glyoxal is frequently detected in fermented food and beverages. It is found in beer, wine and tea.
Environmental Fate[1]	
Soil/Water/Air	Glyoxal's production and use as a crosslinking agent in permanent-press fabrics, textiles, organic synthesis, glues, and biocides may result in its release to the environment through various waste streams. Glyoxal is also released to the environment from the combustion of wood, automobile exhaust, and the atmospheric degradation of aromatic and olefinic hydrocarbons. It may also be produced as a disinfection byproduct during the treatment of drinking water. Glyoxal is also endogenously produced by a variety of enzyme-independent pathways. If released to air, an extrapolated vapor pressure of 255 mm Hg at 25 deg C indicates glyoxal will exist solely in the vapor-phase. Vapor-phase glyoxal is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 34 hours. Glyoxal also undergoes direct photolysis, with an estimated atmospheric lifetime of 5 hours. If released to soil, glyoxal is expected to have very high mobility based upon an estimated Koc of 1. Volatilization from moist soil surfaces is not expected to be an important fate process based upon a Henry's Law constant of 3.33X10-9 atm-cu m/mole. The potential for volatilization of glyoxal from dry soil surfaces may exist based upon the extrapolated vapor pressure of this compound. Screening studies using sewage seed have indicated that glyoxal is readily biodegradable. If released into water, glyoxal is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's Henry's Law constant. Photolysis in sunlit surface waters is expected to be an important fate process because glyoxal absorbs light greater than 290 nm and undergoes direct photolysis in the atmosphere. Glyoxal is not expected to undergo hydrolysis in the environment due to the lack of hydrolyzable functional groups. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low.

Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	From an oral 28 day repeat dose toxicity test conducted in accordance with OECD TG 407 a NOAEL was established at 40 mg/kg bw/day (active substance), based on dose-related changes in body weight gain at higher doses. A single inhalation toxicity study in rats revealed no systemic toxicity even at the highest dose of 0.4 mg/m^3.
Carcinogenicity	Results from several carcinogenicity studies, tumour initiation/promotion studies and in vitro cell transformation assays show that ethanedial is not carcinogenic.
Mutagenicity/ Genotoxicity	Ethanedial was shown to be mutagenic in both bacterial and mammalian cells in vitro. Unscheduled DNA synthesis was reported in one study in mice in vivo, but only within the pyloric sphincter and liver and not in more remote organs.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Available data on ethanedial and an analogue of ethanedial present in aqueous solutions suggest no effects on fertility or developmental toxicity in the absence of material toxicity.
Acute Toxicity	Ethanedial is moderately toxic via the oral and inhalation routes. In a guideline study in rats, an oral LD50 for a 40% ethanedial aqueous solution was reported at 3300 mg/kg bw. This corresponds to 1320 mg/kg bw/day for the active ingredient. An LC50 for inhalation toxicity was established at 2.44 g/L (active ingredient). Ethanedial is therefore considered to be of low dermal toxicity.
Irritation	Animal studies indicate that ethanedial is a skin and eye irritant
Sensitisation	Based on both animal and human studies, ethanedial is also considered a skin sensitiser.
Health Effects Summary	Ethanedial is moderately toxic via the oral and inhalation routes. In a guideline study in rats, an acute oral median lethal dose (LD50) for a 40% ethanedial aqueous solution was reported at 3 300 mg/kg bw. This corresponds to 1 320 mg/kg bw day for the active ingredient. A median lethal concentration (LC50) for inhalation toxicity was established at 2.44 g/L (active ingredient). Ethanedial is of low dermal toxicity. Animal studies indicate that ethanedial is a skin and eye irritant. From both animal and human studies, ethanedial is also a skin sensitiser.
Key Study/Critical Effect for Screening Criteria	A single repeat dose inhalation toxicity study in rats revealed no systemic toxicity even at the highest dose of 10 mg/m^3. From an oral 28-day repeat dose toxicity test conducted in accordance with OECD TG 407, a No-Observed-Adverse-Effect Level (NOAEL) was established at 40 mg/kg bw/day (active substance), based on dose related changes in body weight gain at higher doses. An adjustment factor of three is applied for inadequate duration of this study, as the no-effect dose was derived from a 28 day study. Consequently, for the purposes of quantifying the health risk of the chemical, an adjusted NOAEL of 13.3 mg/kg bw/day is used in this risk assessment.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	215 mg/L 96 h-LC50 fish. The result of the key study on freshwater invertebrates (BASF, 1988) indicates no acute toxicity of glyoxal (40% in aqueous solution) to Daphnia magna. The EC50 value is above 100 mg/L even when it is considered that no analytical monitoring was performed since glyoxal was shown to be stable at least for this 48-h period. In a GLP guideline study following OECD 210, the chronic treatment of early-life-stages of fish with the test item (Glyoxal 40%) under flow-through conditions resulted in no substance-related effects. Referring to the nominal concentrations of the active substance glyoxal, the NOEC was 119 mg a.i./L (BASF, 2009).
Determination of PNEC aquatic	An assessment factor of 100 has been applied to the reported LC50 of 215 mg/L for fish. The PNECaquatic is 2.15 mg/L.

Current Regulatory Controls[4]	
Australian Hazard Classification	Ethanedial is classified as hazardous for human health in the Hazardous Substances Information System (HSIS) with the following risk phrases (Safe Work Australia 2013): • Muta. Cat. 3 (Mutagenic Substances, Category 3) • R68 (Possible risk of irreversible effects) • Xn; R20 (Harmful by inhalation) • Xi; R36/38 (Irritating to eyes and skin) • R43 (May cause sensitisation by skin contact)
Australian Occupational Exposure Standards	No specific exposure standards were available.
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica 2013). Time Weighted Average (TWA): • 0.1 mg/m³ [Belgium, Columbia, Canada (Alberta, British Columbia, Saskatchewan), • Italy, Nicaragua, Portugal, Spain, United States of America] • 0.5 mg/m³ (0.2 ppm) [Denmark]. • Short Term Exposure Limit (STEL): • 0.3 mg/m³ [Canada (Saskatchewan)].
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1,2]	
P/vP Criteria fulfilled?	Expected to be readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	As the Log Pow is 0.85 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

1. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
2. ECHA REACH, Glyoxal, Retrieved 2019: https://echa.europa.eu/
3. HSDB (n.d.). Hazardous Substances Data Bank. Retrieved 2019, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB

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Toxicity Summary - Guanidine, hydrochloride (1:1)

Chemical and Physical Properties[2]	
CAS number	50-01-1
Molecular formula	CH5N3.ClH
Molecular weight	95.53 g/mol
Solubility in water	2,150 g/L at 20 °C
Melting point	188 °C
Boiling point	No data available.
Vapour pressure	For the pure solid guanidinium chloride the vapour pressure is expected to be much lower than 0.000005 Pa.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Solid, powder, odourless
Overview	This substance is used in the following products: laboratory chemicals, extraction agents and pharmaceuticals. This substance has an industrial use resulting in manufacture of another substance (use of intermediates).
Environmental Fate[2]	
Soil/Water/Air	The guanidine ion is expected to have such a long hydrolysis half-life at environmentally relevant pH that the measurement is not feasable. Due to the low vapour pressure the substance under investigation will not be present in the gas phase in the atmosphere in appreciable amounts and therefore the elimination path photodegradation in air will be only of minor importance. Guanidine chloride is inherently biodegradable. Guanidine chloride is highly water soluble. For the inorganic solid a negligible vapour pressure is expected. According to the measured log Kow < -1.7, a low potential for adsorption is expected (non-ionic adsorption).
Human Health Toxicity Summary[2]	
Chronic Repeated Dose Toxicity	A No Observed Adverse Effect Level (NOAEL) of 100 mg/kg body weight/day for repeated dose toxicity was established from an oral sub chronic toxicity study on Wistar rats according to OECD guideline 408 with Guanidine hydrochloride.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	There is no evidence for genotoxic properties from gene mutation assays in bacteria and mammalian cells, as well as chromosome aberration in mammalian cells.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A NOAEL of 350 mg/kg body weight/day for developmental toxicity was established from a developmental toxicity study according to OECD guideline 414 with Guanidine hydrochloride.
Acute Toxicity	Acute toxicity data on Guanidine hydrochloride are available for the oral, inhalation and dermal route. The data available from three studies for the oral route all indicate LD50 values for Guanidine hydrochloride in the range between 773.6 and 1120 mg/kg bw. The LC50 from an inhalation study for female rats is 3.181 mg/L air (LC50 for male rats = 7.655 mg/L air). The dermal LD50 is > 2000 mg/kg bw.
Irritation	Based on the available data Guanidine hydrochloride is irritating to the skin and irritating to the eye.

Sensitisation	Not sensitising
Health Effects Summary	After oral exposure signs of systemic toxicity including death were observed in acute toxicity studies, thus absorption of guanidine hydrochloride has occurred. As a consequence, it is likely that the substance will also be absorbed if inhaled. This assumption is supported by data from an acute inhalation toxicity study, were systemic effects and death were observed. The substance is irritating to the skin and eye. The substance is not skin sensitising and there is no evidence of genotoxic toxicity.
Key Study/Critical Effect for Screening Criteria	NOAEL (rat) of 100 mg/kg bw/day from sub-chronic oral toxicity study.
Ecological Toxicity[2]	
Aquatic Toxicity	Short-term toxicity to aquatic organisms: Fish: LC50 (96 h) = 690 mg/L a.i. for Pimephales promelas (test with read-across substance Guanidine nitrate). Invertebrates: EC50 (48h) = 70.2 mg/L for Daphnia magna (test with read-across substance Guanidine nitrate, similar to OECD 202). Algae and cyanobacteria: ErC50 (72 h) = 33.5 mg/L for Pseudokirchneriella subcapitata (test with read-across substance Guanidine nitrate Long-term toxicity to aquatic organisms: Fish: NOEC = 181 mg/L for Fathead minnow (test with read-across substance Guanidine nitrate, similar to OECD 210). Invertebrates: NOEC = 2.9 mg/L for Daphnia magna (test with read-across substance Guanidine nitrate, similar to OECD 211).
Determination of PNEC aquatic	PNEC not calculated. Acute and chronic results for species for all three tropic levels are above 1 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Guanidine chloride is inherently biodegradable.
B/vB criteria fulfilled?	No. Log Kow is -1.7 @ 20 °C and BCF is 3.2 L/kg ww
T criteria fulfilled?	No. Acute and chronic toxicity data >1 mg/L for all three tropic levels.
Overall conclusion	Not PBT
Revised	October 2019

References

1. ECHA REACH, Guanidinium chloride, Retrieved 2019: https://echa.europa.eu/

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Toxicity Summary - Kaolin

Chemical and Physical Properties[1,2,4,5]	
CAS number	1332-58-7
Molecular formula	H2Al2Si2O8 H2O
Molecular weight	258 (approx)
Solubility in water	Insoluble
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	Not combustible
Colour/Form	White, greyish-white, or slightly coloured
Overview	Kaolin is a mixture of different minerals. Its main component is kaolinite and it frequently contains quartz, mica, feldspar, illite and montmorlilonite. Kaolinite composition is tiny sheets of triclinic crystals with pseudohexagonal morphology. It is formed by rock weathering. Kaolin is used in paper production, in paints, rubber, plastic, ceramic, chemical, pharmaceutical and cosmetic industries. It has a high fusion point and is the most refractory of all clays. Kaolin is listed in FIFRA 25(b) and US EPA List 4A. It is also listed as GRAS (Generally Regarded as Safe) by the U.S. Food and Drug Administration (FDA GRAS database). A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[4]	
Soil/Water/Air	Kaolin is a natural component of the soil and occurs widely in ambient air. It has a density of 2.1–2.6 g/cm^3. The cation exchange capacity of kaolinite is considerably less than that of montmorillonite, in the order of 2–10 meq/100 g, depending on the particle size, but the rate of the exchange reaction is rapid, almost instantaneous (Grim, 1968). Kaolinite adsorbs small molecular substances such as lecithin, quinoline, paraquat, and diquat, but also proteins, polyacrylonitrile, bacteria, and viruses (McLaren et al., 1958; Mortensen, 1961; Weber et al., 1965; Steel & Anderson, 1972; Wallace et al., 1975; Adamis & Timár, 1980; Schiffenbauer & Stotzky, 1982; Lipson & Stotzky, 1983). The adsorbed material can be easily removed from the particles because adsorption is limited to the surface of the particles (planes, edges), unlike the case with montmorillonite, where the adsorbed molecules are also bound between the layers (Weber et al., 1965). Upon heating, kaolinite starts to lose water at approximately 400 °C, and the dehydration approaches completeness at approximately 525 °C (Grim, 1968). The dehydration depends on the particle size and crystallinity.
Human Health Toxicity Summary [1,4]	
Chronic Repeated Dose Toxicity	Long-term exposure to kaolin may lead to a relatively benign pneumoconiosis, known as kaolinosis. Deterioration of lung function has been observed only in cases with prominent radiological alterations. Based on data from China clay workers in the United Kingdom, it can be very roughly estimated that kaolin is at least an order of magnitude less potent than quartz.
Carcinogenicity	A4; Not classifiable as a human carcinogen

Mutagenicity/ Genotoxicity	Recently, manufactured nano/microparticles such as fullerenes (C60), carbon black (CB) and ceramic fiber are being widely used because of their desirable properties in industrial, medical and cosmetic fields. However, there are few data on these particles in mammalian mutagenesis and carcinogenesis. To examine genotoxic effects by C60, CB and kaolin, an in vitro micronuclei (MN) test was conducted with human lung cancer cell line, A549 cells. In addition, DNA damage and mutations were analyzed by in vivo assay systems using male C57BL/6J or gpt delta transgenic mice which were intratracheally instilled with single or multiple doses of 0.2 mg per animal of particles. In in vitro genotoxic analysis, increased MN frequencies were observed in A549 cells treated with C60, CB and kaolin in a dose-dependent manner. These three nano/microparticles also induced DNA damage in the lungs of C57BL/6J mice measured by comet assay. Moreover, single or multiple instillations of C60 and kaolin, increased either or both of gpt and Spi- mutant frequencies in the lungs of gpt delta transgenic mice. Mutation spectra analysis showed transversions were predominant, and more than 60% of the base substitutions occurred at G:C base pairs in the gpt genes. The G:C to C:G transversion was commonly increased by these particle instillations. Manufactured nano/microparticles, CB, C60 and kaolin, were shown to be genotoxic in in vitro and in vivo assay systems.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	Occupationally inhaled kaolin produced chronic pulmonary fibrosis. In an acute oral study in which 120 rats were fed doses of Kaolin ranging from 100 to 210 g/kg. Fourteen rats were controls. Kaolin was inert and nonstatic except for the danger of bowel obstruction resulting in perforation. The clinical signs were listlessness, anorexia, oliguria, hypothermia, and dyspnea. These were a pathological reaction from over distension of the alimentary canal by an inert solid. The number of fatalities and the incidence and advance of bowel obstruction along the small intestine were dose related. The dose that killed 50% of the rats by bowel obstruction was 149 g/kg.
Irritation	Causes moderate eye irritation. May cause irritation of the respiratory system
Sensitisation	No data available.
Health Effects Summary	Kaolin is toxic to a variety of mammalian cells in vitro, and it produces transient inflammation in the lungs of experimental animals after intratracheal instillation.
Key Study/Critical Effect for Screening Criteria	No data available.

Ecological Toxicity [4]	
Aquatic Toxicity	The 24- and 48-h LC50 values for kaolinite toxicity to the water flea (Daphnia pulex) were >1.1 g/litre (Lee, 1976). Georgia kaolin caused <10% mortality of sea urchin (Strongylocentrosus purpuratus), Japanese clam (Tapes japonica), hermit crab (Pagurus hirsutiusculus), isopod (Sphaeroma pentodon), mud snail (Nassarius obsoletus), blue mussel (Mytilus edulis), and tunicates (Molgula manhattensis and Styela montereyensis) within 5–12 days. The 200-h LC10 values for coast mussel (Mytilus californianus), black-spotted bay shrimp (Crangon nigromaculata), migrant prawn (Palaemon macrodactylus), dungeness crab (Cancer magister), and the polychaete Neanthes succinea were 26, 16, 24, 10, and 9 g/litre, respectively. The 100-h LC10 values for the tunicate Ascidia ceratodes, amphipod Anisogammarus confervicolus, and shiner perch (Cymatogaster aggregata) were 7, 38, and 1 g/litre, respectively (McFarland & Peddicord, 1980). No effect on the hatching success or egg development rate of four marine fish species — red seabream (Pagrus major), black porgy (Acanthopagrus schlegeli), striped knifefish (Oplegnathus fasciatus), and threeline grunt (Parapristipoma trilineatum) — was observed at kaolinite concentrations up to 10 g/litre for 24 h. Larvae were more sensitive to kaolinite: the 12-h LC50 values were 170 and 710 mg/litre for P. trilineatum and O. fasciatus, respectively; mortality was also observed for P. major at concentrations of 1000 mg/litre and above (Isono et al., 1998).
Determination of PNEC aquatic	Kaolin has low toxicity to aquatic species, a large number of which have been tested. As such, $PNEC_{aquatic}$ has not been determined.
Current Regulatory Controls[2,3]	
Australian Hazard Classification	No hazard classification according to GHS criteria
Australian Occupational Exposure Standards	TWA: 10 mg/m^3
International Occupational Exposure Standards	TLV: (respirable fraction): 2 mg/m^3, as TWA
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	Not applicable. Acute toxicity data >1 mg/L in water flea, thus Kaolin does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

1. HSDB (n.d.). Hazardous Substances Data Bank. Retrieved 2019, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. IPCS Kaolin, Retrieved 2019: http://www.inchem.org
3. Safe Work Australia, Hazardous Substances System, Retrieved 2019: http://hcis.safeworkaustralia.gov.au/

4. IPCS INCHEM; Environmental Health Criteria (EHC) Monographs. Bentonite, kaolin, and selected clay minerals (EHC 231). Available from, as of June 25, 2007: http://www.inchem.org/pages/ehc.html
5. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au

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Toxicity Summary - Potassium Hydroxide

Chemical and Physical Properties[1,2,3]	
CAS number	1310-58-3
Molecular formula	KOH
Molecular weight	56.11
Solubility in water	1100 g/l at 25°C
Melting point	406°C
Boiling point	1327°C
Vapour pressure	1.3 hPa at 719°C
Henrys law constant	No data available.
Explosive potential	The solution in water is a strong base. It reacts violently with acid and is corrosive to metals such as aluminium, tin, lead and zinc. This produces a combustible / explosive gas. Reacts with ammonium salts. This produces ammonia. This generates fire hazard. Contact with moisture and water may generate heat.
Flammability potential	Not combustible. Contact with moisture or water may generate sufficient heat to ignite combustible materials.
Colour/Form	White or slightly yellow odourless lumps, rods, pellets.
Overview	Potassium hydroxide is a strong alkaline substance that dissociates completely in water to K+ and OH- ions. KOH is commercialised as a solid or as solutions with varying concentrations. It has many industrial uses; less than 2% is for wide dispersive use. It is used in paint and varnish removers, drain cleaners, degreasing agents and dairy pipeline cleaners.
Environmental Fate[4]	
Soil/Water/Air	The high water solubility and low vapour pressure indicate that KOH will be found predominantly in the aquatic environment. KOH is present in the environment as potassium and hydroxyl ions, which implies that it will not adsorb on particulate matter or surfaces and will not accumulate in living tissues.
Human Health Toxicity Summary[1,3,4]	
Chronic Repeated Dose Toxicity	No studies were identified regarding the repeated dose toxicity of KOH in animals
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	There is no evidence for a mutagenic activity. K+ and OH- are not expected to be systemically available in the body over the normal limits, under non-irritating conditions. A genotoxic effect is also not very likely because both the K+ and OH- ions are naturally present in the human body.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Studies to the reproduction of KOH are not available. Based on the results of corresponding potassium salts like KCl and K2CO3, effects in non-irritating doses/concentrations to reproduction or development are not expected for KOH. The calculated NOAEL for the potassium ion is approximately 164 mg/kg bw.

Acute Toxicity	Potassium hydroxide has moderate acute toxicity based on results from three animal studies in rats following oral exposure. The median lethal dose (LD50) in rats is reported as 273–1230 mg/kg bw. The concentrations used in these tests were not reported. Observed sub-lethal effects included hyperexcitability, followed by apathy and weakness. Haemorrhaging of the stomach and intestine, and adhesions of abdominal organs (stomach, pancreas, spleen, liver and small intestine) were seen following administration of both lethal and sub-lethal doses (OECD, 2002). In contrast, the LD50 value in rats of potassium chloride, 3000 mg/kg bw, is much higher than that of potassium hydroxide, indicating low toxicity of the potassium ion (OECD, 2002).
Irritation	Solid KOH is corrosive. Depending on the concentration, solutions of KOH are non-irritating, irritating or corrosive and they cause direct local effects on the skin, eyes and gastrointestinal tract. Systemic effects are not to be expected. Solutions with concentrations higher than 2% are corrosive, while concentrations of about 0.5 to about 2.0 % are irritating.
Sensitisation	Based on the reported negative results in a guinea pig study and human experience, potassium hydroxide is not considered to be a skin sensitiser (OECD, 2002). Potassium hydroxide has been used extensively for many decades by industry and by consumers. However, skin sensitisation has never been described as secondary to skin irritation or burns. As discussed previously, both the potassium and the hydroxide constituents are ions that are naturally present in the body. For this reason, it is very unlikely that skin sensitisation would result from exposure to the chemical (OECD, 2002)
Health Effects Summary	Potassium hydroxide is corrosive to the skin, eyes, and gastrointestinal and respiratory tracts. Based on human data, concentrations of 0.5–2.0 % are irritating to the skin, while a concentration greater than 2.0 % is corrosive (OECD, 2002). The constituent ions of potassium hydroxide are naturally present in the body. Chronic systemic health effects such as repeated dose toxicity (apart from alkalosis), carcinogenicity and reproductive toxicity are not expected following exposures at non-irritating concentrations. There are limited available data on systemic health effects of potassium hydroxide in vivo (REACH). The very limited data on potassium chloride (OECD, 2002) concludes that there is no evidence of systemic toxicity of the endogenous potassium ion. In addition, similar results were reported for sodium hydroxide (NICNAS). Potassium salts are generally considered by NICNAS to be of low concern to human health (NICNAS, 2012).
Key Study/Critical Effect for Screening Criteria	No oral TRV apply. Acute toxicity only (irritant and corrosive). Systemic effects are not to be expected. The Australian drinking water guideline value for pH may apply to potassium hydroxide.
Ecological Toxicity [4]	
Aquatic Toxicity	The hazard of KOH for the environment is caused by the hydroxyl ion (pH effect). For this reason the effect of KOH on the organisms depends on the buffer capacity of the aquatic or terrestrial ecosystem. Also the variation in acute toxicity for aquatic organisms can be explained for a significant extent by the variation in buffer capacity of the test medium. The LC50 value of acute fish toxicity was in the order of 80 mg/l. It was 880 mg/l for KCl and ranged between 125-189 mg/l for NaOH. The LC50 values of acute invertebrate toxicity for KCl was 660 mg/l (Daphnia magna) and 630 mg/l (Ceriodaphnia dubia), and for NaOH 40 mg/l (Ceriodaphnia dubia). The EC50 algae value (Nitscheria linearis) was 1337 mg/l for KCl.
Determination of PNEC aquatic	It is not considered useful to calculate a PNEC for potassium hydroxide because factors such as the buffer capacity, the natural pH, and the fluctuation of the pH are very specific for a certain ecosystem. Based on the information above, a PNECaquatic was not derived for potassium hydroxide.
Current Regulatory Controls[1]	

Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xn; R22 (acute toxicity) C; R35 (corrosivity)
Australian Occupational Exposure Standards	TWA: 2 mg/m^3 (peak limitation), Safe Work Australia
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit of 0.5–2 mg/m^3 time weigh ted average (TWA) in different countries such as Bulgaria, Chile, Denmark, Poland and Sweden and 1–2 mg/m^3 short-term exposure limit (STEL) in countries such as the United Kingdom, Spain, South Africa and Poland.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable (ionic species ubiquitous in environment)
T criteria fulfilled?	No chronic toxicity data exist on potassium hydroxide; however, the acute EC(L)50s for KCl are >0.1 mg/L in fish, invertebrates and algae. Thus, potassium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier II Assessment for Potassium hydroxide: Retrieved 2019: https://www.nicnas.gov.au
2. HSDB (n.d.). Hazardous Substances Data Bank. Retrieved 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
3. IPCS Potassium Hydroxide, Retrieved 2015: http://www.inchem.org
4. OECD (2008). Screening Information Dataset (SIDS) Initial Assessment Report for Potassium Hydroxide (CAS No. 1310-58-3)
5. Safe Work Australia Workplace Exposure Standards for Airborne Contaminants, 2013.
6. ECHA REACH, Potassium Hydroxide, Retrieved 2015: http://echa.europa.eu

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Toxicity Summary - Smectite

Chemical and Physical Properties[1,2,3]	
CAS number	12199-37-0
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	No data available.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Off-white to tan fine flakes or powder
Overview	Smectites commonly result from the weathering of basic rocks. Smectite formation is favoured by level to gently sloping terranes that are poorly drained, mildly alkaline (such as in marine environments), and have the high Si and Mg potentials (Borchardt, 1977). Other factors that favour the formation of smectites include the availability of Ca and the paucity of K (Deer and others, 1975). Poor drainage is necessary because otherwise water can leach away ions (e.g. Mg) freed in the alteration reactions. Smetites are used in the industry as fillers, carriers, absorbents and a component in drilling fluids (Grim, 1962). A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[4*]	
Soil/Water/Air	Limited data is available for smectite, read across data has been obtained from bentonite. Bentonite is a rock formed of highly colloidal and plastic clays composed mainly of montmorillonite, a clay mineral of the smectite group, and is produced by in situ devitrification of volcanic ash. Bentonite's production and use in domestic products, cat litter, construction materials, ceramics, pharmaceuticals, beer and wine production and cosmetics may result in its release to the environment through various waste streams. Its use in drilling muds, in agricultural practice as a carrier and an animal feed binder will result in its direct release to the environment. Bentonite is a colloidal native hydrated aluminum silicate (clay) found in midwest of USA and in Canada. Occupational exposure to bentonite may occur through inhalation of dust and dermal contact with this compound at workplaces where bentonite is produced or used. Use data indicate that the general population may be exposed to bentonite via ingestion of and dermal contact with consumer products containing bentonite.
Human Health Toxicity Summary[4*]	
Chronic Repeated Dose Toxicity	Mice maintained on diets containing bentonite displayed slightly reduced growth rates. Mice treated with higher doses showed minimal growth and fatty livers and fibrosis of the liver and benign hepatomas. Bentonite increased the susceptibility of mice to pulmonary infection.
Carcinogenicity	No adequate studies are available on the carcinogenicity of bentonite.

Mutagenicity/ Genotoxicity	The genotoxic potential of bentonite particles (diameter < 10 um) with an a-quartz content of up to 6% and different chemical modifications (alkaline, acidic, organic) was investigated. Human lung fibroblasts (IMR90) were incubated for 36 hr, 48 hr, or 72 hr with bentonite particles in concentrations ranging from 1 to 15 ug/sq cm. Genotoxicity was assessed using the micronucleus (MN) assay and kinetochore analysis. The generation of reactive oxygen species (ROS) caused by bentonite particles via Fenton-like mechanisms was measured acellularly using electron spin resonance (ESR) technique and intracellularly by applying an iron chelator. The results show that bentonite-induced genotoxic effects in human lung fibroblasts are weak. The formation of micronuclei was only slightly increased after exposure of IMR90 cells to an acidic sample of bentonite dust with a quartz content of 4-5% for 36 hr (15 ug/sq cm), 48 hr (5 ug/sq cm), and 72 hr (1 ug/sq cm), to an alkaline sample with a quartz content of 5% for 48 hr and 72 hr (15 ug/sq cm), and to an acidic bentonite sample with 1% quartz for 72 hr (1 ug/sq cm). Native (untreated) and organic activated bentonite particles did not show genotoxic effects in most of the experiments. Also, bentonite particles with a quartz content < 1% were negative in the micronucleus assay. Generation of ROS measured by ESR was dependent on the content of transition metals in the sample but not on the quartz content or the chemical modification. Reduction of MN after addition of the iron chelator 2,2'-dipyridyl showed that ROS formation also occurs intracellularly. It was concluded that the genotoxic potential of bentonite particles is generally low but can be altered by the content of quartz and available transition metals.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Limited studies did not demonstrate developmental toxicity in rats after oral exposure to bentonite.
Acute Toxicity	Single intratracheal injection into rodents of bentonite and montmorillonite with low quartz content caused dose and particle side dependent effects, as well as transient local inflammation, which included oedema and increased lung weight. Single intratracheal exposures of rats to bentonite caused storage foci in the lungs. After intratracheal exposure of rats to this material with high quartz content, fibrosis is noted.
Irritation	The powder may contain large amounts of free silica which can produce pneumoconiosis with chronic inhalation.
Sensitisation	No data available.
Health Effects Summary	The substance can be absorbed into the body by inhalation. The substance is mildly irritating to the eyes and skin. The substance may have effects on the lungs. This may result in fibrosis.
Key Study/Critical Effect for Screening Criteria	No study available.
Ecological Toxicity [4*]	
Aquatic Toxicity	The 96-h LC50 for rainbow trout (Oncorhynchus mykiss) of Wyoming bentonite, used as a viscosifier in drilling fluids, was 19 g/litre (Sprague & Logan, 1979).
Determination of PNEC aquatic	PNEC has not been calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.

Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[4]	
P/vP Criteria fulfilled?	No data available for Smectite. Information on bentonite reported that Biodegradation of bentonite appears to be minimal.
B/vB criteria fulfilled?	No, bioaccumulation appear minimal for montmorillonite compounds
T criteria fulfilled?	No, read across data from bentonite reported 96h LC50 for fish was > 1 mg/L. Thus, it is not expected to meet the toxicity criteria.
Overall conclusion	Not PBT
Revised	April 2019

* No data available for Smectite. Toxicity data for Bentonite is presented as a surrogate.

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
2. HSDB Hazardous Substances Data Bank. U.S. National Library of Medicine, Retrieved 2019: http://toxnet.nlm.nih.gov/
3. USGS Coastal and Marine Geology Program, Smectite Group. Retrieved 2019: https://pubs.usgs.gov/of/2001/of01-041/htmldocs/clays/smc.htm
4. IPCS Bentonite, Kaolin and Selected Clay Minerals, Retrieved 2015: http://www.inchem.org

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Toxicity Summary - Sodium bicarbonate

Chemical and Physical Properties [1,2,4,5,6]	
CAS number	144-55-8
Molecular formula	NaHCO3
Molecular weight	84.01
Solubility in water	96 g/L (at 20 °C)
Melting point	Decomposes when heated over 50 °C
Boiling point	Decomposes
Vapour pressure	Negligible, ionizable inorganic compound
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	white, odourless, crystalline powder
Overview	Sodium bicarbonate is classified by the U.S. Food and Drug Administration (FDA) as a 'Generally Recognised as Safe' (GRAS) ingredient in food with no other limitation than current good manufacturing practice (FDA, 1978; FDA, 1983). In the EU it is approved as a food additive (EU, 2000) and a feed ingredient (EU, 1998).In Australia it is recognised by Food Standards Australia New Zealand (FSANZ) as a food additive. Sodium bicarbonate is used as animal feed additive, human food additive and it is used in pharmaceuticals. It is also used for the production of other chemicals and used in cosmetics and detergents and other household cleaning products. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[3]	
Soil/Water/Air	The high water solubility and low vapour pressure indicate that sodium bicarbonate will be found predominantly in the aquatic environment. Sodium bicarbonate is present in the environment as sodium and bicarbonate ions, which implies that it will not adsorb on particulate matter or surfaces and will not accumulate in living tissues.
Human Health Toxicity Summary [2,3]	
Chronic Repeated Dose Toxicity	There are no directly relevant studies on repeated dose exposure, however, knowledge of prior use and available literature does not indicate any adverse effects of long-term use of exposure via any route. In humans there is a long history of sodium bicarbonate used as an antacid in doses up to 4 g without adverse effects of long-term use, although it is recommended not to use high doses of pure sodium bicarbonate instead of antacids. In addition, sodium bicarbonate is an important extracellular buffer in vertebrates and is therefore readily regulated in the body.
Carcinogenicity	As with other sodium salts, high doses of sodium bicarbonate promote carcinoma formation in rat urinary bladder after pre-exposure to initiator or BBN. However, when rats were only exposed to sodium bicarbonate no carcinogenic effect on the urinary bladder was found. Based on the available information there are no indications that sodium bicarbonate has carcinogenic effects.
Mutagenicity/ Genotoxicity	*In vitro* bacterial and mammalian cell tests showed no evidence of genotoxic activity.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Sodium bicarbonate did not induce developmental effects when administered orally at the following doses: 580 mg/kg bw (mice), 340 mg/kg bw (rats) and 330 mg/kg bw (rabbits). Furthermore the substance will usually not reach the foetus when the exposure to sodium bicarbonate is sufficiently low, as it does not become systemically available.

Acute Toxicity	Acute oral ingestion by the patients may result in a ruptured stomach due to excessive gas development. Acute or chronic excessive oral ingestion may cause metabolic alkalosis, cyanosis and hypernatraemia. These conditions are usually reversible, and will not cause adverse effects.
Irritation	Sodium bicarbonate is a minimal or mild ocular and skin irritant
Sensitisation	No data available
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water screening value for sodium (180 ppm, aethestic) and pH may apply to sodium bicarbonate.
Ecological Toxicity [3]	
Aquatic Toxicity	In a 96-hr acute flow-through test with rainbow trout (Oncorhynchus mykiss) a NOEC of 2,300 mg/l and a LC50 of 7,700 mg/l were determined. The test was conducted under GLP conditions and according to FIFRA Guideline Reference number 72-1. In a 96-hr acute flow-through test with bluegill sunfish (Lepomis macrochirus) a NOEC of 5,200 mg/l and a LC50 of 7,100 mg/l were determined. The test was conducted under GLP conditions and according to FIFRA Guideline Reference number 72-1. In a 48-hr acute flow-through test with Daphnia magna a NOEC of 3,100 mg/l and a LC50 of 4,100 mg/l were determine. The test was conducted under GLP conditions and according to FIFRA Guideline Reference number 72-2. A (chronic) reproduction test with Daphnia magna was carried out. Test solutions were prepared to contain the appropriate concentrations of salts to yield a total hardness of170 mg/l $CaCO_3$. At the tested concentration $NaHCO_3$ of 576 mg/l the survival was 100% and the cumulative number of offspring per female did not significantly differ from the control. This demonstrates that the 21-day Daphnia magna NOEC is higher than 576 mg/l. Standard toxicity tests with algae or aquatic plants have not been found, but test medium for acute algae tests contain 50 mg/l sodium bicarbonate. Glass slides were exposed to a portion of a small stream with an addition of sodium bicarbonate to a concentration of 45 mg/l for a period of 63 days. An increasing algal standing crop compared to the controls was found. Except for a small increase of Cyanophycea species, no shift in species was determined.
Determination of PNEC aquatic	It is not considered useful to calculate a PNEC for sodium bicarbonate because factors such as the buffer capacity, the natural pH, and the fluctuation of the pH are very specific for a certain ecosystem. Based on the information above, a PNECaquatic was not derived for sodium bicarbonate.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	Sodium bicarbonate is an inorganic salt that is present in the environment as sodium and bicarbonate ions. Biodegradation is not applicable to these inorganic ions. Thus, the persistent criterion is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Sodium and bicarbonate ions are essential to all living organisms and its

	extracellular concentrations are actively regulated. Thus, sodium bicarbonate is not expected to bioaccumulate.
T criteria fulfilled?	The 21 d chronic NOEC is 576 mg/L for Daphnia. Thus, sodium bicarbonate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	March 2019

References

1. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. IPCS Sodium Bicarbonate, Retrieved 2015: http://www.inchem.org
3. OECD (2008). Screening Information Dataset (SIDS) Initial Assessment Report for Sodium Bicarbonate (CAS No. 144-55-8).
4. FSANZ 2014, Food Standards Australia New Zealand Food Additives – Alphabetical list.
5. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
6. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

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Toxicity Summary - Sodium carbonate

Chemical and Physical Properties[1,2,3,4,6]	
CAS number	497-19-8
Molecular formula	Na_2CO_3
Molecular weight	105.99 g/mol
Solubility in water	215 g/l at 20 °C
Melting point	851 °C
Boiling point	Decomposition
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	It reacts violently with acids and reacts with magnesium, phosphorous pentoxide causing explosion hazard
Flammability potential	Reacts with fluorine causing fire hazard
Colour/Form	White powder
Overview	Sodium carbonate has been reviewed in the OECD-SIDS program (OECD, 2002a,b).Sodium carbonate is a strong alkaline compound with a pH of 11.6 for a 0.1M aqueous solution. The pKa of carbonate (CO3 2-) is 10.33, which means that at a pH of 10.33 both carbonate and bicarbonate are present in equal amounts. In water, sodium carbonate dissociates into sodium ion (Na+) and carbonate (CO3 2-). The carbonate ions will react with water, resulting in the formation of bicarbonate and hydroxide, until equilibrium is established. Sodium carbonate is used in many countries (e.g. U.S. and EU) as a food additive. It is regarded as a 'Generally Recognised as Safe' (GRAS) substance in food with no limitation other than current good manufacturing practice. Sodium carbon is extensively used across a range of industries and processes such as in the manufacturing of sodium salts, glass, soap/detergents and aluminium
Environmental Fate[1,2,3,4]	
Soil/Water/Air	The high water solubility and low vapor pressure indicate that sodium carbonate will be found predominantly in the aquatic environment. In water, sodium carbonate dissociates into sodium (Na+) and carbonate (CO3 2-) and both ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	No chronic oral and dermal data are available. Due to the biological importance of the products formed by the stomach acid (biocarbonate and carbon dioxide), systemic toxicity is not expected. In rats, histopathological changes of the respiratory tract and the lungs were seen following repeated inhalation exposure to sodium carbonate (70 mg/m^3 aqueous sodium cabonate at pH 11.6 for 3.5 months) and potassium carbonate (0.4 mg/L potassium carbonate at pH 9.9 for 21days). These effects were considered local responses to the high alkalinity of this group of chemicals (OECD, 2002; REACHa; REACHb).
Carcinogenicity	No data are available. Based on the available data from carcinogenicity studies with related substances (sodium bicarbonate and potassium bicarbonate), the chemicals in this group are not considered carcinogenic (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.

Mutagenicity/ Genotoxicity	Based on the available data, this chemical is not considered to be genotoxic (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the limited information available, this chemical does not show specific reproductive or developmental toxicity (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.
Acute Toxicity	In animal tests, this chemical was of low acute toxicity following oral exposure. The median lethal dose (LD50) was >2000 mg/kg bw in rats (OECD, 2002; REACHa; REACHb).The majority of the animals that died following acute oral exposure to sodium carbonate at concentrations up to 2600 mg/kg/bw showed oral or nasal discharge, lesions in the liver, mottled lungs, mottled or pale kidneys and a red or partly gas-filled gastro-intestinal tract. In animal tests, this chemical was of low acute toxicity following dermal exposure. The median lethal dose (LD50) was >2000 mg/kg bw in rats (OECD, 2002; REACHa; REACHb). No systemic effects were observed following dermal exposure to sodium carbonate. Local severe skin irritation (severe erythema and oedema) was seen at the application site (OECD, 2002; REACHa; REACHb). In animal tests, this chemical was of low acute toxicity following inhalation exposure. The median lethal dose (LC50) was >2000 mg/m^3 in rats (OECD, 2002; REACH, a & b). Signs of respiratory impairment including dyspnoea, wheezing, excessive salivation and a distended abdomen were observed immediately after inhalation exposure to sodium carbonate of up to 2300 mg/m^3. Excessive salivation, repeated swallowing and a lack of appetite were observed 2–5 hours after exposure. Animals that died had lesions in the anterior trachea, posterior pharynx and larynx, along with an accumulation of mucus, vesiculation and mucosal oedema (REACHa).
Irritation	Sodium carbonate is classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in HSIS (Safe Work Australia). However, in several eye irritation studies in rabbits, sodium carbonate was found to be severely irritating to the eyes, with effects including conjunctivitis, marked corneal opacity and iritis, which persisted for seven days (REACHa; REACHb). The available data support an amendment to the current HSIS eye irritation classification for sodium carbonate.
Sensitisation	Based on the limited data available, sodium carbonate is not considered to be skin sensitisers (OECD, 2002; REACHa; REACHb). No structural flags for sensitisation are present.
Health Effects Summary	The critical health effects for risk characterisation include serious eye damage and respiratory irritation because of the high basicity of the chemicals in this group. Skin irritation and corrosion of eyes and mucous membranes are also of concern where long-term exposure to the solid or concentrated solutions may occur. These effects are particularly relevant to domestic use of the chemicals. Sodium carbonate was not genotoxic or carcinogenic. Reproductive toxicity studies are not available; however, no effects on reproductive organs were noted when rats were exposed to sodium carbonate aerosol for over three months. Developmental studies with rats did not show any toxicity.
Key Study/Critical Effect for Screening Criteria	A No Observed Adverse Effect Level (NOAEL) was not available. Based on the absence of adverse effects observed in a repeat dose inhalation toxicity study, for the purposes of quantifying potential health risk, the highest dose tested in the inhalation exposure study in rats of 70 mg/m^3 (equivalent to 9.67 mg/kg bw/day) is used in the human health risk assessment.
Ecological Toxicity [1,2,3,4]	
Aquatic Toxicity	The acute 96-hour LC50 to three sizes of Bluegill sunfish (*Lepomis macrochirus*) exposed to sodium carbonate is 300 mg/L for all sizes. The acute 96-hour LC50 to mosquitofish (*Gambusia affinis*) is 740 mg/L. The acute 48-hour EC50 value to the invertebrate *Ceriodaphnia* cf. *dubia* is from 200 to 227 mg/L.

Determination of PNEC aquatic	PNECaquatic: Experimental results are available for two trophic levels. Acute E(L)C50 values are available for fish (300 mg/L) and *Ceriodaphnia* (200 mg/L). On the basis that the data consists of short-term results from two trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 200 mg/L for Daphnia. The PNECaquatic is 0.2 mg/L.
Current Regulatory Controls[1]	
Australian Hazard Classification	Sodium carbonate is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): 'Xi; R36 (Irritating to eyes)'.
Australian Occupational Exposure Standards	Sodium carbonate has an exposure standard of 7.5 mg/m^3 (5 ppm) time weighted average (TWA) and 15 mg/m^3 (10 ppm) short-term exposure limit (STEL) (Safework Australia).
International Occupational Exposure Standards	Occupational exposure standard limits for sodium and potassium carbonate recommended by other countries are provided below (Galleria Chemica, 2013): US Dept of Energy (DOE) Temporary Emergency Exposure Limits (TEELs): Sodium carbonate: TEEL-0 = 10 mg/m^3 , TEEL-1 = 30 mg/m^3 , TEEL-2 = 50 mg/m^3, TEEL-3 = 500 mg/m^3 No other country has an occupational exposure limit specifically for sodium and potassium carbonate, although many countries have assigned a generic TWA exposure limits of 10 mg/m^3 (inhalable dust), and 3 mg/m^3 (respirable dust) for particles not otherwise classified (PNOC).
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[4,6]	
P/vP Criteria fulfilled?	Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	No chronic toxicity data exist; however, the acute EC(L)50s are >0.1 mg/L. Thus, does not meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	March 2019

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1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier II Assessment for Alkaline Salts-Carbonates: Retrieved 2019: https://www.nicnas.gov.au
2. HSDB Hazardous Substances Data Bank. U.S. National Library of Medicine, < http://toxnet.nlm.nih.gov/>,
3. OECD (2011) SIDS Initial Assessment Report for SIAM 15 (OECD SIDS). *Sodium carbonate: CAS Nº:497-19-8*. United Nations Environment Programme (UNEP) Publications. From http://www.chem.unep.ch/irptc/sids/OECDSIDS/Naco.pdf,
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6. ECHA REACH, Sodium carbonate, Retrieved 2019: https://echa.europa.eu/

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Toxicity Summary - PERFORMATROL®

Chemical and Physical Properties[1,2]	
CAS number	Not provided
Molecular formula	No data available.
Molecular weight	No data available.
Solubility in water	Water soluble
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Clear, colourless, odourless, viscous liquid
Overview	PERFORMATROL® shale stabilizer is a low weight polymer that stabilizes reactive clays and shale by inhibiting the uptake of water and thereby mitigating their swelling or dispersion tendencies. PERMORMATROL shale stabilizer can also flocculate any dispersed clays or colloidal particles and aid their removal by solids control equipment. PERFOMATROL shale stabilizer is effective in freshwater or monovalent brines, is shear thinning, provides lubricity, has a low environmental toxicity, is highly biodegradable and is non-hazardous to rig personnel. PERFORMATROL shale stabilizer is stable to 250°F (121°C) but may achieve higher temperature stability with the use of oxygen scavengers.
Environmental Fate	
Soil/Water/Air	No data available.
Human Health Toxicity Summary[1,2]	
Chronic Repeated Dose Toxicity	No data available to indicate product or components present at greater than 0.1% are chronic health hazards.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	Non-irritating to rabbit's eye.
Sensitisation	No data available.
Health Effects Summary	No data available.
Key Study/Critical Effect for Screening Criteria	No data available.

Ecological Toxicity	
Aquatic Toxicity	The polymers are expected to be a low concern for toxicity to aquatic organisms. Due to their poor solubility and high molecular weights, they are not expected to be bioavailable.
Determination of PNEC aquatic	No PNEC values were calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be highly biodegradable.
B/vB criteria fulfilled?	Polymers are expected to have very high molecular weights and poor water solubility. They are not expected to be bioavailable, hence the polymers do not meet the criteria for bioaccumulation.
T criteria fulfilled?	There are no aquatic toxicity studies on this polymer. Polymers are expected to have low aquatic toxicity because of their very high molecular weights and poor water solubility. As such, the polymers do not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2020

References

1. PERFORMATROL®, Product Data Sheet, Haliburton, Dated: 8/31/2010
2. PERFORMATROL®, Safety Data Sheet, Haliburton, Revision date: 30 September 2015, Revision number: 24

Toxicity Summary - Hexadec-1-ene

Chemical and Physical Properties[1,2,3]	
CAS number	629-73-2
Molecular formula	C16H32
Molecular weight	224.42
Solubility in water	0.00144 at 25°C
Melting point	4.1
Boiling point	284.9 at 1013 hPa
Vapour pressure	0.00352 hPa at 25°C
Henrys law constant	0.541 – 16.9 atm-m^3/mole
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Hexadec-1-ene are liquids at room temperature.
Overview	Hexadec-1-ene also known as 1-hexadecene are mono-olefins. It is an alkene in the C6-C18 range. These products are produced commercially in closed systems and are used primarily as intermediates in the production of other chemicals. No non-intermediate applications have been identified. Any occupational exposures that do occur are most likely by the inhalation and dermal routes.
Environmental Fate[1]	
Soil/Water/Air	Members of this category do not contain any hydrolysable functional groups, so will not undergo hydrolysis. Category members with carbon numbers from C6 to C24 have been shown to be readily biodegradable in biodegradation screening tests. The estimated half-life of 1-hexene in air is 10.2 hours. The soil adsorption coefficients (Koc) range from 149 for C6 to 230,800 for C18, indicating increasing partitioning to soil/sediment with increasing carbon number. It is expected that C16-C18 olefins would partition primarily to soil. Volatilization from water is predicted to occur rapidly (hours to days).
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	Repeated-dose studies, using the inhalation (C6 alpha), dermal (C12-C16), or oral (C6 alpha and internal linear/branched; C8 and C14 alpha; and C16, C18 and C20-C24 internal linear/branched) routes of exposure, have shown comparable levels of low toxicity in rats. In females, alterations in body and organ weights, changes in certain clinical chemistry/hematology values, and liver effects were noted (NOELs of ≥ 100 mg/kg oral or ≥ 3.44 mg/L (1000 ppm) inhalation). In males, alterations in organ weights, changes in certain clinical chemistry/hematology values, liver effects, and male rat-specific kidney damage that is likely associated with the alpha 2- globulin protein were noted (LOELs ≥ 100 mg/kg oral only). The male rat kidney damage was seen in oral studies with C6, C8 and C14 linear alpha olefins and C6 internal branched olefins, but was not seen in studies with C16/C18 or C20 - C24 internal linear/branched olefins. The noted liver effects were seen in oral studies with C14 alpha olefins (minimal-to-mild hepatocyte cytoplasmic vacuolation with increased liver weight in males and females) and with C20-C24 internal olefins (minimal centrilobular hepatocyte hypertrophy with increased liver weight in females only). No effects were present in the study with C20-C24 internal olefins following a 4-week recovery period, indicating reversibility of the observed effects. These liver effects seen only with the larger molecules may be indirect effects of an intensified liver burden, rather than a direct toxic effect of the olefin. Based on evidence from neurotoxicity screens included in repeated dose studies with C6 and C14 alpha olefins and with C6, C16/C18 and C20-C24 internal linear/branched olefins, the category members are not neurotoxic.

Carcinogenicity	No carcinogenicity tests have been conducted on C6 – C18 alpha or internal olefins; however, there are no structural alerts indicating a potential for carcinogenicity in humans.
Mutagenicity/ Genotoxicity	Based on the weight of evidence from studies with alpha and internal olefins, category members are not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on evidence from reproductive/developmental toxicity screens in rats with C6 and C14 alpha olefins and C6 and C18 linear/branched internal olefins, along with the findings of no biologically significant effects on male or female reproductive organs in repeated dose toxicity studies, the category members are not expected to cause reproductive or developmental toxicity.
Acute Toxicity	Olefins (alkenes) ranging in carbon number from C6 to C24, alpha (linear) and internal (linear and branched) demonstrate low acute toxicity by the oral, inhalation and dermal routes of exposure: Rat oral LD50 >5 g/kg; rat 4-hr inhalation LC50 range = 110 mg/L (32,000 ppm) to 6.4 mg/L (693 ppm) for C6 to C16; and rat/rabbit dermal LD50 > highest doses tested (1.43 - 10 g/kg).
Irritation	These materials are not eye irritants. Prolonged exposure of the skin for many hours may cause skin irritation.
Sensitisation	These materials are not skin sensitizers.
Health Effects Summary	Olefins (alkenes) ranging in carbon number from C6 to C24, alpha (linear) and internal (linear and branched) demonstrate low acute and chronic toxicity by the oral, inhalation and dermal routes of exposure.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity in rats was considered the most sensitive endpoint with a NOEL of 100 mg/kg.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Short term toxicity 96-hr LC50 > solubility Actual concentration negligible. Fish 96-hr LL0 = 1000 mg/L (nominal) Long term toxicity: NOEC (21 days) 19.4 µg/L (invertebrates)
Determination of PNEC aquatic	An assessment factor of 1000 is applied to the lowest NOEC of 19.4 µg/L (invertebrates). A PNECaqua of 0.0019 µg/L was derived.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1,2]	
P/vP Criteria fulfilled?	No. Readily biodegradable. The C6-C18 olefins have been shown to degrade to an extent of approximately 8 to 81% in standard 28-day biodegradation tests.
B/vB criteria fulfilled?	No. Based on calculated bioconcentration factors, hexadec-1-ene are not expected to bioaccumulate (BCF = 71).

T criteria fulfilled?	No. Chronic toxicity data >0.01 mg/L in fish, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

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Toxicity Summary - Lead

Chemical and Physical Properties[1,2,3,4]	
CAS number	7439-92-1
Molecular formula	Pb
Molecular weight	207.2
Solubility in water	Insoluble
Melting point	326 °C at 101.3 kPa
Boiling point	600 °C at 101.3 kPa
Vapour pressure	0
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Blueish-white metal with bright lustre, very soft, highly malleable
Overview	Lead is a naturally occurring element found in the Earth's crust at an average concentration of approximately 15 to 20 mg/kg. Lead is used principally in the production of batteries, metal alloys, X-ray shielding materials, ammunition, chemical resistant linings and pigments. It has also been used historically as an additive in petrol and also in many paints. Lead is a poor conductor of electricity and is very resistant to corrosion. Lead is rarely found in its metallic form in nature and commonly occurs as a mineral with sulphur or oxygen.
Environmental Fate[1]	
Soil/Water/Air	The atmosphere is the main environmental transport media for lead that is deposited onto surface water and soils. Upon release to the atmosphere, lead particles are dispersed and ultimately removed from the atmosphere by wet or dry deposition. Lead deposition is typically greatest closer to lead emission sources. An important factor in determining the atmospheric transport of lead is particle size distribution. Large particles settle out of the atmosphere more rapidly and are deposited relatively close to emission sources and smaller particles may be transported much farther distances. After deposition, particles may be resuspended and redeposited. The cycling of lead in aquatic environments is governed by chemical, biological, and mechanical processes. The exchange between sediment and surface water will be affected by pH, ionic strength, formation of organic complexes with Pb ions, and oxidation-reduction potential of the environment.
Human Health Toxicity Summary[4]	
Chronic Repeated Dose Toxicity	Oral: A lowest observed adverse effect level (LOAEL) of 200 ppm (corresponding to PbB levels of 40–60 mg/dL) was derived for lead acetate from a repeated dose toxicity study in Sprague Dawley (SD) rats following the guidelines set out in a US EPA chronic feeding study. Lead acetate was administered in drinking water (which was freely accessible [ad libitum]) to male rats (18 animals/dose group) at 0, 200, 500 or 1000 ppm per day for four, eight or 12 weeks. Decreased body weight and increased kidney weight as a percentage of body weight were reported at all dose ranges at four weeks of exposure. Dermal: In a report available on repeated dose toxicity during dermal exposure, rats were exposed to lead acetate, lead oleate, lead arsenate or tetraethyl lead for 24 hours. The test groups had lead compounds applied either directly to the skin or to skin that had been mechanically injured. Dermal absorption of lead was shown to occur in both test groups. However, comparatively greater absorption of lead was reported in the groups where the skin had been mechanically injured.

	Inhalation: Aerosolised lead nitrate was administered to mice (Swiss Webster) by inhalation at 2.5 mg/m³ per day for 14 or 28 days. It was determined, considering the total retention of the inhaled lead, that each mouse received a dose of 80 µg/day of lead. A statistically significant reduction in the relative size of the spleen and thymus in both test groups was reported when compared with the control group. Increased lung weight was noted in both test groups and an increase in lead concentration was reported in the liver, lung and kidney; although the 28-day group was noted to show a greater concentration than the 14-day group. There were no apparent differences in body weight and food consumption noted for either test group.
Carcinogenicity	A review conducted by the International Agency for Research on Cancer (IARC), indicated that there was sufficient evidence in experimental animals and limited evidence in humans for the carcinogenicity of inorganic lead compounds. The review resulted in the classification of inorganic lead compounds as probably carcinogenic to humans (Group 2A).
Mutagenicity/ Genotoxicity	Lead compounds are considered genotoxic to mammalian cells.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a reproductive and developmental toxicity screening test in SD rats, lead acetate was administered in drinking water to nine females at 0.6 % weight per volume (w/v) (equivalent to 502 mg/kg bw/day) on gestation days 5–21. A stillbirth rate of 19 % was recorded in the test group compared with a 2 % rate noted in the control group. The dams and offspring in the test group had PbB levels >200 µg/dL. In a subsequent reproductive and developmental toxicity screening test in SD rats, lead acetate was administered in drinking water to 10 females at 0.05 % w/v, eight females at 0.15 % w/v and nine females at 0.45% w/v, on gestation days 5–21. Stillbirth rates of 3(±3), 10(±6) and 28(±8) % were recorded for increasing dose groups respectively compared with a 4(±3) % rate noted in the control group. At birth, the male pups had PbB levels of 40(±1), 83(±8) and 120(±120) µg/dL for increasing dose groups respectively, while the female pups had PbB levels of 42(±7), 67(±16) and 197(±82) µg/dL. A developmental LOAEL of 0.05 % (equivalent to 42 mg/kg bw/day) was reported for this study. Recent studies have investigated the effect of lead exposure in occupational groups and in general populations living near industrial plants. Although the evidence reported is predominantly qualitative and dose-effect relationships have largely not been established, it has been suggested that moderately high PbB levels in humans could result in spontaneous abortion, pre-term delivery, alterations in sperm and decreased male fertility. Data pertaining to low level exposure to lead contributing to developmental toxicity in infants and young children were recently reviewed. Consensus exists between the reports, which suggest that PbB levels in humans >10 µg/dL can affect paediatric intellectual development. In addition, data regarding the effects on children of higher levels of lead exposure were reviewed. Although neurobehavioral deficits were reported in children with PbB levels <10 µg/dL, there is uncertainty regarding the reported effects of estimates. Even so, the US Centres for Disease Control and Prevention (CDC) has a reference level of 5 µg/dL, for which any levels above it is recommended that public health action be initiated.
Acute Toxicity	Lead oxides are generally demonstrated to be of low acute toxicity in animal tests following oral exposure. The rate oral medial lethal doses (LD50s) for lead oxides are generally reported to be > 2000 mg/kg bw for male and female rats. No clinical signs were reported. Several lead compounds, including lead oxides, were reported to exhibit low acute toxicity in animal tests. Dermal median lethal dose (LD50) values in rats are reported to be >2000 mg/kg bw. The rat median lethal concentrations (LC50s) for lead oxide (PbO) is reported to be > 5.05 mg/L for male and female rats. No abnormal signs were observed. Lead metal is expected to have lower bioavailability.
Irritation	Lead compounds are not considered to irritate the skin, eyes or cause serious eye damage.
Sensitisation	Non-sensitisers

Health Effects Summary	The critical health effects for risk characterisation include systemic long-term effects (reproductive and developmental toxicity, carcinogenicity and mutagenicity). The chemical may also cause harmful effects following repeated exposure and harmful systemic effects following a single exposure.
Key Study/Critical Effect for Screening Criteria	The lowest blood lead levels studied were ≤5 µg/dL which has been associated with serious adverse effects.
Ecological Toxicity[1,5]	
Aquatic Toxicity	Short-term toxicity data: LC50 (96 h) 40.8 µg/L (Fish) LC50 (48 h) 26 µg/L (Invertebrates) EC50 (72 h) 20.5 µg/L (algae) Long-term toxicity data: NOEC (53 days) 13.3 µg/L (Fish) NOEC (42 days) 5.9 µg/L (Invertebrates) EC10 (72 h) 6.1 µg/L (algae)
Determination of PNEC aquatic	The PNEC freshwater is 2.4 µg Pb/L.
Current Regulatory Controls[4,5,6,7,8,9]	
Australian Hazard Classification	Lead metal (CAS No. 7439-92-1 as lead, inorganic dusts & fumes (as Pb)) is listed in the Hazardous Substances Information System (HSIS), but no classification is specified. For classification purposes, the chemical is considered to be covered by the generic 'lead and lead compounds' classification as hazardous with the following risk phrases for human health in HSIS: Xn; R20/R22 (Harmful by inhalation and if swallowed) Xn; R33 (Danger of cumulative effects) Repr. Cat. 1; R61 (Reproductive toxicity—may cause harm to the unborn child) Repr. Cat. 3; R62 (Reproductive toxicity—possible risk of impaired fertility)
Australian Occupational Exposure Standards	Time weighted average (TWA): 0.15 mg/m^3 for lead compounds (as lead). Short-term exposure limits (STEL): No specific exposure standards are available
International Occupational Exposure Standards	For lead compounds in general, the following exposure limits were identified: TWA = 0.05 mg/m^3 [Bulgaria, Canada, China, Italy, Malaysia, USA] TWA = 0.10 mg/m^3 [Austria, New Zealand, Republic of South Africa, Sweden] TWA = 0.15 mg/m^3 [Argentina, Egypt, EU (Directive 98/24/EC), Malta, Singapore] TWA = 0.20 mg/m^3 [Thailand] STEL: 0.10 mg/m^3 [Austria] STEL: 0.15 mg/m^3 [Canada] STEL: 0.45 mg/m^3 [Argentina, Egypt]
Australian Food Standards	The tolerable limit for lead is 25 µg/kg bw/week.
Australian Drinking Water Guidelines	Based on health considerations, the concentration of lead in drinking water should not exceed 0.01 mg/L.
Aquatic Toxicity Guidelines	A high reliability freshwater trigger value for lead of 3.4 µg/L was calculated using the statistical distribution method at 95% protection. A marine high reliability trigger value for lead of 4.4 µg/L was calculated using the statistical distribution method with 95% protection.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (lead as a metal do not degrade and traditional persistence measures used for organic substances do not equally apply to metals).
B/vB criteria fulfilled?	Not applicable. Due to their natural occurrence, biota will naturally accumulate metals at least to some degree without deleterious effect and non-essential metals such as lead are homeostatically regulated to some extent.
T criteria fulfilled?	Yes. Lead fulfils the toxicity criteria based on the most sensitive NOEC, HC5-50 and PNEC values, which are below 10µg/L.

Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

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Toxicity Summary - Phosphorodithioic acid, mixed O,O-bis(isobutyl and pentyl) esters, zinc salts

Chemical and Physical Properties[1,2,3]	
CAS number	68457-79-4
Molecular formula	C16H36O4P2S4Zn
Molecular weight	548.1
Solubility in water	1.658 g/L at 22°C and pH 5
Melting point	-21°C
Boiling point	Decomposes before boiling
Vapour pressure	0.003 - 0.107 Pa at 25 - 70°C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Viscous, amber-coloured liquid capable of producing an odour characteristic of sulphur-containing compounds
Overview	The uses and applications for this substance include: Antioxidant; lubricating oil additive for corrosion and wear resistance; accelerator for rubber. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	The test substance is hydrolytically stable at pH 4, 7 and 9 as defined by the OECD 111 criterion of a < 10% change in the concentration of the parent compound. The substance has a low octanol water partition coefficient. It is not readily biodegradable under test conditions. Based on the weight of evidence from read across to structurally similar ZDDP substances with BCF data in fish (from Japanese MITI data, US EPA database, CAESAR database), measured Log Kow data, and QSAR predictions, this substance is expected to have low bioaccumulation potential.
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	The oral repeat dose toxicity was evaluated with rats at doses as high as 160 mg/kg/day for up to 52 consecutive days in accordance with OECD 422. Substance-related toxicity was limited to moribundity, adverse clinical signs, and epithelial hyperplasia, hyperkeratosis, and inflammation of the stomach. The NOAEL for systemic toxicity was 160 mg/kg/day. The NOEL for portal of entry irritation and related secondary effects parental toxicity was 40 mg/kg/day.
Carcinogenicity	Not expected to be carcinogenic.
Mutagenicity/ Genotoxicity	No non-threshold mode of action is associated with this substance, in particular, the test substance has no genotoxic potential. The weight of evidence suggests that the test substance is not expected to present a significant risk for mutagenicity or carcinogenicity in humans,
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The reproductive toxicity of this substance was evaluated with rats at doses as high as 160 mg/kg/day for up to 52 consecutive days in accordance with OECD 422. The NOAEL and NOEL for reproductive fertility and neonatal toxicity was determined to be 160 mg/kg/day.
Acute Toxicity	This substance does not show any evidence of toxicity via the oral route of exposure in animals when tested in accordance with OECD Guideline 401. The rat oral LD50 is 3,600 mg/kg in male rats. Sublethal effects of lethargy, diarrhea, piloerection, chromodacryorrhea, chromorhinorrhea and ptosis were observed. Necropsy observations included lung and gastrointestinal abnormalities, but no

	specific organ toxicity is significant; all animals showed expected bodyweight gain during the course of study. This substance does not show adverse toxicity effects via the dermal route of exposure in animals when tested in accordance with OECD Guideline 402. The rat dermal LD50 is greater than 20,000 mg/kg in rabbits. No mortality occurred. Toxic signs observed included lethargy, diarrhea, ataxia, ptosis, alopecia, emaciation, and yellow nasal discharge. No specific organ toxicity is evident.
Irritation	The substance is a skin and eye irritant.
Sensitisation	Not a skin sensitizer.
Health Effects Summary	The substance causes skin and eye irritation. Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The oral repeated dose toxicity in rats was considered the most sensitive endpoint with a NOEL of 160 mg/kg bw/day.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Short term toxicity: LC50 (4 days): 46 mg/L (fish) LL50 (4 days): 4.5 mg/L (fish) EL50 (48 h): 23 mg/L (invertebrates) EL50 (72 h): 21 mg/L (algae) Long term toxicity: NOEC (21 days): 0.4 mg/L (invertebrates)
Determination of PNEC aquatic	Data from short-term tests with three trophic levels and one long-term test on invertebrates are available. An assessment factor of 100 is applied to the lowest NOEC of 0.4 mg/L (invertebrates). A PNECaqua of 0.004 mg/L was derived.
Current Regulatory Controls [4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	Yes. Not readily biodegradable.
B/vB criteria fulfilled?	No. Based on the measured log Kow value of less than 3, this substance is not bioaccumulative.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

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Toxicity Summary - Sulphur dioxide

Chemical and Physical Properties[1,2,3]	
CAS number	7446-09-5
Molecular formula	SO_2
Molecular weight	64.064
Solubility in water	114 g/L at 20 °C
Melting point	-75.5 - -74.5 °C
Boiling point	-10.05 - -10 °C at 101.3 - 101.325 kPa
Vapour pressure	327.1 kPa at 20 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Colourless gas with a characteristic, irritating, pungent odour
Overview	Sulphur dioxide is a colourless gas with a pungent odour. It is a liquid when under pressure. Sulphur dioxide dissolves in water very easily. It cannot catch fire. Sulphur dioxide in the air results primarily from activities associated with the burning of fossil fuels (coal, oil) such as at power plants or from copper smelting. In nature, sulphur dioxide can be released to the air, for example, from volcanic eruptions.
Environmental Fate[1,3]	
Soil/Water/Air	Once released into the environment, sulphur dioxide moves to the air. In the air, sulphur dioxide can be converted to sulfuric acid, sulphur trioxide, and sulphates. Sulphur dioxide dissolves in water. Once dissolved in water, sulphur dioxide can form sulphurous acid. Soil can absorb sulphur dioxide, with uptake being dependent on the pH and moisture content of the soil.
Human Health Toxicity Summary [1,2,3,4]	
Chronic Repeated Dose Toxicity	Based on the available data, repeated inhalation exposure to sulphur dioxide is associated with local effects. The airway response to the chemical indicates a defence mechanism to local irritation, such as mild to moderate pathological changes in tracheal and lung tissues, that may lead to persistent defects with prolonged exposure. In a non-guideline study, three groups of male Sprague-Dawley (SD) rats (70/group) were treated with 0, 10, or 30 ppm (0, 28.2, or 84.6 mg/m^3) sulphur dioxide for 21 weeks (six hours/day, five days/week) by whole body exposure. Mild to moderate pathological changes in tracheal and lung tissues were detected at the 10 and 30 ppm groups, with no significant recovery detected in the respiratory tract during the four-week post-exposure period. In another non-guideline study, male SD rats were exposed to 1 ppm (2.8 mg/m^3) sulphur dioxide for either four or eight months (five hours/day, five days/week) by whole body exposure. Temporary bronchiolar epithelial hyperplasia was observed at four months only. Respiratory function was impaired at four months (not examined at eight months). No other details of the study were provided. No adverse systemic effects were reported in multiple non-guideline chronic or subchronic studies in dogs, rats, guinea pigs and cynomolgous monkeys treated daily for various durations and a range of concentrations of the chemical.
Carcinogenicity	Based on the available data, the chemical is not considered to be carcinogenic. In a non-guideline study, male SD rats were exposed to 10 or 30 ppm (28.2 or 84.6 mg/m^3) sulphur dioxide for 21 weeks (six hours/day, five days/week) and followed for up to two years. The rats exposed to the chemical had normal survival and showed increases in tumour occurrence over their lifetimes. Lack of carcinogenic potential was supported by another nonguideline study, where no increases in lung tumours were seen in rats (sex and strain not specified) exposed chronically to 10

	ppm sulphur dioxide for 534 days (five hours/day, five days/week) and observed for further 260 days. In a non-guideline study, male and female mice (strain not specified) treated with daily short-term exposures (five minutes/day, five days/week) to a high concentration of 500 ppm (1410 mg/m^3) sulphur dioxide over their lifetime (300 days or more) had increased incidence and larger primary lung tumours at an earlier age when compared to untreated controls.
Mutagenicity/ Genotoxicity	Based on the available data, the chemical is potentially mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the available data, the chemical is not considered to be a reproductive toxicant. Some evidence exists for the chemical to potentially cause developmental toxicity.
Acute Toxicity	In a non-guideline study, male CD-1 rats (8/dose) were exposed to sulphur dioxide gas concentrations of 224, 593, 965, 1168, or 1319 ppm (632, 1670, 2720, 3295, or 3720 mg/m^3) for four hours and observed for 14 days following exposure. The median lethal concentration (LC50) was between 965–1168 ppm/4 hours. No deaths occurred at the 593 ppm concentration, while the 1319 ppm concentration was lethal to 100% of rats. Clinical signs included respiratory difficulties followed by exhaustion and death. In another non-guideline study, male Syrian hamsters were exposed to sulphur dioxide gas at concentrations of 40, 200, or 400 ppm (113, 564, or 1130 mg/m^3) for 4–6 hours. All hamsters died due to development of respiratory distress following exposure to 400 ppm of the chemical. No deaths occurred at 40 and 200 ppm. Ciliary loss in the trachea was observed at 40 and 200 ppm. The calculated LC50 values of sulphur dioxide for male Swiss mice were 9,600 ppm (27,080 mg/m^3)/ 5 min, 4,800 ppm (13,540 mg/m^3)/ 10-min, 3,800 ppm (10,720 mg/m^3)/ 15-min, and 3,400 ppm (9,590 mg/m^3)/ 30-min. Clinical signs and cause of deaths were not reported.
Irritation	Sulphurous acid, which is formed when sulphur dioxide comes in contact with moist surfaces, is the primary cause of irritation and corrosivity of the chemical
Sensitisation	Available data suggest potential respiratory sensitisation potential for the chemical. In a non-guideline study, male Dunkin-Hartley or female Dunkin-Hartley Pirbright-White guinea pigs were exposed to 0.1–16 ppm (0.28–45.1 mg/m^3) sulphur dioxide for five to eight hours a day for five consecutive days, and additionally exposed to ovalbumin aerosol on days 3, 4 and 5 for 45 minutes/day, followed by provocation on day 13 by 1 % ovalbumin aerosol. Exposure to the chemical at the low concentration of 0.1 ppm significantly enhanced the development of ovalbumin-induced asthmatic reactions (increases in airway resistance and infiltration of inflammatory cells and epithelial damage in bronchial and lung tissue) in guinea pigs. Exposure to sulphur dioxide alone had no effect. In another non-guideline study, male Hartley guinea pigs (12/group) were exposed to sulphur dioxide. The initial phase consisted of intraperitoneal (i.p.) injection of 10 mg Candida albicans in physiological saline vehicle. Two weeks later, the guinea pigs were exposed to 5 ppm of the chemical 30 times (four hours/day, five days/week). Two weeks after exposure to the chemical, the animals were exposed to C. albicans for 30 minutes. Exposure of guinea pigs to the chemical increased sensitivity to C. albicans and resulted in significantly increased numbers of animals with prolonged expiration and/or inspiration and in a decrease of respiratory rate and even mortality in 25% of sulphur dioxide exposed animals.
Health Effects Summary	The critical health effects for risk characterisation include local effects (corrosive effects on the eyes, skin and respiratory tract).
Key Study/Critical Effect for Screening Criteria	An minimal risk level (MRL) of 0.01 ppm has been derived for acute-duration exposure (14 days or less) to sulphur dioxide. This MRL is derived from the study by Sheppard et al. (1981) in which exercising mild asthmatics were exposed to ≥0.1 ppm sulphur dioxide for 10 minutes. The two most sensitive subjects developed slight bronchoconstriction after inhaling 0.1 ppm sulphur dioxide (ATSDR).
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Sulphur dioxide, however, is a gaseous substance and does not remain present in the aquatic environment under this form: Sulphur dioxide will react with water (or water vapour) to form sulphurous acid. Consequently, an E(L)C50, EC10 or NOEC

	expressed as mg SO2/L cannot be determined (i.e., no acute or chronic reference values can be generated). Secondly, as SO2 is not present in the aquatic compartment for a relevant time period, this substance will not cross biological membranes, or will not interact with it in another way.
Determination of PNEC aquatic	Not determined
Current Regulatory Controls[1,5]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Acute toxicity – category 3 Skin corrosion – category 1B Gases under pressure
Australian Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): Time-weighted average (TWA) of 5.2 mg/m^3 (2 ppm) Short-term exposure limits (STEL) 13 mg/m^3 (5ppm)
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (occupational exposure limit (OEL) or TWA) of 1 – 5.3 mg/m^3 and STEL of 5-13 mg/m^3 in most countries. The STEL established by American Conference of Governmental Industrial Hygienists (ACGIH) is 0.25 ppm (0.7 mg/m^3). The chemical is included in US NIOSH Substances Immediately Dangerous to Life or Health (IDLH) List at a level of 100 ppm (282 mg/m^3). US Department of Energy (DOE) has Temporary Emergency Exposure Limits (TEELs) for Protective Action Criteria (PAC): PAC-1 at 0.2, PAC-2 at 0.75 and PAC-3 at 30 ppm (84.6 mg/m^3).
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic substance, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to this inorganic substance.
T criteria fulfilled?	Not applicable.
Overall conclusion	It is not currently possible to categorise the environmental hazards of inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

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Toxicity Summary - 1,3,5-Triazine-1,3,5(2H,4H,6H)-triethanol

Chemical and Physical Properties[1,2,3]	
CAS number	4719-04-4
Molecular formula	C9H21N3O3
Molecular weight	219.28
Solubility in water	Miscible at 20°C and at pH 5, 7, and 9
Melting point	-79 °C
Boiling point	110.1°C at 101.325 kPa
Vapour pressure	0 Pa at 25 °C
Henrys law constant	0 Pa m^3/mol at 25 °C
Explosive potential	Non-explosive
Flammability potential	Not classified
Colour/Form	Viscous yellow liquid
Overview	The substance in is generally used as a biocide to control bacterial growth.
Environmental Fate[1]	
Soil/Water/Air	After evaporation or exposure to the air, the substance will be rapidly degraded by photochemical processes. Based upon a calculated log Koc adsorption to soil phase is not expected. From the water surface the substance will not evaporate into the atmosphere. The substance will preferentially distribute into the compartment water.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a subchronic oral toxicity study in Wistar rats with administration of the test substance in drinking water for 3 months, the NOAEL was determined to be 64 mg/kg/day based on reduced water consumption at this dose level but without any corroborating changes in-life or pathologically (BASF SE, 2002). In a repeated dose oral toxicity 90-day study conducted according to the OECD TG 442, the chemical was administered to Wistar CrlGlxBrlHan rats (10/sex/dose) at dietary concentrations of 200 ppm (14 mg/kg bw/day in males; 21 mg/kg bw/day in females), 1000 ppm (64 mg/kg bw/day in males; 91 mg/kg bw/day in females), and 5000 ppm (285 mg/kg bw/day in males; 339 mg/kg bw/day in females). The animals were observed for signs of toxicity or mortality up to twice a day for 3 months. At the end of the study, neither mortality nor clinical symptoms of toxicity were observed, and the appearance and behaviour of the animals showed no treatment related changes. Repeat dose exposure to the chemical via dermal route is not considered to be hazardous. In a subchronic dermal toxicity 90-day study, male and female Charles River rats (10 animals per sex per dose) were treated with the chemical under semi-occlusive conditions for 6 hours/day, 5 days/week for 90 days. Doses were 0, 5, 50 or 250 mg/kg bw/day. The application site was not washed between doses. No mortality occurred during the test. There were no treatment related clinical signs. Yellow staining at the site of application in the 50 and 250 mg/kg bw/day groups was seen. In a repeated dose inhalation toxicity study (OECD Guideline 412) Wistar rats (10 animals per sex per dose) were exposed (nose only) to the aerosol chemical at 3, 10, 30 and 100 mg/m^3. The highest concentration was decreased to 50 mg/m^3 after the first exposure day for females and the second exposure day for males due to clinical signs indicative of a severe irritant response. The animals were exposed for 6 hrs/day for 5 consecutive days per week for 4 weeks. The target concentrations were maintained throughout the exposure period. Severe clinical signs of toxicity (gasping, intermittent respiration, respiration sound, red encrusted nose, hypothermia, poor general state and yellow discoloured fur), significantly reduced body weight change in males and premature death of 5 of the 10 males were observed in the highest dose group (initially 100 mg/m^3, then lowered to 50 mg/m^3). In the 30 mg/m^3 and 10 mg/m^3 groups, intermittent respiration, rales, red

	encrusted nose, squamous metaplasia occurred in all treated groups. The presence of erosion/ulceration of the larynx, squamous metaplasia of the nasal cavity, squamous metaplasia of the carina epithelium, necrosis of the u-shaped cartilage of the larynx, epithelial hyperplasia of the larynx and degeneration of the bronchial epithelium for both sexes were noted. In the lowest dose group (3 mg/m^3): multifocal squamous metaplasia of the larynx in all animals; necrosis of the u-shaped cartilage of the larynx in 1/10 males; degeneration of the bronchial epithelium in 3/10 males and 7/10 females and squamous metaplasia of the carina epithelium in 4/10 males and 3/10 females were noted). In conclusion, exposure of male and female Wistar rats to the aerosol of the chemical caused concentration-related local irritation of the respiratory tract. Systemic toxicity was not observed in clinical chemistry, haematology or in histological examinations up to 30 mg/m^3. The reduced body weight gain and premature death were considered to be associated with the severe local irritation. Based on histopathology findings in larynx, trachea and lung, a no observed adverse effect concentration (NOAEC) could not be established for the local irritation effect under the current study conditions. For systemic effects the NOAEC is 30 mg/m^3.
Carcinogenicity	Carcinogenicity studies for the chemical are not available. In a poorly documented dermal study with only limited number of animals (NMRI mice), limited scope of parameters examined and with short study duration, the chemical did not result in any carcinogenic effects. Many methodological details of the study are lacking. The test substance was applied to a shaved area of the upper part of the back. Applications, 0.15%, 1.5 % and 15% of the chemical (purity not specified) were made three times a week, over 31 consecutive weeks. All mice survived to the end of the study. Slight dysplasia was reported in two high-dose animals. Hyperplasia occurred in one mid-dose and seven high-dose mice. Three of the high-dose animals had degenerative changes (amyloid deposition) in the kidney, but not the spleen or liver. The test substance did not induce papillomas. No information is provided on clinical observations in the treated animals.
Mutagenicity/ Genotoxicity	Genotoxicity potential of the chemical was tested in several in vitro and in vivo genotoxicity tests. Based on the weight of evidence from the available data, the chemical is not considered to be genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Studies for reproductive toxicity are not available. In a prenatal developmental toxicity study in rats, artificially inseminated female Sprague-Dawley rats (24/group) were administered the aqueous chemical (78.5% 1,3,5-tris(2-hydroxyethyl)hexahydro-1,3,5-triazine) by gavage at doses of 0, 250, 500, and 750 mg/kg/day in deionised water on gestation days 6 through 15. All animals survived the duration of the study. High dose females exhibited post-dosing salivation. Rales, laboured breathing, wheezing, and tachypnea were observed occasionally in the mid and high dose groups toward the end of the dosing period. No other clinical signs were reported. Maternal body weight gain and food consumption were significantly lower in the high dose females during the dosing period than the controls. Stomach lesions characterised by ulceration and/or scarring of the mucosa were observed in 14 of 20 high dose females. No gross abnormalities were reported in the other dosage groups. No differences were seen between the control and treated dams with respect to pregnancy rates, number of corpora lutea, implantation sites, number of live foetuses, or early and late resorptions. There were no abortions and no premature deliveries. At these doses, developmental toxicity as measured by foetal pup weight, external, or visceral, abnormalities was not seen. There were increased incidences of vestigial 14th ribs and retarded ossification of the vertebral thoracic centra which appeared to be dose-related. The effects were not statistically significant, and the incidence of these abnormalities is highly variable in rats, they are not considered treatment related. The maternal no observed adverse effect level (NOAEL) is 500 mg/kg bw/day, based on decreased body weight gain, ulcerations and/or scarring of the stomach mucosa at the higher dose. The NOAEL for developmental toxicity is 750 mg/kg bw/day.
Acute Toxicity	In the only available oral acute toxicity study (OECD Guideline 401) groups of 10 fasted Wistar rats (5 per sex) were given a single oral dose of the test substance at dose levels of 500, 1000 or 2000 mg/kg bw. Four males and all females in the 2000 mg/kg bw dose group and two males and four females in the 1000 mg/kg bw

	dose group died within two days after administration. Necroscopy findings of the animals that died included agonal congestion, erythema, erosion in the glandular stomach and discolouration of the mucosa of the forestomach and the glandular stomach. Observed sub-lethal effects included general depressed activity, staggering, paresis and diarrhoea. The median lethal dose (LD50) was calculated as 763 mg/kg bw in rats. The chemical has low acute toxicity based on results from an animal test following dermal exposure. The LD50 in rats in this study was >4000 mg/kg bw. The chemical has high acute toxicity following inhalation exposure based on results from animal tests. The median lethal concentration (LC50) in rats is 0.371 mg/L.
Irritation	The chemical did not cause irritation to the skin in rabbits exposed dermally to 0.5 mL of the unchanged substance for four hours via a test patch moistened with the substance. Slight irritation was observed in rabbits administered 0.1 mL of the chemical in the conjunctival sac of the right eye but was reversible within 8 days. No eye lesions remained in any of the test animals at the end of the three-week observation period
Sensitisation	The substance was considered to be a skin sensitiser in studies with guinea pigs. Case studies on humans have indicated that the chemical is a skin sensitising agent.
Health Effects Summary	The critical health effects for risk characterisation include acute toxicity effects from oral and inhalation exposure and skin sensitisation.
Key Study/Critical Effect for Screening Criteria	The subchronic oral repeated dose toxicity in rats was considered the most sensitive endpoint with a NOAEL of 64 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	Fish: LC50 (4 days) 16.07 - 240.04 mg/L LC100 (4 days) 58.9 mg/L Invertebrates: EC50 (48 h) 11.9 mg/L LC50 (48 h) 60.67 mg/L EC100 (48 h) 17.5 mg/L Algae: EC50 for freshwater algae: 6.6 mg/L EC50 for marine water algae: 21 mg/L EC10 or NOEC for freshwater algae: 3.4 mg/L EC10 or NOEC for marine water algae: 10 mg/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 1000 is applied to the lowest EC50 of 6.6 mg/L (algae). A PNECaqua of 7 µg/L was derived.
Current Regulatory Controls[2,4,5,6]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HCIS): Skin sensitisation – category 1 Specific target organ toxicity (repeated exposure) – category 1 Acute toxicity (inhalation) - category 3 Acute toxicity (ingestion) - category 4
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica). US DOE Temporary Emergency Exposure Limits (TEELs) TEEL 1: 2.3 mg/m^3; TEEL 2: 25 mg/m^3 and TEEL 3: 150 mg/m^3.

Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable.
B/vB criteria fulfilled?	No. Based on Log Kow = -2.3 - -1.3 at 24 °C and pH 5 – 9 (Log Kow < 4.2)
T criteria fulfilled?	No. Acute toxicity data >1 mg/L in fish, invertebrates and algae, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

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Toxicity Summary - Zinc

Chemical and Physical Properties[1,2,3,4]	
CAS number	7440-66-6
Molecular formula	Zn
Molecular weight	65.38
Solubility in water	Insoluble
Melting point	409°C
Boiling point	No data
Vapour pressure	1 at 487°C
Henrys law constant	Not applicable
Explosive potential	No data
Flammability potential	Not flammable
Colour/Form	Bluish-white, shiny metal
Overview	Zinc is a naturally occurring element found in the earth's surface rocks. Because of its reactivity, zinc metal is not found as the free element in nature. Powdered zinc is explosive and may burst into flames if stored in damp places. Zinc is found in the air, soil, and water and is present in all foods. Metallic zinc is used in industry to coat steel and iron as well as other metals to prevent rust and corrosion. Metallic zinc is also mixed with other metals to form alloys such as brass and bronze. Metallic zinc is also used to make dry cell batteries. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[3]	
Soil/Water/Air	Zinc partitions to the air, water, and soil. Zinc occurs in the environment mainly in the +2 oxidation state (ATSDR, 2005). Adsorption is the dominant fate of zinc, resulting in enrichment of zinc in suspended and bed sediments. Zinc can occur in both suspended and dissolved forms in surface water. In the aquatic environment, zinc partitions to sediments or suspended solids in surface waters through sorption onto hydrous iron and manganese oxides, clay minerals, and organic material. The transport of zinc in the aquatic environment is controlled by anion species. In natural waters, complexing agents, such as humic acid, can bind zinc. The stability of zinc complexes depends on the pH of the water and the nature of the complex. Zinc sorbs strongly onto soil particulates. The mobility of zinc in soil depends on the solubility of the speciated forms of the element and on soil properties such as cation exchange capacity, pH, redox potential, and chemical species present in soil.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Following longer-term exposure to lower doses (~0.5–2 mg zinc/kg/day) of zinc compounds, the observed symptoms generally result from a decreased absorption of copper from the diet, leading to early symptoms of copper deficiency. The most noticeable manifestation of the decreased copper levels is anaemia, manifesting as decreased erythrocyte number or decreased hematocrit. High-dose zinc administration has also resulted in reductions in leukocyte number and function. Some studies have also found decreases in high-density lipoprotein (HDL) levels in humans exposed to increased levels of zinc; however, not all studies have confirmed this observation. Long-term consumption of excess zinc may also result in decreased iron stores, although the mechanism behind this effect is not presently clear.
Carcinogenicity	Available studies of zinc-induced carcinogenic effects in humans and animals following both oral or inhalation exposure have not adequately demonstrated an increase in cancer incidence following long term exposure to zinc compounds.

Mutagenicity/ Genotoxicity	Genotoxicity studies conducted in a variety of test systems have failed to provide evidence for mutagenicity of zinc. However, there are indications of weak clastogenic effects following zinc exposure.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Available studies have not presented evidence of reproductive or developmental effects in humans or animals following inhalation of zinc compounds. Effects on reproductive or developmental end points have been noted in oral-exposure animal studies, but generally only at very high doses (>200 mg/kg/day).
Acute Toxicity	The effects of inhalation exposure to zinc and zinc compounds vary somewhat with the chemical form of the zinc compound, but the majority of the effects seen will occur within the respiratory tract. Following inhalation of zinc oxide, and to a lesser extent zinc metal and many other zinc compounds, the most commonly reported effect is the development of “metal fume fever” which is characterized by chest pain, cough, dyspnoea, reduced lung volumes, nausea, chills, malaise, and leucocytosis. Symptoms generally appear a few hours after exposure and are reversible 1–4 days following cessation of exposure.
Irritation	Not irritating.
Sensitisation	Not sensitising.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The chronic reference dose (RfD) was based on the average LOAEL of 0.91 mg/kg/day for blood effects observed in four principal studies on male and female adults.
Ecological Toxicity[1,5]	
Aquatic Toxicity	Fish: 24 µg/L (Oncorhynchus tshawytscha; from LC50) to 1316 µg/L (Ptylocheilus oregonensis; from LC50). Amphibians: Ambystoma opacum, 180 µg/L (from LOEC). Crustaceans: 5.5 µg/L (C. dubia; from LC50) to 25.3 µg/L (C. dubia). Molluscs: 54 µg/L (Dreissena polymorpha) to 11,200 µg/L (Velesunio ambigua), a NOEC of 487 µg/L was measured for Physa gyrina. Annelid: one species, Limnodrilus hoffmeisteri, 560 µg/L (from LC50).
Determination of PNEC aquatic	The PNECaquatic (freshwater) is determined to be 20.6 µg/L.
Current Regulatory Controls[5,6,7,8]	
Australian Hazard Classification	H260 (In contact with water releases flammable gases which may ignite spontaneously) H250 (Catches fire spontaneously if exposed to air) H410 (Very toxic to aquatic life with long-lasting effects)
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	An exposure limit for zinc and its inorganic compounds (inhalable fraction) (TWA) of 2 mg/m^3 and (respirable fraction) (TWA) of 0.1 mg/m^3 in Germany.
Australian Food Standards	Tolerable limit = 45 mg/person/day
Australian Drinking Water Guidelines	Based on aesthetic considerations (taste), the concentration of zinc in drinking water should be less than 3 mg/L. No health-based guideline value is proposed for zinc.
Aquatic Toxicity Guidelines	A freshwater and marine high reliability trigger value of 8 µg/L was calculated for zinc.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (zinc is an essential element and is ubiquitous in environment).

B/vB criteria fulfilled?	No. As an essential element, zinc is commonly regulated by the organism and do not bioaccumulate or biomagnify.
T criteria fulfilled?	Not applicable. Zinc is an essential nutrient for all living organisms.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

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Toxicity Summary - Distillates (Fischer-Tropsch), C8-26-branched and linear

Chemical and Physical Properties[1,2]	
CAS number	848301-67-7
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	1 mg/L at 20°C and pH 5.1 - 5.3
Melting point	-20°C
Boiling point	218 - 357 °C at 101.1 kPa
Vapour pressure	0.54 Pa at 25°C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Colourless, liquid, mild-paraffinic odour
Overview	Gas-to-liquid (GTL) products are synthetic hydrocarbons produced from natural gas using a Fischer–Tropsch process. This process yields a synthetic crude oil that consists of saturated hydrocarbons, primarily linear alkanes, with increasing amounts of branched (methyl-groups) alkanes as the chains get longer. In addition, small amounts of cycloalkanes (branched cyclopentanes and cyclohexanes) may be formed as the polymerisation reaction prolongs. This synthetic crude can subsequently be refined to a range of products very similar to petroleum refining. However, in contrast to their petroleum-derived analogues, GTL products are essentially free of unsaturated or aromatic constituents and also no sulphur-, oxygen-, or nitrogen-containing constituents are present.
Environmental Fate[1]	
Soil/Water/Air	The substance is expected to be readily biodegradable. It has a Log Koc of > 5.63 and is expected to be immobile in soils. If released into water, the substance is expected to adsorb to suspended solids and sediment based upon the Log Koc.
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	NOAEL (rat, oral): 200 mg/kg bw/day
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	The substance was found to be non-mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	The acute oral median lethal dose (LD50) of the test material in the female Sprague-Dawley CD strain rat was estimated to be greater than 5000 mg/kg bodyweight.
Irritation	Not irritating based on read across data.
Sensitisation	Not sensitising based on read across data.
Health Effects Summary	The critical health effect for risk characterisation is chronic repeated dose toxicity from oral exposure.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity in rats via oral exposure was considered the most sensitive endpoint with a NOAEL of 200 mg/kg bw/day.

Ecological Toxicity [1,8]	
Aquatic Toxicity	Short-term toxicity: NOEC (48 h): 1000 mg/L (fish) LC50 (7 day): >100000 mg/L (fish) EL50 (72 h): >1000 mg/L (invertebrates) EL50 (48 h): 1000 mg/L (crustaceans) EL50 (72 h): 1000 mg/L (algae) Long-term toxicity: NOEL (33 day): >100 mg/L (fish) NOEL (21 day): <100 mg/L (invertebrates)
Determination of PNEC aquatic	Based on the lowest chronic endpoint for aquatic toxicity (100 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 1 mg/L.
Current Regulatory Controls [2,3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[3] µg/L (ANZECC, 2000)
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. Readily biodegradable.
B/vB criteria fulfilled?	No. Based on log BCF of 3.17 or BCF of 1479.
T criteria fulfilled?	No. Acute toxicity data >1 mg/L in fish and invertebrates, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2022

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Toxicity Summary - Fatty acids, tall-oil, reaction products with polyethylenepolyamines

Chemical and Physical Properties[1]	
CAS number	68910-93-0
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available.
Melting point	-85 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified
Colour/Form	Liquid
Overview	This substance is used by consumers, in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
Environmental Fate[1]	
Soil/Water/Air	One study investigating the adsorption/desorption behaviour of Fatty acids, tall-oil, ethoxylated (CAS 61791-00-2) is available. The study was performed according to GLP and OECD guideline 121 (BASF 2017). 6 different peaks were observed with log Koc values ranging from < 1.8 to > 5.63. The two main components (> 85%) show log Koc values > 4. Thus, adsorption of Fatty acids, tall-oil, ethoxylated to solid soil is expected. The test with the source substance was conducted according to OECD Guideline 301B, under GLP conditions (BASF 2005). Domestic, non-adapted activated sludge was exposed to the test substance for 28 days at 22°C, and biodegradation was measured by CO2 consumption. After 28 days, the test substance reached a biodegradation of 90 - 100 %. Based on the results for the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable. The test substance consists of components with log Kow values in the range of 5 to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological mebranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be bioaccumulative.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats.
Carcinogenicity	No data available.

Mutagenicity/ Genotoxicity	The test substance is not mutagenic in bacteria, as determined in an OECD 471 study. The test substance is not chromosome damaging, as determined in an OECD 487 study. The test substance is not mutagenic in mammalian cells, as determined in an OECD 476 study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of the test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats. The NOAEL for reproductive performance and fertility was set to 1000 mg/kg bw/d for male and female Wistar rats.
Acute Toxicity	In an acute oral toxicity study performed similar to OECD guideline 401 (BASF 1971), three groups of rats consisting of 10 animals/sex/dose were treated by single gavage application with an aqueous solution of the test substance (10000, 8000, 6400 mg/kg bw). The animals were observed for mortality and for clinical symptoms of toxicity over a period of 7 days. At the end of the observation period, the surviving animals were sacrificed for the purpose of necropsy. No mortality occurred at the tested concentrations. At all doses mastication, irregular breathing, redness of the eyes and closed eyes were seen immediately after dosing. The next morning mastication and irregular breathing was observed. On the following days, no clinical sings were observed. Pathological examination revealed hydrometra in 3 animals exposed to 10000 mg/kg bw, 2 animals exposed to 8000 mg/kg bw, and 3 animals exposed to 6400 mg/kg bw. Based on the results obtained under the test conditions of this study, the acute oral LD50 was determined to be > 10000 mg/kg bw. To evaluate the potential acute inhalation toxicity of the test substance an Inhalation Risk Test conducted according to a BASF internal testing method (BASF 1971). The test demonstrates the toxicity of an atmosphere saturated with vapours of the volatile components of a test substance at the temperature chosen for vapour generation (20 °C). Rats were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. The animals were exposed for 8 hour. The exposure concentration was estimated to be 0.28 mg/L based on evaporated substance. In addition to mortality, clinical signs were recorded and necropsy on surviving animals performed. No mortality occurred and no clinical sign were noted during exposure and observation period. In one animal exposed for 8 hours hydrometra was observed after necropsy. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. In another Inhalation Risk Test of similar design, Rats (12 animals) were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. This time vapours were generated at 20 °C as well as 50 °C. The exposure concentrations were 0.04 mg/L and 0.34 mg/L. Rats were exposed for 8 hour. As in the previous study, no mortality occurred after exposure up to 8 hours. Clinical sings observed in the animals exposed to the vapour generated at 20°C included mild escape attempts when exposure began and at the end of the exposure period slight eye irritation was observed. The next day, the animals were without symptoms. In the animals exposed to the vapour generated at 50 °C escape attempts were noted in the first 60 minutes of exposure. Exposure to the saturated atmosphere caused slight eye irritation. At the end of the exposure period, all clinical signs were resolved. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. Based on the inhalation studies, no conclusion on LC50 can be drawn, because the tested concentrations are too low in relation to the classification criteria.
Irritation	The test substance was not irritant or corrosive to the skin in a GLP-compliant OECD 431 and 439 study. The test substance was not irritant to the eyes in a GLP-compliant OECD 492 study.

	Based on the available information, classification for skin and eye irritation is not warranted, in accordance with EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation No. (EC) 1272/2008.
Sensitisation	The test substance did not show an indication of skin sensitising potential in an OECD 429 (LLNA) study. However, an earlier Buehler test (OECD 406) did indicate skin sensitising potential of the substance.
Health Effects Summary	Possible sensitiser.
Key Study/Critical Effect for Screening Criteria	The NOAEL for general systemic toxicity of 1000 mg/kg bw/d was selected as the key study.
Ecological Toxicity [1]	
Aquatic Toxicity	Short-term toxicity tests with the target substance for all trophic levels (fish, daphnia, algae) are available. The test substance did not indicate to be harmful to freshwater fish (96h-LL50 > 100 mg/L), but showed to be toxic to aquatic invertebrates (48h-EL50 = 12.41 mg/L) and harmful to algae (72h-EL50 = 39.7 mg/L). Hence, aquatic invertebrates were most susceptible to the test substance and this effect value was used for the PNEC derivation. Long-term toxicity data with the source substance are only available for algae. The algal test revealed the substance to be of low toxicity to algae (72h-EL10 = 7.08 mg/L). In addition, data are available for toxicity to microorganisms. A test on respiration inhibition with activated sludge resulted in an 3h-EC10 of > 10000 mg/L indicating that detrimental effects in STPs are not to be expected.
Determination of PNEC aquatic	A PNECaqua = 0.012 mg/L can be calculated based on the lowest acute toxicity value (EL50 = 12.41 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 1000.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Based on the results from the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable.
B/vB criteria fulfilled?	No. The test substance consists of components with log Kow values of > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological membranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be B or vB.
T criteria fulfilled?	No. Available short-term and long-term toxicity tests with aquatic organisms resulted in effect values > 1 mg/L. Thus, this substance does not meet the screening criteria for toxicity.

Overall conclusion	Not PBT
Revised	January 2022

References

1. ECHA REACH, Fatty acids, tall-oil, ethoxylated, Retrieved 2019: https://echa.europa.eu/

Toxicity Summary - Mineral Oil

Chemical and Physical Properties[1,2,3]	
CAS number	8042-47-5
Molecular formula	UVCB
Molecular weight	UVCB
Solubility in water	Insoluble
Melting point	-60 - 0 °C at 101.3 - 101.325 kPa
Boiling point	218 - 800 °C at 101.3 kPa
Vapour pressure	10 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Liquid, odourless
Overview	A highly refined petroleum mineral oil consisting of a complex combination of hydrocarbons obtained from the intensive treatment of a petroleum fraction with sulphuric acid and oleum, or by hydrogenation, or by a combination of hydrogenation and acid treatment. Additional washing and treating steps may be included in the processing operation. It consists of saturated hydrocarbons having carbon numbers predominantly in the range of C15 through C50. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[3]	
Soil/Water/Air	The environmental fate assessment of these chemicals indicates they have low to very low vapor pressures, very low solubility in water, high octanol-water partition coefficients, and high sorption to organic matter. Thus, these chemicals will exhibit very poor migration, due to their high sorption and low solubility in water, as well as low potential for volatility. Fugacity modelling suggests they would remain partitioned to the terrestrial phase, remaining sorbed to soil or the foliar surfaces to which they are applied.
Human Health Toxicity Summary [2,3]	
Chronic Repeated Dose Toxicity	The effects of long-term exposure include possible dermatitis with repeated or prolonged contact with skin
Carcinogenicity	Evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals.
Mutagenicity/ Genotoxicity	The mutagenicity of various test materials were all characterized as being non-mutagenic, in general, but with problems due to the presence of suspended oil droplets, due to the poor water solubility of the test materials.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	It was concluded from dermal dosing studies, that mineral oil had no effects (on mortality, clinical signs of toxicity, body weight, food consumption, absolute organ weights, microscopic changes in reproductive organs of parental animals, number of corpora lutea, implantation sites, live pups per litter, no gross anomalies, and body weights of pups or weight gains of pups). In a 4-week inhalation study, there were no treatment related effects on sperm morphology. In a one-generation reproduction study, both males and females were dosed by gavage, and there were no adverse effects (no clinical findings, growth weights and food consumption was normal, no effects on fertility and mating indices in either males or females, and at necropsy, organ weights and histopathology were considered normal by the study authors). Two other studies were reported with white mineral oil, both via single daily gavage doses. In one study, both sexes were dosed, and some effects were observed, which the study authors concluded were within the “spectrum of malformations [which] occurs spontaneously in Sprague-Dawley rat.” In the

	companion study in which only pregnant females were dosed, foetal effects were noted, but "the study authors considered these malformations to be minor and within the normal ranges for the strain of rat" (SpragueDawley). In general, these studies were performed at very high dosages, from about 900 mg/kg-bw/day (1 mL/kg-bw/day) to about 4500 mg/kg-bw/day (5 mL/kg-bw/day).
Acute Toxicity	A short-term exposure duration dermal NOAEL of 2000 mg/kg/day was observed in a 28-day repeat-dose study, in which no adverse effects were observed at the highest test concentration (2000 mg/kg/day). A short-term exposure duration inhalation LOAEL of 146.64 mg/kg/day was observed in a 28-day inhalation study. Adverse effects were reported at the lowest exposure dosage, 0.5 mg/L, based on the following observations: (1) multiple lung effects, (2) increased white blood cell counts in males, (3) increased absolute liver weight, (4) accessory spleens and/or abnormally coloured spleens, and (5) additional microscopic findings. An intermediate-term exposure duration inhalation NOAEL of 26.1 mg/kg/day was observed in a 90-day inhalation study, in which effects were observed at 0.9 mg/L, but there were no adverse effects observed at 0.1 mg/L
Irritation	Slight eye irritation in rats and rabbits.
Sensitisation	Not a dermal sensitizer.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The intermediate-term inhalation NOAEL of 26.1 mg/kg/day, derived from a 90-day inhalation study, based on effects observed at 0.9 mg/L, with no adverse effects observed at 0.1 mg/L was considered the most sensitive endpoint.
Ecological Toxicity [1]	
Aquatic Toxicity	Rainbow trout 96 hr LL50 (48 h) 100 mg/L
Determination of PNEC aquatic	This substance has a low acute toxicity concern to aquatic organisms and thus required no further assessment.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	MAK: (respirable fraction): 5 mg/m^3; peak limitation category: II(4); pregnancy risk group: C
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. Not readily biodegradable based on read across study.
B/vB criteria fulfilled?	Not applicable. This substance is a UVCB.
T criteria fulfilled?	No. The acute LL50 value in fish is >1 mg/L. Thus, it does not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2022

References

1. ECHA REACH, White mineral oil (petroleum), Retrieved 2022: https://echa.europa.eu/.
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/
3. USEPA 2007. Revised Reregistration Eligibility Decision for Aliphatic Solvents, 29 November 2007. US Environmental Protection Agency Office of Pesticide Programs.
4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Partially hydrolysed polyacrylamide

Chemical and Physical Properties[1,2,3,4]	
CAS number	9003-05-8
Molecular formula	(C3H5NO)x
Molecular weight	1,000,000 to > 50,000,000 g/mol for polyacrylamide copolymers used as flocculants
Solubility in water	Water soluble
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Polyacrylamide polymers can exist in cationic, anionic or non-ionic forms, depending on their ionic charge. The non-ionic form of polyacrylamide is generated from the basic polymerisation of acrylamide. Anionic polyacrylamide polymer can then be formed from the hydrolysis of the acrylamide homopolymer either simultaneously during the polymerisation process or as a subsequent step. Anionic polyacrylamide polymer can also be formed from the copolymerisation of acrylamide and acrylic acid. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [3]	
Soil/Water/Air	No studies on the environmental fate of anionic polyacrylamide are available. As a high-molecular weight, water-soluble polymer, it is not expected to biodegrade or bioaccumulate. The environmental fate of anionic polyacrylamide will be determined primarily by adsorption. The polyanions in this group are expected to partition onto natural colloids in surface waters and in soil and are not expected to undergo long-range transport in the environment.
Human Health Toxicity Summary [1,2,4]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	Mouse LD50 (oral): 12950 mg/kg Rabbit LD50 (oral): 11250 mg/kg Rat LD50 (oral): >1000 mg/kg
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.

Key Study/Critical Effect for Screening Criteria	The oral acute toxicity in rats was considered the most sensitive endpoint with a LD50 of 1000 mg/kg.
Ecological Toxicity [3]	
Aquatic Toxicity	Fathead minnow LC50: 810 mg/L Rainbow trout LC50: > 100 mg/L Bluegill sunfish LC50: >300 mg/L Daphnia magna LC50: 470 mg/L
Determination of PNEC aquatic	Anionic polyacrylamide has a low acute toxicity concern to aquatic organisms and thus required no further assessment.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	Yes. Anionic polyacrylamide is a large molecular weight, water-soluble polymer. It is not expected to be readily biodegradable; thus, it meets the screening criteria for persistence.
B/vB criteria fulfilled?	No. Pharmacokinetic studies showed that anionic polyacrylamide was not bioavailable to rats when ingested; this is most likely due to its large size (high molecular weight) and presumed resistance to break down in the gastrointestinal tract. Anionic polyacrylamide is thus not expected to be bioavailable to aquatic or terrestrial organisms. It is not expected to meet the criteria for bioaccumulation.
T criteria fulfilled?	No. The acute LC50 values in fish and invertebrates are >1 mg/L. Thus, it does not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2022

References

1. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
3. EHS Support, Anionic Polyacrylamide. Available at: https://www.santos.com/wp-content/uploads/2021/04/Anionic-Polyacrylamide-March-2021.pdf. Retrieved February 2022.
4. ChemIDplus, Polyacrylamide, Retrieved February 2022: https://chem.nlm.nih.gov/chemidplus/rn/9003-05-8.
5. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
6. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Phosphoric ester of ethoxylated fatty alcohol

Chemical and Physical Properties[1]	
CAS number	68585-36-4
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available.
Melting point	-85 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified
Colour/Form	Liquid
Overview	This substance is used by consumers, in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
Environmental Fate[1]	
Soil/Water/Air	One study investigating the adsorption/desorption behaviour of Fatty acids, tall-oil, ethoxylated (CAS 61791-00-2) is available. The study was performed according to GLP and OECD guideline 121 (BASF 2017). 6 different peaks were observed with log Koc values ranging from < 1.8 to > 5.63. The two main components (> 85%) show log Koc values > 4. Thus, adsorption of Fatty acids, tall-oil, ethoxylated to solid soil is expected. The test with the source substance was conducted according to OECD Guideline 301B, under GLP conditions (BASF 2005). Domestic, non-adapted activated sludge was exposed to the test substance for 28 days at 22°C, and biodegradation was measured by CO2 consumption. After 28 days, the test substance reached a biodegradation of 90 - 100 %. Based on the results for the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable. The test substance consists of components with log Kow values in the range of 5 to > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological mebranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be bioaccumulative.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats.
Carcinogenicity	No data available.

Mutagenicity/ Genotoxicity	The test substance is not mutagenic in bacteria, as determined in an OECD 471 study. The test substance is not chromosome damaging, as determined in an OECD 487 study. The test substance is not mutagenic in mammalian cells, as determined in an OECD 476 study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of this Combined Repeated Dose Toxicity Study with the Reproduction/Developmental Toxicity Screening Test, the oral administration by gavage of the test substance to Wistar rats revealed no adverse signs of toxicity in male and female animals at a dose level of 1000 mg/kg bw/d. Thus, the no observed adverse effect level (NOAEL) for general systemic toxicity was 1000 mg/kg bw/d for male and female Wistar rats. The NOAEL for reproductive performance and fertility was set to 1000 mg/kg bw/d for male and female Wistar rats.
Acute Toxicity	In an acute oral toxicity study performed similar to OECD guideline 401 (BASF 1971), three groups of rats consisting of 10 animals/sex/dose were treated by single gavage application with an aqueous solution of the test substance (10000, 8000, 6400 mg/kg bw). The animals were observed for mortality and for clinical symptoms of toxicity over a period of 7 days. At the end of the observation period, the surviving animals were sacrificed for the purpose of necropsy. No mortality occurred at the tested concentrations. At all doses mastication, irregular breathing, redness of the eyes and closed eyes were seen immediately after dosing. The next morning mastication and irregular breathing was observed. On the following days, no clinical sings were observed. Pathological examination revealed hydrometra in 3 animals exposed to 10000 mg/kg bw, 2 animals exposed to 8000 mg/kg bw, and 3 animals exposed to 6400 mg/kg bw. Based on the results obtained under the test conditions of this study, the acute oral LD50 was determined to be > 10000 mg/kg bw. To evaluate the potential acute inhalation toxicity of the test substance an Inhalation Risk Test conducted according to a BASF internal testing method (BASF 1971). The test demonstrates the toxicity of an atmosphere saturated with vapours of the volatile components of a test substance at the temperature chosen for vapour generation (20 °C). Rats were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. The animals were exposed for 8 hour. The exposure concentration was estimated to be 0.28 mg/L based on evaporated substance. In addition to mortality, clinical signs were recorded and necropsy on surviving animals performed. No mortality occurred and no clinical sign were noted during exposure and observation period. In one animal exposed for 8 hours hydrometra was observed after necropsy. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. In another Inhalation Risk Test of similar design, Rats (12 animals) were exposed sequentially to the vapours, generated by bubbling 200 l/h air through a substance column of about 5 cm above a fritted glass disc in a glass cylinder. This time vapours were generated at 20 °C as well as 50 °C. The exposure concentrations were 0.04 mg/L and 0.34 mg/L. Rats were exposed for 8 hour. As in the previous study, no mortality occurred after exposure up to 8 hours. Clinical sings observed in the animals exposed to the vapour generated at 20°C included mild escape attempts when exposure began and at the end of the exposure period slight eye irritation was observed. The next day, the animals were without symptoms. In the animals exposed to the vapour generated at 50 °C escape attempts were noted in the first 60 minutes of exposure. Exposure to the saturated atmosphere caused slight eye irritation. At the end of the exposure period, all clinical signs were resolved. Since no mortality occurred at the concentrations tested an LC50 estimation cannot be made. Based on the inhalation studies, no conclusion on LC50 can be drawn, because the tested concentrations are too low in relation to the classification criteria.
Irritation	The test substance was not irritant or corrosive to the skin in a GLP-compliant OECD 431 and 439 study. The test substance was not irritant to the eyes in a GLP-compliant OECD 492 study.

	Based on the available information, classification for skin and eye irritation is not warranted, in accordance with EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation No. (EC) 1272/2008.
Sensitisation	The test substance did not show an indication of skin sensitising potential in an OECD 429 (LLNA) study. However, an earlier Buehler test (OECD 406) did indicate skin sensitising potential of the substance.
Health Effects Summary	Possible sensitiser.
Key Study/Critical Effect for Screening Criteria	The NOAEL for general systemic toxicity of 1000 mg/kg bw/d was selected as the key study.
Ecological Toxicity [1]	
Aquatic Toxicity	Short-term toxicity tests with the target substance for all trophic levels (fish, daphnia, algae) are available. The test substance did not indicate to be harmful to freshwater fish (96h-LL50 > 100 mg/L), but showed to be toxic to aquatic invertebrates (48h-EL50 = 12.41 mg/L) and harmful to algae (72h-EL50 = 39.7 mg/L). Hence, aquatic invertebrates were most susceptible to the test substance and this effect value was used for the PNEC derivation. Long-term toxicity data with the source substance are only available for algae. The algal test revealed the substance to be of low toxicity to algae (72h-EL10 = 7.08 mg/L). In addition, data are available for toxicity to microorganisms. A test on respiration inhibition with activated sludge resulted in an 3h-EC10 of > 10000 mg/L indicating that detrimental effects in STPs are not to be expected.
Determination of PNEC aquatic	A PNECaqua = 0.012 mg/L can be calculated based on the lowest acute toxicity value (EL50 = 12.41 mg/L) for aquatic invertebrates (Daphnia) with the assessment factor of 1000.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Based on the results from the read-across substance, Fatty acids, tall oil, ethoxylated (EO > 1 < 2.5) (CAS 61791-00-2) is considered to be readily biodegradable.
B/vB criteria fulfilled?	No. The test substance consists of components with log Kow values of > 10 (KOWWIN v1.68) indicating a potential for bioaccumulation. But due to rapid environmental biodegradation, metabolisation via enzymatic hydrolysis (monoesters and diesters) as well as sterical hindrance of crossing biological membranes (high molecular weight of diesters) a relevant uptake and bioaccumulation in aquatic organisms is not expected. This is supported by low BCF values of < 100 L/kg ww (BCFBAF v3.01, Arnot-Gobas, including biotransformation, upper trophic) calculated for different components of the UVCB (mono- and diester EO1 to EO5). Thus, taking all information into account, the test substance is not considered to be B or vB.
T criteria fulfilled?	No. Available short-term and long-term toxicity tests with aquatic organisms resulted in effect values > 1 mg/L. Thus, this substance does not meet the screening criteria for toxicity.

Overall conclusion	Not PBT
Revised	January 2022

References

1. ECHA REACH, Fatty acids, tall-oil, ethoxylated, Retrieved 2019: https://echa.europa.eu/

Toxicity Summary - Polyanionic cellulose, low viscosity

Chemical and Physical Properties[1,2,3,4]	
CAS number	9004-32-4
Molecular formula	C8H15NaO8
Molecular weight	262.19
Solubility in water	The sodium salt disperses and its solubility in water depends upon the degree of substitution.
Melting point	300°C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	White or slightly yellowish, almost odourless and tasteless hydroscopic powder, consisting of very fine particles, fine granules or fine fibres.
Overview	Sodium carboxymethyl cellulose (CMC) is used in drilling muds, detergents, resin emulsion paints, adhesives, printing inks, and textile sizes. It is also used as a protective colloid, a stabilizer for foods, and a pharmaceutical additive. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [4]	
Soil/Water/Air	Sodium carboxymethylcellulose is biodegradable, but is not considered to be readily biodegradable. It is not expected to bioaccumulate. All of the polymers in this group are expected to be water soluble. If discharged into natural waters, sodium carboxymethylcellulose is expected to be present as a polyanion as a result of the ionisation of the carboxymethyl substituents. Comparatively complex partitioning behaviour in aquatic systems may occur based on the well-established interactions between colloids and carboxymethylcellulose, which is a key part of the function of this polymer in laundry detergents. No experimental partition coefficient data are available for sodium carboxymethylcellulose. Based on its high water solubility, the substance is likely to be mobile in the environment.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Ten rats received 300 to 500 mg of CMC daily for two months without any adverse effect. Another group of 10 rats received a diet containing 20% of CMC for 63 days. Slight growth retardation and a laxative effect were observed. Organ weights and both gross and microscopic pathological examination revealed no abnormalities. Oral rat TDLo: 227 g/kg/13W (continuous)
Carcinogenicity	Carboxymethyl cellulose sodium salt is a “suspected carcinogen”.
Mutagenicity/ Genotoxicity	Carboxymethylcellulose has been used often as the vehicle control in a number of genotoxicity studies as the control agent or vehicle and as such would not be expected to show activity in these types of studies.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In several studies, carboxymethylcellulose and its sodium salt have been used as the vehicle in developmental, embryotoxic and teratogenic studies on rats, mice or rabbits and as such would not be expected to have any adverse effect.
Acute Toxicity	Rats, guinea pigs and rabbits showed no symptoms after administration by stomach tube of 3000 mg/kg in three divided doses. Rat LD50 (oral): 270000 mg/kg/bw Guinea pig LD50 (oral): 160000 mg/kg/bw

	A 4-hr inhalation LC50 value of 5.8 g/m^3 has been reported for the sodium salt in rats.
Irritation	No data available.
Sensitisation	Suspected skin sensitiser
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The oral rat chronic toxicity TDLo: 227 g/kg/13W (continuous) was considered the most sensitive endpoint.
Ecological Toxicity [4]	
Aquatic Toxicity	Brachydanio rerio 96-hour LC50 >2,500 mg/L Daphnia magna 48-hour EC50 >5,000 mg/L Daphnia magna 48-hour EC50 87.26 mg/L Selenastrum capricornutum 96-hour EC50 500 mg/L
Determination of PNEC aquatic	This compound has a low acute toxicity concern to aquatic organisms and thus required no further assessment.
Current Regulatory Controls [5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	No. Sodium carboxymethylcellulose is a water-soluble semisynthetic polymer that is not readily biodegradable. Therefore, it meets the screening criteria for persistence.
B/vB criteria fulfilled?	No. Not expected to bioaccumulate.
T criteria fulfilled?	No. The acute EC50 of sodium carboxymethylcellulose is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2022

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Toxicity Summary - Disodium, Trisodium, Tetrasodium EDTA

Chemical and Physical Properties [1,2,3]	
CAS number	139-33-3 – Disodium EDTA 150-38-9 – Trisodium EDTA 64-02-8 – Tetrasodium EDTA
Molecular formula	Na2EDTA – Disodium EDTA NA3EDTA – Trisodium EDTA NA4EDTA – Tetrasodium EDTA
Molecular weight	336.21 g/mol - Disodium EDTA 380.17 g/mol – Tetrasodium EDTA
Solubility in water	$1.0X10^{+6}$ mg/L (miscible) at 25 ^{o}C - Disodium EDTA
Melting point	242 ^{o}C - Disodium EDTA >300 ^{o}C – Tetrasodium EDTA
Boiling point	252 ^{o}C (decomposes) - Disodium EDTA
Vapour pressure	Negligible
Henrys law constant	Negligible
Explosive potential	No data found
Flammability potential	No data found
Colour/Form	Solid granular materials
Overview	Disodium, trisodium and tetrasodium EDTA are members of the Amino Carboxylic Acid-Based Chelants Category. EDTA is a metal-complexing agent and may act to mobilise some heavy metals in the environment. EDTA is used widely in industry and agriculture. It is used in laundry detergents, water softening, electroplating, textile and paper production, as a food additive, and in cosmetics. Most of these uses will result in the release of EDTA to the aquatic environment. It is also used as a drug in chelation therapy, particularly in cases involving lead poisoning. EDTA is poorly absorbed in the gut and does not form any significant metabolites. It does not accumulate in the body. Long-term feeding studies with rats and dogs reported no interference to mineral metabolism. Results from other studies have been affected by the formation of zinc complexes in the gastrointestinal tract,which prevents the zinc from being absorbed. As metal-organic salts, or inner salts, all category members decompose before melting upon sufficient heating (generally at temperatures > 200 °C). Therefore true melting points are not applicable. Chelants that are metal salts do not exist as discrete neutral molecules, and therefore cannot volatilize, exert appreciable vapour pressure, or boil. Therefore, vapour pressure and boiling point data are not applicable for such chelants and are not determined. Henry's law constants are also expected to be negligible. Chelants that exist as neutral molecules (not metal salts) can exert vapour pressure, but in this case the vapour pressure is exceedingly low. All category members are highly soluble to miscible in water (generally > 10,000 mg/L) and insoluble in organic solvents, therefore also possessing negative partition coefficients (log Kows). The ability of chelants to remove and add ions to solution is the mechanism whereby these chemicals produce toxicity. Environmental fate and ecological and mammalian toxicity profiles are consistent within the category. A Tier 1 Human Health Assessment for these chemicals has been conducted by NICNAS which concluded that these chemicals were identified as low concern to human health.

Environmental Fate [1,2,3]	
Soil/Water/Air	EDTAs have demonstrated high stability to hydrolysis, and most are commercially available primarily or solely in aqueous solution. EDTAs emitted to waterways will remain dissolved in this environmental compartment. If emitted to soil or sediment, they will exhibit high water solubility and soil mobility. This behaviour is based on the presence of multiple carboxylate anion groups in the molecular structure, and is supported by the demonstrated high water solubility and negligible vapor pressure of EDTAs. Results of recent studies indicate that EDTA, calcium EDTA and Na2EDTA can biodegrade under certain conditions.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a 13-week repeated-dose toxicity study, rats (both sexes) fed Na2EDTA (0, 1, 5, 10%) showed mortality at the highest dose. In addition, there was decreased food consumption (emaciation at 10%) and diarrhea at doses of 5% (approximately 4206 mg/kg bw/day) and above. The NOAEL was 1% (approximately 692 mg/kg bw/day). Range finding studies with higher dose levels revealed diarrhea, emaciation, loss of body weight and sometimes parakeratosis in esophagus and forestomach as well as decreased hemoglobin and hematocrit levels. In a 2- year bioassay in rats and mice (both sexes) with Na3EDTA (0, 3750 or 7500 ppm) a NOAEL of 7500 ppm (approximately 500 mg/kg bw/day in rats and 938 mg/kg bw/day in mice; highest dose tested) was determined.
Carcinogenicity	An oral two-year study with Na3EDTA trihydrate in mice and rats indicated no evidence of carcinogenicity. The amino carboxylic acid-based chelants category members are not expected to be carcinogens.
Mutagenicity/ Genotoxicity	Available data indicate disodium and trisodium EDTA do not induce gene mutations or chromosomal aberrations in vitro or in vivo.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Chronic studies with Na3EDTA that included histological examination of gonadal tissues for evidence of adverse effects also showed no adverse effects on reproductive organs. The weight of evidence from a two-generation reproductive toxicity study in rats shows that dietary ingestion of 1% Na2EDTA (approx. 920 mg/kg bw/day) had no effect on reproduction; however, no litters were produced at 5% (approx. 4600 mg/kg bw/day); the NOAEL for reproductive toxicity was 920 mg/kg bw/day. Developmental toxicity data are available for EDTA, CaNa2EDTA, Na2EDTA, Na3EDTA, and Na5DTPA. Data from multigenerational and prenatal developmental toxicity studies suggest that developmental effects are observed in the presence of maternal toxicity and are related to plasma zinc concentrations. Studies on developmental toxicity showed a specific fetotoxic and teratogenic potential of EDTA, Na2EDTA and CaNa2EDTA; a LOAEL of 1000 mg/kg bw/day was determined. Increased proportions/litter and significantly lower fetal body weights are indicative for an impaired fetal development. The pattern of malformations comprised cleft palate, severe brain deformities, eye defects, micro- or agnathia, syndactyly, clubbed legs and tail anomalies. These effects were exhibited in studies using maternally toxic dose levels. The mechanism resulting in developmental effects is found to occur via zinc depletion resulting in zinc deficit. These effects are independent of whether the acid or sodium or calcium salts are applied.
Acute Toxicity	Limited acute inhalation toxicity data with atmospheres enriched in the dusts of certain of the chelants were generally without effect in rats. However, inhalation of respirable dust aerosols of Na2EDTA in male rats exposed to 30, 300 or 1103 mg/m^3 6 hours/day for up to 5 days produced adverse effects at all concentration levels. Mortality was observed at 1103 mg/m^3 following a single 6-h exposure. These effects were fully reversed in surviving animals after a 14-day recovery. Acute dermal toxicity studies in rats, oral LD50 values for Na2EDTA, Na3EDTA were > 2000 mg/kg bw
Irritation	The aminocarboxylic acid-based chelants are not irritating to moderately irritating to the skin, and slightly to moderately irritating to the eyes in rabbits. The irritancy potential is related to the pH of the individual salt. Thus, more acidic members of the category such as disodium EDTA have inherently greater irritancy potential.

Sensitisation	The aminocarboxylic acid-based chelants are not skin sensitisers based on studies in mice and guinea pigs.
Health Effects Summary	These chemicals have been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian Drinking Water Guideline (0.25 mg/L, health) may be used. for EDTA
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	According to the results from different ecotoxicological studies, EDTA mainly influences the pathway of metal ions. For EDTA long-term studies with fish, daphnids and algae are available. The following results were found: *Danio rerio*: 35 d-NOEC > 26.8 mg/L (CaNa2EDTA); *Daphnia magna*: 21d-NOEC = 22 mg/L; *Scenedesmus subspicatus*: 72h-EC10 = > 100 mg/L. For Na2EDTA, *Daphnia magna*: 21d-NOEC = 25 mg/L.
Determination of PNEC aquatic	The effects assessment of EDTA is based on long-term tests, which are available for fish,daphnids and algae. The most sensitive endpoint could be found for *Daphnia magna* with a NOEC of 22 mg/l H4EDTA. An assessment factor of 10 has been used leading to a PNECaqua of 2.2 mg/l.
Current Regulatory Controls [4]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available
Australian Drinking Water Guidelines	The Australian Drinking Water Guideline for EDTA is 0.25 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment [1,2,3]	
P/vP Criteria fulfilled?	EDTAs are not readily biodegradable and as such are persistent in the environment.
B/vB criteria fulfilled?	EDTAs have a low potential for bioaccumulation.
T criteria fulfilled?	The acute aquatic toxicity of EDTAs are > 0.01 mg/L. Hence the substances do not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).
Revised	December 2018

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Toxicity Summary - Talc

Chemical and Physical Properties [1,4]	
CAS number	14807-96-6
Molecular formula	H2-O3-Si 3/4Mg or Mg3Si4O10(OH)2
Molecular weight	78.10 (estimate)
Solubility in water	Insoluble in water, cold acids or in alkalis
pH	9.0 to 9.5
Melting point	800-900°C (disintegration; WHO 2005)
Boiling point	549.7°C (estimate)
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	NA
Flammability potential	Not flammable
Colour/Form	white to gray-white, fine crystalline powder.
Overview	Talc finely powdered hydrous magnesium silicate mineral sometimes found in association with asbestos. After being mined, it is processed to remove impurities and powdered. Talc is a useful commercial product due to its fragrance retention, luster, purity, softness, and whiteness as well as its chemical inertness and oil and grease adsorption. Talc is a mineral composed of hydrated magnesium silicate. Talc refers to both mineral talc and industrial mineral products that are marketed under the name talc and contain proportions of mineral talc that range from about 35% to almost 100%. Industrial talc generally refers to products that contain abundant minerals other than talc; cosmetic talc now normally contains >98% talc but the content may have been lower in the past. Pharmaceutical talc contains >99% talc. Talcum powder is cosmetic-grade talc. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment. Further assessment of the environmental risks from the use of this chemical is also not required.
Environmental Fate [2,3]	
Soil/Water/Air	As a mineral, talc does not biodegrade

Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity Carcinogenicity	Talc-based body powder, when used perineally, is classified by IARC as group 2B as possibly carcinogenic to humans. However, talc for general use not containing asbestos or asbestiform fibres is classified as group 3 as not classifiable to its carcinogenicity to humans. Talc containing asbestiform fibres is classified by IARC as group 1 for carcinogenic to humans. Talc alone failed to induce respiratory tumors, granulomas or mesothelial proliferation in a hamster study but produced tumours of the larynx, trachea and lungs when tested in association with benzo(a)pyrene. In a rat study of aerosol talc there was some evidence of carcinogenic activity of talc in male F344/N rats and clear evidence of carcinogenic activity in female F344/N rats. No evidence of carcinogenicity was evident in intraperitoneal or inhalation studies in hamsters. Male and female Wistar rats were given in their diet 0 or 50 mg/kg of commercial talc [characteristics unspecified] for the life of the animals (average survival was 702 and 649 days, respectively). There was no significant difference in the talc-fed animals compared with control animals (Gibel *et al.*, 1976). In humans and experimental animals, the effects of talc are dependent on the route of exposure, and the dose and properties of the talc. Talc pneumoconiosis was somewhat more prevalent and severe among miners exposed to talc containing asbestiform minerals and/or asbestos than among those exposed to talc without such contaminants. However, the role of quartz and asbestos in the observed pneumoconiosis could not be ruled out. Among drug users, intravenous injection of talc present as a filler in the drugs resulted in microembolization in a variety of organs and alterations in pulmonary function. In animal studies, talc has been shown to cause granulomas and mild inflammation when inhaled. Observations of the effects that occurred in the lungs of rats exposed by inhalation to talc suggested that the operative mechanisms may be similar to those identified for carbon black, and talc is known to cause the release of cytokines, chemokines and growth factors from pleural mesothelial cells. IARC: There is *inadequate evidence* in humans for the carcinogenicity of inhaled talc not containing asbestos or asbestiform fibres. There is *limited evidence* in experimental animals for the carcinogenicity of talc not containing asbestos or asbestiform fibres. Inhaled talc not containing asbestos or asbestiform fibres is *not classifiable as to its carcinogenicity (Group 3)*.
Mutagenicity/ Genotoxicity	Talc was not mutagenic in host-mediated assays in mice. It did not produce chromosomal aberrations or dominant lethal mutations in rats. The IARC (1987) review of talc included unpublished results from a 1974 study conducted by Litton Bionetics that showed no mutagenic activity for talc *in vitro* or *in vivo.* Talc did not induce mutations in *Salmonella typhimurium* strains TA1530 or HisG46, or in the yeast, *Saccharomyces cerevisiae***.** No chromosomal aberrations were observed in human fibroblasts treated with talc *in vitro. In vivo* tests conducted in rats gave negative results for induction of chromosomal aberrations in bone marrow cells and dominant lethal mutations in germinal cells
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No teratological effects were observed in hamsters, rats, mice, or rabbits after oral administration of 900-1600 mg/kg. No teratologic effects were observed in hamsters, rats, mice, or rabbits after oral administration of talc. The doses used were 1,600 mg/kg for rats and mice on days *6* through 15 of gestation; 1,200 mg/kg for hamsters on day 6 through 10 of gestation; and 900 mg/kg for rabbits on days 6 through 18 of gestation
Acute Toxicity	Acute inhalation exposure to talc causes symptoms such as cough, dyspnea, sneezing, vomiting, and cyanosis. Other inhalation exposure symptoms include diffuse pleural thickening and fibrous adhesions of pleural surfaces. Respiratory distress syndrome has been reported in children after massive accidental inhalation of talcum powder. Animal (rat, dog, rabbit) studies showed internal accumulation of talc after short- and long-term inhalation exposure as well as numerous lung afflictions such as fibrosis and inflammation.
Irritation	In monkey eyes, talc in the anterior chamber has induced persistent glaucoma. Talc can induce severe granulomatous reactions when introduced into wounds. It has induced granulomas in and about the human eye when as a dusting powder for surgeons' gloves.

Sensitisation	Talc particles are smaller than 1 um and these particles are respirable and produce an intense inflammatory response characterized by cough, rhinitis, dyspnea, and vomiting.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health, and it is listed by the US Food and Drug Administration (FDA) as a Generally Recognised as Safe (GRAS) substance.
Key Study/Critical Effect for Screening Criteria	There are no adequate studies for which to derive am oral reference dose. Talc is poorly absorbed from the gastrointestinal tract, if at all, and the limited data available by the oral route indicate that talc is essentially non-toxic by the oral route of exposure
Ecological Toxicity [2,3,4]	
Aquatic Toxicity	No data were found. Talc is expected to have low toxicity to the environmental based on its ubiquity in the environment, its low bioavailability, and its widespread use in consumer products (Zazenski et al. 1995).
Determination of PNEC aquatic	PNEC values for talc cannot be calculated.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	TWA: 2.5 mg/m^3
International Occupational Exposure Standards	NIOSH: TWA 2 mg/m^3
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [4]	
P/vP Criteria fulfilled?	Talc does not biodegrade in the environment. It is a naturally-occurring mineral and is persistent in the environment. However, for the purposes of this PBT assessment, it does not meet the criteria for persistence.
B/vB criteria fulfilled?	Talc is not expected to be bioavailable to aquatic organisms; thus, it is does not meet the criteria for bioaccumulation
T criteria fulfilled?	Talc is not expected to be bioavailable to aquatic organisms; thus, it is does not meet the criteria for toxicity.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment (UNECE 2007; US EPA 2007).
Revised	April 2018

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Toxicity Summary - Amides, tall-oil fatty, N,N-bis(hydroxyethyl)

Chemical and Physical Properties [1,2]	
CAS number	68155-20-4
Molecular formula	UVCB
Molecular weight	370 (typical C18 monounsaturated)
Solubility in water	Dispersible
Melting point	<25 °C (liquid)
Boiling point	>300 °C (estimated)
Vapour pressure	$<1.0\times10^{-10}$ (estimated)
Henrys law constant	$<1.0\times10^{-10}$ (estimated)
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Liquid
Overview	Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include other basic organic chemical manufacturing as surface active agents and intermediates; pesticide and other agricultural chemical manufacturing as surface active agents; soap and cleaning compound manufacturing as surface active agents; support activities for mining as surface active agents; and petrochemical manufacturing as surface active agents. Non-confidential commercial and consumer uses of this chemical include lubricants, greases and fuel additives.
Environmental Fate [1,2]	
Soil/Water/Air	The members of the fatty nitrogen derived amides category are long-chain alkyl substituted amides used in commercial product mixtures. The category consists of three subcategories: Subcategory I, fatty acid amides; Subcategory II, fatty alkanolamides; and Subcategory III, fatty acid reaction products with amines. The components of Subcategory I are solids possessing low vapor pressure and low water solubility. The substances in Subcategory II contain solids and liquids with negligible to low vapor pressure and tend to be dispersible in water. The substances in Subcategory III also contain solids and liquids possessing negligible to low vapor pressure that tend to be dispersible in water. The fatty acid amides (Subcategory I) and the fatty acid reaction products with amines (Subcategory III) are expected to possess low mobility in soil. The fatty alkanolamides (Subcategory II) are expected to possess moderate to high mobility in soil. Volatilization is low to moderate for the fatty acid amides and low for the fatty alkanolamides and the fatty acid reaction products with amines. The rate of hydrolysis is considered negligible for all category members. The rate of atmospheric photooxidation is considered moderate to rapid for members of each subcategory; however, this is not expected to be an important environmental fate process since these substances are not expected to exist in the vapor phase in the atmosphere. The overall weight of evidence suggests that the members of the fatty nitrogen derived amides category should possess low persistence (P1) and low bioaccumulation potential (B1) with the exception of two members of subcategory III. Fatty acids, tall-oil, reaction products with tetraethylenepentamine and fatty acids, tall-oil, reaction products with polyethylenepolyamines are expected to possess low persistence (P1), but moderate bioaccumulation potential (B2). As there is limited toxicological data on amides, tall oils fatty, N,N-bis(hydroxyethyl), read across information has been obtained from oleamide DEA (CAS No. 93-83-4) because amides, tall oils fatty, N,N-bis(hydroxyethyl) is

	predominantly diethanolamides of unsaturated C18 fatty acids similar to the composition of oleamide DEA.
Human Health Toxicity Summary [1,2, 3,4]	
Chronic Repeated Dose Toxicity	Based on read-across from CAS 93-83-4, an oral sub-acute repeated dose toxicity study reported NOAEL = 750 mg/kg/day. Groups of 10 male and 10 female Wistar rats were orally gavaged with the substance diluted in olive oil, 5 d/week for 28 d at doses of 0, 70, 250, 750 (Days 1-14) and 1500 (Days 15-28) mg/kg bw/d. Clinical signs, bodyweight, haematology, clinical chemistry, urinalysis, gross and microscopic pathology were recorded. Additional groups of 5 male and 5 female rats were kept for a 4 month recovery period. No treatment-related adverse effects were observed at any of the doses. Changes in the forestomach at some doses including controls were attributed to the use of olive oil and found to be reversible after end of exposure. Under the study conditions, the 28 d NOAEL to rats was considered to be >750 mg/kg bw/day (Potokar, 1983).
Carcinogenicity	Not regarded as carcinogenic.
Mutagenicity/ Genotoxicity	Based on read-across from CAS 93-83-4, the test substance was negative in short-term in vitro and in vivo genotoxicity tests.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on read-across from CAS 68603-42-9, the results from a developmental toxicity study showed that repeated oral administration of COMPERLAN KD to pregnant rats on day 6 through 15 of gestation, caused no symptoms of cumulative toxicity up to a dose level of 1000 mg/kg/day. With the exception of salivation and propulsion of the head during the dose administration, there were no treatment-related effects. Also, COMPERLAN KD does not reveal any embryotoxic or teratogenic potential at dose levels up to 1000 mg/kg/day (author of the report).
Acute Toxicity	Acute oral and dermal toxicities of CAS 68140-00-1 in rat and rabbit, respectively, are low. Further, CAS 93-83-4 is not considered acutely toxic via oral route of exposure with a LD50 of 10,000 mg/kg in rats. Based on read-across from CAS 68140-00-1, an oral acute toxicity test on rats reported LD50 > 5 g/kg. All animals survived the 8-day observation period and no adverse effects were observed. With respect to the determined LD50 value, it is assumed that the LD50 value for female rats also exceeds the limit dose of > 2000 mg/kg body weight. In a dermal acute toxicity test on rabbits, LD50 > 2 g/kg was reported. All animals survived. All animals appeared normal through day 14. Two females that had abraded skin lost weight (0.01 and 0.25 kg) over the 14-day post-exposure period. All remaining rabbits gained weight through day 14. Swiss-Webster mice (4 males/dose) were administered “Alkanolamide #1”, identified in the robust summary as CASRN 68144-20-4, via whole body exposure for 3 hours. Doses were 86- 219 mg/m3 (0.086 – 0.219 mg/L). Animals were observed for several days. No mortality was observed. LC50 > 0.219 mg/L
Irritation	CAS 93-83-4 is considered irritating to skin and eyes.
Sensitisation	The test substance did not cause sensitisation on laboratory animals.
Health Effects Summary	Acute oral and dermal toxicities of CAS 93-83-4 are low. It is considered a skin and eye irritant but does not cause skin sensitisation. It is considered not toxic via repeated oral doses and not genotoxic or carcinogenic. It has no reported adverse reproductive or developmental effects.
Key Study/Critical Effect for Screening Criteria	The oral repeated dose toxicity in rats was considered the most sensitive endpoint with a NOAEL of 750 mg/kg bw/day.
Ecological Toxicity [1, 3]	
Aquatic Toxicity	Based on read-across for CAS No: 68603-42-9 Daphnia: EC50 (24-hour): 3.3 mg active matter/l Daphnia: 48-hour LC50 = 2.15 and 2.64 mg/l Based on read-across for CAS No: 112-84-5 The experiment measured the survival and reproduction of Daphnia magna over a 21-day exposure to the test and control substances. Daphnids were cultured in

	the laboratory using Elendt M7 medium and a daily feeding regiment of green algal cells (Chlorella vulgaris). Four experimental groups: control (Elendt M7 medium), solvent control (0.1 ml methanol/l), 33 µg/l, and 100 µg/l (nominal concentrations) were used in a static-renewal exposure system. All test solutions were prepared with Elendt M7 medium. Replicate test vessels consisted of 4 oz glass bottles containing 100 ml of test solution. There were 10 replicates per experimental group. On the day of test initiation, neonate daphnids were removed from cultures and placed in a crystallizing dish containing Elendt M7 medium. One daphnid was placed in each replicate test vessel, and each vessel was randomly placed in the testing area. Light intensity was not measured, but ambient laboratory lighting was provided with a photoperiod of 16 hours light/8 hours dark. Each day, test solutions were renewed, and the daphnids were fed 1.7 x 10(5) cells/ml of Chlorella vulgaris. Adult survival and reproduction was assessed each day and neonates were removed daily. The pH, dissolved oxygen (DO) and total hardness (as mg/l CaCO(3)) were measured on test days 0, 1, every Tuesday and Friday and on day 21. Means and ranges for temperature, water pH, DO and total hardness were 19.7 °C (14.5 - 25.0 °C), 7.6 (7.2 - 8.1), 8.2 mg/l (4.5 - 9.3 mg/l) and 245 mg/l (234 - 256 mg/l) as CaCO(3), respectively. Concentrations of the test substance in exposure solutions were measured on test days 0, 1, 5, 9, 12, 16 and 19 in both the old and the new solutions. Effect concentrations were based on mean measured concentrations. 21 d NOEC = 0.08 mg/L
Determination of PNEC aquatic	Applying an assessment factor of 1000 to the NOEC (0.08 mg/l) gives a PNEC of 0.08 µg/l.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable based on similar substances.
B/vB criteria fulfilled?	No. Based on BAF = 108 and log Kow of 3 (estimated)
T criteria fulfilled?	No. Acute toxicity data was >1 mg/L.
Overall conclusion	Not PBT
Revised	January 2019

References

1. OECD, Amides, tall-oil fatty, N,N-bis(hydroxyethyl), Retrieved 2019: http://www.echemportal.org
2. USEPA Hazard Characterization Document, Fatty Nitrogen Derived (FND) Amides Category, September 2010
3. Halliburton Safety data sheet Date / Revised: 31.08.2018 Version: 3 Product: DCA-32014
4. ECHA REACH, Amides, C18-unsatd., N,N-bis(hydroxyethyl), Retrieved 2022: https://echa.europa.eu/

Toxicity Summary - Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues

Chemical and Physical Properties[1]	
CAS number	68909-77-3
Molecular formula	C36H78N6O14
Molecular weight	UVCB
Solubility in water	100 g/L at 20 °C
Melting point	-20 °C at 101.3 kPa
Boiling point	223 °C at 101.3 kPa
Vapour pressure	0.55 - 20 Pa at 20 - 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified (50%), Non-flammable (50%)
Colour/Form	Liquid
Overview	The residuum from the reaction of diethylene glycol and ammonia. It consists predominantly of morpholine-based derivatives such as [(aminoethoxy)ethyl]morpholine, [(hydroxyethoxy)ethyl]morpholine, 3-morpholinone, and 4,4'-(oxydi-2,1-ethanediyl)bis[morpholine].
Environmental Fate[1]	
Soil/Water/Air	The substance is hydrolytically stable at pH 4, 7 and 9 at 25°C. Adsorption to solid soil phase is not to be expected. Based on the assessment of the components, it can be concluded that the mixture will not evaporate into the atmosphere. The substance is not readily biodegradable. Based on the low log Kow, the substance will have a low potential for bioaccumulation. Over time, the mixture will preferentially distribute into the compartment water.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	No adverse effects were observed in male and female rats in a 28 days and a 90 days repeated dose toxicity test conducted according to OECD 407 and OECD 408 respectively (Calvert Laboratories, Inc., 2011 and Envigo Research Limited, 2018) in which animals were exposed orally (gavage) to 0, 100, 500 or 1000 mg/kg bw/d (28 days study) and to 0, 10, 100 or 1000 mg/kg bw/d (90 days study). In both studies, an NOAEL of 1000 mg/kg bw was determined.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vivo micronucleus test on mouse bone marrow erythrocytes (BioReliance, 2010), performed according to OECD guideline 474, the animals were exposed orally (via gavage) with 500, 1000, 2000 mg/kg. This did not induce a statistically positive increase in micronuclei in the hemopoietic cells of the mouse bone marrow at the time intervals evaluated under the experimental condition of this assay. No toxicity was observed. Vehicle and positive controls were valid.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A Reproductive / Development Toxicity Screening Testing in Rats was performed according to OECD guideline 421 (Calvert Laboratories, Inc., 2011, Klimisch 1). In this GLP-compliant study, male and female Sprague-Dawley rats (10 animals/sex/dose) were exposed to 1000 mg/kg bw/day. Control animals received concurrent vehicle (water). The rats were exposed on a daily basis, starting two weeks prior to cohabitation until the day before the scheduled euthanasia (minimum of 4 weeks) for males and starting for a minimum of 15 days prior to cohabitation, during cohabitation and from presumed gestation days 0 through day 19 of gestation for females. One female animal was found dead on lactation day 2. All other females survived until scheduled sacrifice. No treatment-related effects were observed in clinical signs, mortality, body weight (gain), food consumption, gross pathology, organ weights or histopathology in the parental

	animals. There was no treatment-related effect on reproductive performance or in reproductive parameters like for instance number of gravid animals, corpora lutea per dam, total implantations, litter viability or foetal sex ratios. The incidence of neonates born alive/found dead, stillborn or missing between lactation days 0 -4 was comparable among study groups. No treatment-related malformations were observed for neonates. The body weight of neonates was statistically significantly increased with an unknown biological significance for this finding. A NOAEL of 1000 mg/kg bw/day was established.
Acute Toxicity	The oral LD50 in male and female Sprague-Dawley rats was determined to be 5000 mg/kg bw in a reliable, key study conducted similarly to OECD guideline 420 (Calvert Laboratories, Inc., 2010). Calvert Laboratories Inc (2010) determined acute dermal toxicity in 10 male / female rats following a GLP-compliant study performed equivalent to OECD guideline 402 (key study, Klimisch 1). Only one dose was tested (2000 mg/kg bw). No mortality was observed. Shortly after exposure, local erythema and oedema effects were observed in both males and females. The effects seemed to be reversible in males and 1 female. In the 4 other females, necrosis and slouching appeared.
Irritation	The skin irritation potential of the test substance is investigated in a key, reliable study performed according to OECD guideline 404 (Allen, 1994; Klimisch 2) in 3 rabbits. Semi-occlusive patches were removed from shaved test sites after exposure periods of 3 min, 1h, and 4h to 0.5mL of the test substance. The Draize scoring system was used to evaluate the results. No erythema/eschar formation and no oedema formation is observed after 3 min and 1 hour exposure. After 4 hours of exposure, very slight erythema in all 3 animals and very slight oedema in 2 animals was observed, but this was fully reversible within 24 - 48 hrs. Calvert Laboratories, Inc. (2010) investigated the eye irritation potential of the test substance in a key, reliable study performed according to EU method B.5 (Klimisch 1) in 3 rabbits. The treated eyes (with 0.1mL test substance) will remain unrinsed for at least 24 hours after instillation. The 24-, 48- and 72-hours scores will be added separately for each animal and each total divided by 3 to yield the individual mean scores for each animal. Based on the data and according to the criterial of the CLP regulation, the test substance is classified as irritant to the eyes (category 2).
Sensitisation	Based on a guinea pig maximization study, performed according to the OECD guideline 406 (Allen, 1996; Klimisch 2), the test substance is considered not sensitising to the skin.
Health Effects Summary	This chemical may cause skin and eye irritation.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 1000 mg/kg bw/day from the 90 day repeated oral toxicity study.
Ecological Toxicity [1]	
Aquatic Toxicity	In a static test following the procedures of the German national standard DIN 38412 using Leuciscus idus as test species a LC50 (96 h) of 681.2 mg/L (nominal) was determined [BASF AG, 1988; Study No. 10F0118/885140]. In conclusion, the substance is with high probability not acutely harmful to fish. The EC50 of the test item on daphnids was found to be greater than 122 mg/L (measured value) in a GLP guideline study according to OECD 202 [BASF SE, 2010; Study No. 50E0396/09E012]. Therefore, the test substance is with high probability acutely not harmful to aquatic invertebrates. A study was performed to assess the effect of the test item on the growth of the green alga Pseudokirchneriella subcapitata. The method followed that described in the OECD Guidelines for Testing of Chemicals (2006) No 201, "Freshwater Alga and Cyanobacteria, Growth Inhibition Test" referenced as Method C.3 of Commission Regulation (EC) No 440/2008. The effect of the test item on the growth of Pseudokirchneriella subcapitata has been investigated over a 72-Hour

	period. the ErC50(72h) of the test item is 45 mg/L for Pseudokirchneriella subcapitata. The toxicity to microorganisms was determined in a GLP short-term respiration test according to OECD guideline 209 using activated sludge from a municipal sewage treatment plant. After 180 minutes no inhibition effect on the respiration rate at the highest test concentration (1000 mg/L) was observed [BASF 2010; Study No. 08G0396/09G004]. Therefore, it can be concluded that inhibition of the degradation activity of activated sludge is not anticipated when introduced in appropriately low concentrations.
Determination of PNEC aquatic	The available short-term aquatic tests covering the three trophic levels (fish, daphnids, algae) showed the lowest L(E)C50 to be 45 mg/L in algae. An assessment factor of 1000 was used for a resulting PNEC for of 0.045 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not readily biodegradable. Thus, it is expected to meet the screening criteria for persistence.
B/vB criteria fulfilled?	As the Log Pow is 0.565 at 20 °C (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.1 mg/L. Thus, it is not expected to meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	March 2019

References

1. ECHA REACH, Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivs. residues, Retrieved 2019: https://echa.europa.eu/

Toxicity Summary - (2-Methoxymethylethoxy)propanol

Chemical and Physical Properties[1,2,3]	
CAS number	34590-94-8
Molecular formula	C7H16O3
Molecular weight	148.20
Solubility in water	1 g/L at 25 °C and pH 7
Melting point	-83 °C at 101.325 kPa
Boiling point	190 °C at 101.325 kPa
Vapour pressure	37.1 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Colourless organic liquid with a mild odour
Overview	(2-Methoxymethylethoxy) propanol is used as hydraulic fluid and as a high boiling solvent. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment.
Environmental Fate[1]	
Soil/Water/Air	The substance has a low Kow and a high water solubility, therefore has a low potential for adsorption to soil or sediments, and a low potential for bioaccumulation in biota. If released to air, The substance will rapidly react in the atmosphere with hydroxyl radicals. If released directly to water, the substance will remain in the water compartment and ultimately biodegrade, as the substance meets the criteria for “ready biodegradation reaching the 10 day window
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	The 28-day oral gavage study in rats is of high quality and considered to be reliable without restrictions. The only effects observed during this study were salivation and increased liver weights at the highest dose level. The liver weight increase observed at the highest dose level was only slight and no histopathologic changes, except for hypertrophy, accompanied this effect. There were no changes in clinical chemistry (ALP, ASP) indicating a liver damage. The same effect was observed with other structurally related molecules, e.g. propylene glycol methyl ether has been shown to cause liver weight increases via a phenobarbital-like enzyme induction mode of action and it is highly likely that dipropylene glycol methyl ether liver weight increases occur via the same mode of action. As this is an adaptive effect typical for many glycol ethers, it is not considered as adverse. Based on the results of this study a no observed adverse effect level (NOAEL) of 1000 mg/kg bw/day and a no observed effect level (NOEL) of 200 mg/kg/day can be established in rats under the conditions of this study. The two studies via the dermal route are both reliable with restrictions as they were not conducted under GLP, but are equivalent to OECD guidelines. No adverse effects were observed up to 1000 mg/kg bw/day in a 28 -day study in rats. In a 90-day study in rabbits dipropylene glycol methyl ether produced some narcosis at 10 ml/kg bw/day and 5 ml/kg bw/day. No narcosis was observed at lower dose levels (1.0 and 3.0 ml/kg bw/day). Mortality was high at the 10.0 ml/kg dose level, some mortality was observed at 5.0 ml/kg bw/day and no mortality was observed at the 1.0 and 3.0 ml/kg bw/day dose levels. No haematological changes occurred at any dosage level. No significant organ weight changes occurred at any dosage level. Observations for gross pathology revealed only gastric distension and occasional gastric irritation in those animals dying at the 10 ml/kg dosage level. Histopathological analysis done on the liver, lung, spleen, adrenal, heart, testes and stomach of those animals receiving the 5.0 and 10.0 ml/kg bw/day dose levels

	revealed no changes. The kidneys of those animals on the 10.0 ml/kg bw/day level showed some granular and some hydropic changes, at the 5.0 ml/kg same kidney abnormalities were observed but they were of no greater intensity than those observed in some of the controls. The effect of severe (repeated and prolonged) exposure to the skin was slight, being similar to that caused by distilled water under similar conditions. Based on the results of this study a NOAEL of 3.0 ml/kg bw/day (2850 mg/kg/day) was established for dermal exposure to dipropylene glycol methyl ether. No significant adverse effects were observed in rats, rabbits, guinea pigs and monkeys after repeated inhalation exposure to dipropylene glycol methyl ether at any of the test concentrations. The 90 -day inhalation studies in rats and rabbits were selected as key studies as these studies are reliable without restrictions. The highest concentration tested in these studies were 200 ppm which was identified as the NOAEC. Based on the molecular weight of 148, this converts to 1232 mg/m^3 at 20 deg Celcius and 1 atm.
Carcinogenicity	No specific studies for the substance are available. Two inhalation studies with propylene glycol methyl ether in rats and mice are available for read-across to dipropylene glycol methyl ether. Both studies are reliable without restrictions as they were conducted under GLP and according to OECD guideline 453. No carcinogenic effect as evidenced by any increase in tumour incidence occurred from exposure to propylene glycol methyl ether
Mutagenicity/ Genotoxicity	The substance was not mutagenic in bacteria (Salmonella typhimuriumTA 1535, TA 1537, TA 1538, TA 98, and TA 100) and in yeast, and no cytogenetic effect were observed in mammalian cells. The data available indicates that the substance is not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No treatment related adverse effects - no maternal toxicity, no embryo-/fetotoxicity and no teratogenicity - were observed in rats or rabbits at the highest attainable concentration of dipropylene glycol methyl ether. The studies in both species are of good quality and reliable without restrictions. The no observed adverse effect level for dipropylene glycol methyl ether is 300 ppm in both species.
Acute Toxicity	Oral - All acute toxicity studies via the oral route reported LD50 values greater than 5000 mg/kg for dipropylene glycol methyl ether. The key study identified for acute oral toxicity is the BASF (1979) study in rats with a reported LD50 of greater than 5000 mg/kg body weight. Inhalation - Via the inhalation route no mortality was observed at the highest attainable concentration (i.e. LC0 values > ca. 552.6 ppm, 3404.47 mg/m^3) in three independent studies. The key study identified is the BASF (1979) study in rats with a LC0 greater than 275 ppm (duration 7 hours) which would be equivalent to approximately 1.69422 mg/L (based on conversion equation at 20 degree celsius and 1 atmosphere). Using Haber's law for converting this 7-hour exposure to a 4 -hour exposure, the equivalent LC0 value is greater than 2.04 mg/L or 2040 mg/m^3. Dermal - For the dermal route, two studies reported no mortality up to the highest dose tested (20 ml/kg bw) in rats and rabbits. One study in rabbits reported a dermal LD50 of 10 ml/kg bw (9510 mg/kg bw). The lowest LD50 will be taken into account for the risk assessment. The other study reported LD50 greater than 19020 mg/kg body weight in rats.
Irritation	Several non-GLP studies in rabbits equivalent or similar to OECD guidelines 404 and 405 are available for the substance. These studies are supported by a human volunteer study for eye irritation and a 90-day dermal study in rabbits. No irritation was observed in rabbits and humans
Sensitisation	No sensitization reaction was observed with the substance in the study with human volunteers.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The oral repeated dose toxicity in rats was considered the most sensitive endpoint with a NOAEL of 1000 mg/kg bw/day.
Ecological Toxicity[1,2,3]	
Aquatic Toxicity	Acute toxicity studies have been conducted in fish, daphnia and algae. In summary, for the aquatic compartment dipropylene glycol methyl ether shows

	EC50s/LC50s that exceed 1000 mg/l in daphnia (48 hr), fish (96 hr) and algae (7 days). The NOEC for reproduction of Daphnia magna corresponds to the highest concentration tested of 0.5 mg/L in the long-term test, which was set very low considering the low acute toxicity of the substance on Daphnia magna. The low chronic toxicity is highlighted in a freshwater algae test with a NOEC at 1000 mg/L. An activated sludge respiration inhibition test showed an EC50 of 4168 mg/L for micro-organisms.
Determination of PNEC aquatic	Data from short-term tests with three trophic levels and one long-term test on invertebrates are available. An assessment factor of 100 is applied to the lowest NOEC of 0.5 mg/L (daphnia). A PNECaqua of 0.005 mg/L was derived.
Current Regulatory Controls[4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	A TWA of 50 ppm (308 mg/m^3) is recommended to protect for eye, nose and throat irritation in exposed workers
International Occupational Exposure Standards	TLV: 100 ppm as TWA; 150 ppm as STEL; (skin). MAK: 310 mg/m^3, 50 ppm; peak limitation category: I(1); pregnancy risk group: D. EU-OEL: 308 mg/m^3, 50 ppm as TWA; (skin)
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable.
B/vB criteria fulfilled?	No. Based on the Log Kow of 0.004 at 25 °C (Log Kow < 4.2).
T criteria fulfilled?	No. Chronic toxicity data >0.01 mg/L in invertebrates, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

References

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2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.industrialchemicals.gov.au/.
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4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - 1-Tetradecene

Chemical and Physical Properties[1,2]	
CAS number	1120-36-1
Molecular formula	C14H28
Molecular weight	196.37
Solubility in water	4.0 x 10^{-4} mg/L at 25°C (estimated)
Melting point	-12°C
Boiling point	233.0 °C
Vapour pressure	1.5 x 10^{-2} mm Hg at 25°C
Henrys law constant	8.48 atm-cu m/mole at 25°C (estimated)
Explosive potential	No data available.
Flammability potential	Non-flammable
Colour/Form	Watery liquid; colourless; mild pleasant odour.
Overview	1-Tetradecene is an anthropogenic compound which is used as a specialty solvent. It may be released to the environment as a fugitive emission during its production and use, and as a result of the burning of plastics.
Environmental Fate[1,2]	
Soil/Water/Air	If released to soil, 1-tetradecene will be essentially immobile. It may rapidly volatilize from moist soil to the atmosphere although its expected strong adsorption to soil may attenuate the rate of this process. 1-Tetradecene will not volatilize from dry soil to the atmosphere. Pure culture studies indicate that 1-tetradecene has the potential to biodegrade in soil and water under aerobic conditions. If released to water, 1-tetradecene will bioconcentrate in fish and aquatic organisms and strongly adsorb to sediment and suspended organic matter. It may rapidly volatilize from water to the atmosphere. The estimated half-life for volatilization from a model river is 4.1 hrs. Its expected strong adsorption to sediment and suspended organic matter may attenuate the rate of this process. The estimated half-life for volatilization from a model pond, which takes into account adsorptive processes, is 7.3 months. If released to the atmosphere, 1-tetradecene may undergo removal by gas-phase reaction with atmospheric oxidants. Estimated half-lives for the reaction with photochemically produced hydroxyl radicals and ozone are 9.3 hrs and 23 hrs.
Human Health Toxicity Summary[1,2]	
Chronic Repeated Dose Toxicity	Guideline repeat dose toxicity studies in rats have been conducted for fourteen members of the higher olefin category, covering C6 to C20-24. The majority of these investigations (27 studies) have used oral (gavage) exposure, with three sub-acute (28-day), nine screening (OECD 421/422), and seven sub-chronic (90-day) studies available for this route. Two sub-acute dermal, two sub-acute inhalation and one sub-chronic inhalation tests, are also available; eight short-term repeat dose range-finding studies are also available. For the oral studies, systemic toxicity findings were typically limited to body weight, liver changes, and effects on clinical chemistry parameters as well as organ weights. Some of the effects observed were adaptive rather than adverse. While most of the studies revealed no systemic toxicity at doses up to 1000 mg/kg bw/day, a conservative NOAEL for this category was determined to be 100 mg/kg bw/day, based on minor effects observed with some category members. The inhalation toxicity NOAEC was determined to be 3,000 ppm (10,326 mg/m^3).
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	There was no evidence of mutagenicity or genotoxicity in any of the studies.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The weight of evidence from oral reproductive and developmental toxicity studies, accompanied with data from oral and inhalation sub-chronic toxicity studies in rats indicate that category members have little or no potential to be considered reproductive/developmental toxicants.
Acute Toxicity	Not acutely hazardous after ingestion, inhalation or skin contact, based on read across animal test data. The acute oral LD50 for hex-1-ene (Neodene 6) alpha olefin in male and female rats was reported as >5600 mg/kg. To assess acute oral toxicity of alkenes, C20-24, groups of 5 fasted female Sprague-Dawley CD strain rats were given a single oral dose (2000 mg/kg bw) of ENORDET O241 and observed for 14 days (Sanders, 2008). There were no treatment related clinical signs, necropsy findings or changes in body weight. The oral LD50 was determined to be greater than 2000 mg/kg in this single sex study.
Irritation	Not irritating to skin and eyes.
Sensitisation	There was no evidence of dermal sensitization in any of the studies.
Health Effects Summary	The substance is expected to have low acute toxicity and is not an irritant.
Key Study/Critical Effect for Screening Criteria	A conservative NOAEL for this category was determined to be 100 mg/kg bw/day, based on minor effects observed with some category members.
Ecological Toxicity[1,2]	
Aquatic Toxicity	Short term toxicity: LC50 (4 days): 3.4 µg/L (fish) EC50 (48 h): 2.8 µg/L (invertebrates) EC50 (4 days): 4.5 µg/L (algae) Long term toxicity: NOEC (21 days): 19.4 µg/L (invertebrates)
Determination of PNEC aquatic	Based on the lowest chronic endpoint for aquatic toxicity (19.4 µg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 0.194 µg/L.
Current Regulatory Controls[3,4,5]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1,4]	
P/vP Criteria fulfilled?	No. Expected to be readily biodegradable.
B/vB criteria fulfilled?	Yes. Bioaccumulation of this substance may occur in aquatic organisms based on the estimated Log Kow of 7.3 (Log Kow > 4.2)
T criteria fulfilled?	No. Chronic toxicity data >0.01 mg/L in invertebrates, thus the substance does not meet the screening criteria for toxicity.

Overall conclusion	Not PBT
Revised	December 2021

References

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4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
5. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Aluminium

Chemical and Physical Properties[1,2,3,4,5]	
CAS number	7429-90-5
Molecular formula	Al
Molecular weight	26.982
Solubility in water	Insoluble
Melting point	660.32°C
Boiling point	2,327°C
Vapour pressure	0
Henrys law constant	No data available
Explosive potential	No data
Flammability potential	Finely divided aluminium dust is easily ignited
Colour/Form	Silver white, malleable, ductile metal, cubic crystal, odourless
Overview	Aluminium is the most abundant metal in the earth's crust and it is widely distributed. Aluminium is a very reactive element and is never found as the free metal in nature. It is found combined with other elements, most commonly with oxygen, silicon, and fluorine. These chemical compounds are commonly found in soil, minerals (e.g., sapphires, rubies, turquoise), rocks (especially igneous rocks), and clays. Aluminium as the metal is obtained from aluminium-containing minerals, primarily bauxite. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment.
Environmental Fate[1]	
Soil/Water/Air	Aluminium is the most abundant metal in the earth's crust, but is never found in its elemental state in nature. In compounds, aluminium occurs in its only oxidation state (+3). The transport and partitioning of aluminium in the environment is determined by its chemical properties, as well as the characteristics of the environmental matrix that affect its solubility. At a pH >5.5, naturally occurring aluminium compounds exist predominantly in an undissolved form such as gibbsite, Al(OH)3, or as aluminosilicates except in the presence of high amounts of dissolved organic material or fulvic acid, which binds with aluminium and can cause increased dissolved aluminium concentrations in streams and lakes. As an element, aluminium cannot be degraded in the environment, but may undergo various precipitation or ligand exchange reactions. The solubility of aluminium in the environment will depend on the ligands present and the pH.
Human Health Toxicity Summary [1,2,3,4,5]	
Chronic Repeated Dose Toxicity	Aluminium has been implicated in causing neurological and hematopoietic effects in individuals with impaired renal function. Respiratory and neurological effects have been observed in workers exposed to finely ground aluminium and aluminium welding fumes. Impaired lung function has been observed in workers employed in various aluminium industries including potrooms, foundry, and welders. Other studies have provided some suggestive evidence that aluminium exposure can result in occupational asthma or pulmonary fibrosis. A common limitation of most of these occupational exposure studies is co-exposure to other compounds, such as silica, which can also damage the respiratory tract. Subtle neurological effects have been observed in workers exposed to aluminium dust in the form of McIntyre powder, aluminium dust and fumes in potrooms, and aluminium fumes during welding. Studies examining the systemic toxicity of aluminum following chronic oral exposure have identified two potential targets of toxicity: the nervous system and the hematopoietic system.

Carcinogenicity	The current weight of evidence does not support an association between inhalation exposure to aluminium metal/aluminium oxide and cancers in the respiratory organs. The weight of evidence also does not support a systemic carcinogenic effect from exposure to aluminium metal and aluminium oxide.
Mutagenicity/ Genotoxicity	Several in vitro studies have found significant increases in the occurrence of micronuclei formation and chromosome aberrations in human lymphocytes; no human in vivo studies were identified. One study examined the in vivo genotoxicity of aluminium and found clastogenic changes in mice receiving an intraperitoneal injection of aluminium chloride. In vitro studies in mammalian and bacterial systems have not found mutagenic alterations.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No studies were located regarding reproductive effects of various forms of aluminium following inhalation, oral, or dermal exposure in humans. No histological alterations were observed in the reproductive tissues of rats or guinea pigs exposed to airborne aluminium chlorhydrate. A number of oral-exposure studies examining reproductive end points in several animal species were identified. In general, the results of these studies suggest that aluminium is not associated with alterations in fertility, mating success, or number of implantations, implantation losses, or litter size.
Acute Toxicity	Aluminium metal (dust/powder) is not to be classified for acute oral, inhalation and dermal toxicity. Oral LD50 (rat) > 2000 mg/kg bw Inhalation LC50 (rat) > 888 mg/m^3 Inhalation NOAEC (rat) = 10 mg/m^3
Irritation	Not irritating to eye and skin.
Sensitisation	Not sensitising
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The toxicological effects of Al in rodents suggests that neurotoxicological and developmental (including neurodevelopmental) endpoints are among the most sensitive indicators of Al toxicity. The LOAEL of 100 mg Al/kg-day for minimal neurotoxicity in the offspring of mice is selected as the basis for the chronic reference dose (RfD). Application of an uncertainty factor (UF) of 100 (3 for use of a minimal LOAEL, 10 for interspecies extrapolation and 3 for intra-human variability where the critical effects have been observed in a sensitive sub-group) results in a provisional RfD of 1 mg Al/kg-day.
Ecological Toxicity[6]	
Aquatic Toxicity	8-day LC50 0.17 mg/L (fish) 8-day LC50 of 2.28 mg/L (amphibian)
Determination of PNEC aquatic	PNEC freshwater: 74.9 µg/L
Current Regulatory Controls[6,7,8,9]	
Australian Hazard Classification	Aluminium powder (pyrophoric): H261 (In contact with water releases flammable gas) H250 (Catches fire spontaneously if exposed to air) Aluminium powder (stabilised): H261 (In contact with water releases flammable gas) H228 (Flammable solid)
Australian Occupational Exposure Standards	Time Weighted Average (TWA): Aluminium (metal dust) = 10 mg/m^3 Aluminium (welding fumes) (as Al) = 5 mg/m^3 Aluminium, alkyls (NOC) (as Al) = 2 mg/m^3 Aluminium, pyro powders (as Al) = 5 mg/m^3 Aluminium, soluble salts (as Al) = 2 mg/m^3

International Occupational Exposure Standards	TLV: 1 mg/m^3, as TWA; A4 (not classifiable as a human carcinogen). MAK: (inhalable fraction): 4 mg/m3; (respirable fraction): 1.5 mg/m3; pregnancy risk group: D
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	A freshwater moderate reliability trigger value of 55 µg/L was derived for aluminium at pH >6.5 using the statistical distribution method (Burr distribution as modified by CSIRO, ANZECC & ARMCANZ 2000 Section 8.3.3.3) with 95% protection and an ACR of 8.2. A freshwater low reliability trigger value of 0.8 µg/L was derived for aluminium at pH <6.5 using an assessment factor (AF) of 20 (essential element) on the low pH trout LC50 figure. The low reliability figures should only be used as indicative interim working levels. There were limited marine data and procedures for calculating an Environmental Concern Level (ECL) (ANZECC & ARMCANZ 2000 Section 8.3.4.5) were used to calculate a low reliability marine trigger value of 0.5 µg/L derived for aluminium using an AF of 200. This figure should only be used as an indicative interim working level but could be revisited as more data become available. The factor of 200 was used because the ECL factor of 1000 was considered excessive for such a commonly found element.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (aluminium as a metal do not degrade and traditional persistence measures used for organic substances do not equally apply to metals).
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to inorganic compounds; aluminium ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	No. LC50 >0.1 mg/L in fish (The lowest measured chronic figure was an 8-day LC50 of 0.17 mg/L for fish).
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

References

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6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
8. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
9. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Ammonium hydrogensulfite

Chemical and Physical Properties[1,2,3]	
CAS number	10192-30-0
Molecular formula	H3N.H2O3S
Molecular weight	99.11
Solubility in water	718 - 6 200 g/L at 0 - 60 °C
Melting point	No data available
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Colourless to yellow crystals
Overview	Ammonium hydrogensulfite are soluble in water. It is non-combustible. It is corrosive to aluminium. It is a strong irritant to skin and mucous membranes. It is toxic by skin absorption.
Environmental Fate[1]	
Soil/Water/Air	The substance has a very low vapour pressure, and also does not sublime. Therefore, the substance will not be present as a gas and no radical reactions can be expected. According to its chemical properties, hydrolysis is not expected/probable. Photodegradation in water is not relevant because it dissociates rapidly into ions and decomposes in water, and it not susceptible to visible light. The substance is an inorganic compound which does not undergo biodegradation. The substance readiliy dissociates in aqueous solution, as with soil moisture. Bioaccumulation is not to be expected. a low log Kow underlines this statement. Due to the ionic salt-character and other physico-chemical properties (negligible vapour pressure, very high water solubility and decomposition in water), the Henry constant is near to zero. Because of its ionic nature, ammonium hydrogensulfite as well as its dissociation products are not volatile from aqueous solutions. Relevant adsorption onto soils, sediments or suspended matter is not expected.
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	Male and female rats received 0, 0.125, 0.25, 0.5, 1.0 or 2.0% $Na_2S_2O_5$ in a thiamine-containing diet (50 ppm) for 104 weeks. Based on the occurrence of occult blood in faeces and changes in gastric morphology at dose levels of 0.5% or more, the NOAEL for local chronic toxicity in this study is represented by the dose of 0.25% metabisulfite (or 0.215% accounting for the loss of metabisulfite). The corrected dose level corresponded to a dose of 108 mg/kg bw/d $Na_2S_2O_5$ or an equivalent dose of 113 mg/kg bw/day ammonium hydrogensulfite. Because there was no evidence of systemic toxicity following chronic treatment, the NOAEL for systemic effects can be expected above the highest dose of 2% sodium metabisulfite corresponding to 955 mg/kg bw/d of $Na_2S_2O_5$ or 996 mg/kg bw/d ammonium hydrogensulfite.
Carcinogenicity	Not considered to be carcinogenic.
Mutagenicity/ Genotoxicity	Not considered to be genotoxic
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Not considered to cause reproductive or developmental toxicity

Acute Toxicity	Based on the described read-across methodology information from sodium sulfite (CAS 7757-83-7), sodium metabisulfite (CAS 7681 -57 -4) and potassium metabisulfite (CAS 16731 -55 -8) were used to determine acute toxicity values (oral, dermal and inhalatiion) for ammonium hydrogensulfite. In total, four reliable animal studies on acute oral exposure for sulfite substances are available, conducted equivalent or similar to OECD guideline 401. One study (Grundler, 1981) indicates a LD50 value of >2610 mg/kg/bw (male and female rats) for the test item sodium sulfite (CAS 7757 -83 -7). One study performed with potassium metabisulfite (CAS 16731 -55 -8) as test item indicated a LD50 >2000 mg/kg/bw (no clinical symptoms were observed in the concentration rang 200 - 2000 mg/kg bw). Two animal study reports on acute oral exposure to sodium metabisulfite (CAS 7681 -57 -4) are available (Hofmann & Jung, 1987 and Zeller&Hofmann, 1974), conducted according to or equivalent/similar to OECD guideline 401. The study of Hofmann & Jung indicated a LD50 >1540 mg/kg/bw. whereas the study performed by Zeller & Hofmann indicated a LD50 value of >3200 mg/kg bw. One study on acute dermal toxicity, performed according to OECD 402 for the test item sodium sulfite (CAS 7757 -83 -7) is available. LD50 value was determined to be greater than 2000 mg/kg/bw (limit test).No systemic clinical observations were observed during clinical examination. No local effects were observed. One study equivalent or similar to OECD 403 for sodium sulfite (CAS 7757 -83 -7) has been performed which indicated a LC50 >5.5 mg/l (limit test). During exposure nothing abnormal was detected. After exposure: substance-contaminated heads, and unstable, staggering gait. After one day nothing abnormal was detected.
Irritation	Not irritating
Sensitisation	Not likely to be skin sensitisers
Health Effects Summary	The main critical effects to human health are severe eye irritation and acute oral toxicity. This chemical will liberate toxic gas when in contact with acid and therefore may cause effects in individuals with a high acid content in the stomach.
Key Study/Critical Effect for Screening Criteria	The chronic repeated dose study in rats with a NOAEL of 113 mg/kg bw/day ammonium hydrogensulfite was used in the risk assessment.
Ecological Toxicity[1]	
Aquatic Toxicity	Algae NOEC/EC10 = 28 mg SO_3^{2-}/L Invertebrates NOEC/EC10 = ≥8.41 mg SO_3^{2-}/L Fish NOEC/EC10 = 50 mg SO_3^{2-}/L
Determination of PNEC aquatic	The lowest value for chronic toxicity was the NOEC for invertebrates of 8.41 mg SO_3^{2-}/L. Applying the AF of 10 results in a PNECaquatic of 0.84 mg SO_3^{2-}/L. Translating this value to H3N.H2O3S gives a PNECaquatic of 1.04 mg test substance/L.
Current Regulatory Controls[2,4,5,6,7]	
Australian Hazard Classification	Acute toxicity – category 4 Eye damage – category 1
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	The following exposure standards are identified for sulfites: An exposure limit (OEL, TWA, STEL, PEL or STV) of 5 – 10 mg/m^3 in different countries such as USA, United Kingdom, Canada, Ireland, Spain, Norway and Switzerland.
Australian Food Standards	The ADI value of 0-0.7 mg/kg bw/day for sulphites was used by FSANZ for the dietary risk assessment.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided

	that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic substance, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic substances.
T criteria fulfilled?	No. Inorganic substance comprising ions of low ecotoxicological concern.
Overall conclusion	It is not currently possible to categorise the environmental hazards of inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

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7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Barite

Chemical and Physical Properties[1,2,3]	
CAS number	13462-86-7
Molecular formula	Ba(SO4)
Molecular weight	233.39
Solubility in water	3.1 mg/L at 20°C
Melting point	1580°C
Boiling point	1600°C at 760 mm Hg (Decomposes)
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Odourless white powder
Overview	Barium sulphate is an inorganic compound. It is partially soluble in water, dissociating into barium and sulphate ions; both are ubiquitous in the environment. The ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	The dissolution of barium substances in the environment and corresponding dissolved Ba levels are controlled by the solubility of barite (BaSO4) and witherite (BaCO3), two naturally occurring barium minerals and the concentration of dissolved Ba cations in freshwater is rather low. However, in the dissolved state, the divalent barium cation, is the predominant form in soil, sediments and water. The solubility of barium compounds increases as solution pH decreases. Barium in soils is not expected to be very mobile because of the formation of water-insoluble salts (sulphate and carbonate) and its inability to form soluble complexes with humic and fulvic materials. Transport, fate, and toxicity of barium in the environment are largely controlled by the solubility of barium minerals. The barium cation is the moiety of toxicological concern, and thus the hazard assessment is based on Ba2+.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level of 4000 pm. Individual effects observed at 2000 ppm barium chloride in drinking water (corresponding to the final barium dose of 61.1 and 80.9 mg Ba/kg bw/day to male and female rats respectively) were regarded as not treatment-related, and this dose level therefore represents the NOAEL. No systemic toxicity was shown to result from long term inhalation exposure in humans to high concentrations of barium sulphate. Particle overload is observed for insoluble particles such as barium sulphate, whereby the rat is the most sensitive species studied, and species-specific differences are demonstrated in various mechanistic animal studies. It has been demonstrated with reasonable certainty that lung overload conditions are not relevant for human health.
Carcinogenicity	There was no evidence of carcinogenic activity (showing no chemical related increase of malignant or benign neoplasms) of barium chloride in both sexes of rats and mice that received 500, 1250, and 2500 ppm. Thus, the concentration of 2500 ppm represents a NOAEL (corresponding to barium doses of 60 and 75 mg/kg bw/d to male and female rats, respectively, and 160 and 200 mg/kg bw/d to male and female mice, respectively).

Mutagenicity/ Genotoxicity	Not likely to be mutagenic or genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Only a screening test is available. However, based on this study there are no indications of a substantial impairment of fertility in rats up to the highest dose tested. Thus, the NOAEL was 4000 ppm (to average doses of 201.5 and 179.5 mg Ba/kg bw/d to male and and female rats, respectively). NOAELs on developmental toxicity for rats of 4000 ppm were derived. However, this NOAEL is of limited value to evaluate the potential for barium to induce developmental effects because there was no exposure of the females during gestation.
Acute Toxicity	The toxicity of barium sulphate and barium chloride is based on the Ba2+cation and therefore on the solubility of the test substance. Barium chloride is well water soluble (ca. 375 g/L) at pH ca. 6.5 (pH of artificial sweat solution), whereas barium sulphate is low soluble (3.1 mg/L at pH 9). Due to the fact that Barium chloride seems to be no toxic via the dermal route it can be concluded that barium sulphate will result in a dermal LD50 of >>2000 mg/kg bw and should therefore not classified as acute toxic to the dermal route.
Irritation	Not irritating to skin or eyes.
Sensitisation	Barium sulphate is expected to be not sensitizing to skin.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity via oral application was considered the key study. Rats were dosed at 61.1 and 80.9 mg Ba2+ /kg bw/day to male and female rats via feed for 90 days. The values refer to 104 and 138 mg/kg bw/day. The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level. Individual effects observed were regarded as non-treatment related.
Ecological Toxicity[1]	
Aquatic Toxicity	Short-term toxicity EC/LC50 values of barium sulphate available for 3 trophic levels: 96 hrs LC50: >3.5 mg/L (Fish) 48 hrs LC50: 14.5 mg/L (Invertebrates) 72 hrs EC50: 1.15 mg/L (Algae) Long-term toxicity data are available for three trophic levels: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.15 mg/L (Algae)
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest EC50 of 1.15 mg/L (algae). A PNECaqua of 115 µg/L was derived.
Current Regulatory Controls[5,6,7,8]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.

PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; barium and sulphate ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L, thus barium sulphate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

References

1. ECHA REACH, Barite sulfate, Retrieved 2021: https://echa.europa.eu/
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3. NCBI, 2021. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved December 2021.
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6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
7. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
8. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Barium Sulphate

Chemical and Physical Properties[1,2,3]	
CAS number	13462-86-7, 7727-43-7
Molecular formula	Ba(SO4)
Molecular weight	233.39
Solubility in water	3.1 mg/L at 20°C
Melting point	1580°C
Boiling point	1600°C at 760 mm Hg (Decomposes)
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Odourless white powder
Overview	Barium sulphate is an inorganic compound. It is partially soluble in water, dissociating into barium and sulphate ions; both are ubiquitous in the environment. The ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	The dissolution of barium substances in the environment and corresponding dissolved Ba levels are controlled by the solubility of barite (BaSO4) and witherite (BaCO3), two naturally occurring barium minerals and the concentration of dissolved Ba cations in freshwater is rather low. However, in the dissolved state, the divalent barium cation, is the predominant form in soil, sediments and water. The solubility of barium compounds increases as solution pH decreases. Barium in soils is not expected to be very mobile because of the formation of water-insoluble salts (sulphate and carbonate) and its inability to form soluble complexes with humic and fulvic materials. Transport, fate, and toxicity of barium in the environment are largely controlled by the solubility of barium minerals. The barium cation is the moiety of toxicological concern, and thus the hazard assessment is based on Ba2+.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level of 4000 pm. Individual effects observed at 2000 ppm barium chloride in drinking water (corresponding to the final barium dose of 61.1 and 80.9 mg Ba/kg bw/day to male and female rats respectively) were regarded as not treatment-related, and this dose level therefore represents the NOAEL. No systemic toxicity was shown to result from long term inhalation exposure in humans to high concentrations of barium sulphate. Particle overload is observed for insoluble particles such as barium sulphate, whereby the rat is the most sensitive species studied, and species-specific differences are demonstrated in various mechanistic animal studies. It has been demonstrated with reasonable certainty that lung overload conditions are not relevant for human health.
Carcinogenicity	There was no evidence of carcinogenic activity (showing no chemical related increase of malignant or benign neoplasms) of barium chloride in both sexes of rats and mice that received 500, 1250, and 2500 ppm. Thus, the concentration of 2500 ppm represents a NOAEL (corresponding to barium doses of 60 and 75 mg/kg bw/d to male and female rats, respectively, and 160 and 200 mg/kg bw/d to male and female mice, respectively).

Mutagenicity/ Genotoxicity	Not likely to be mutagenic or genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Only a screening test is available. However, based on this study there are no indications of a substantial impairment of fertility in rats up to the highest dose tested. Thus, the NOAEL was 4000 ppm (to average doses of 201.5 and 179.5 mg Ba/kg bw/d to male and and female rats, respectively). NOAELs on developmental toxicity for rats of 4000 ppm were derived. However, this NOAEL is of limited value to evaluate the potential for barium to induce developmental effects because there was no exposure of the females during gestation.
Acute Toxicity	The toxicity of barium sulphate and barium chloride is based on the Ba2+cation and therefore on the solubility of the test substance. Barium chloride is well water soluble (ca. 375 g/L) at pH ca. 6.5 (pH of artificial sweat solution), whereas barium sulphate is low soluble (3.1 mg/L at pH 9). Due to the fact that Barium chloride seems to be no toxic via the dermal route it can be concluded that barium sulphate will result in a dermal LD50 of >>2000 mg/kg bw and should therefore not classified as acute toxic to the dermal route.
Irritation	Not irritating to skin or eyes.
Sensitisation	Barium sulphate is expected to be not sensitizing to skin.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity via oral application was considered the key study. Rats were dosed at 61.1 and 80.9 mg Ba2+ /kg bw/day to male and female rats via feed for 90 days. The values refer to 104 and 138 mg/kg bw/day. The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level. Individual effects observed were regarded as non-treatment related.
Ecological Toxicity[1]	
Aquatic Toxicity	Short-term toxicity EC/LC50 values of barium sulphate available for 3 trophic levels: 96 hrs LC50: >3.5 mg/L (Fish) 48 hrs LC50: 14.5 mg/L (Invertebrates) 72 hrs EC50: 1.15 mg/L (Algae) Long-term toxicity data are available for three trophic levels: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.15 mg/L (Algae)
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest EC50 of 1.15 mg/L (algae). A PNECaqua of 115 µg/L was derived.
Current Regulatory Controls[5,6,7,8]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.

PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; barium and sulphate ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L, thus barium sulphate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

References

1. ECHA REACH, Barite sulfate, Retrieved 2021: https://echa.europa.eu/
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Toxicity Summary - Bitumen

Chemical and Physical Properties[1,2]	
CAS number	8052-42-4
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available
Melting point	30 - 128°C at 101.3 - 101.325 kPa
Boiling point	320 - 500°C at 101.325 kPa
Vapour pressure	1 hPa @ 20 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Black or dark brown solid or semi-solid at 20°C and 101.3 kPa
Overview	A very complex combination of high molecular weight organic compounds containing a relatively high proportion of hydrocarbons having carbon numbers predominantly greater than C25 with high carbon-to-hydrogen ratios. It also contains small amounts of various metals such as nickel, iron, or vanadium. It is obtained as the non-volatile residue from distillation of crude oil or by separation as the raffinate from a residual oil in a deasphalting or decarbonization process. Bitumen is also commonly known as asphalt.
Environmental Fate[1]	
Soil/Water/Air	Hydrocarbons are degraded (under aerobic conditions) via mono-oxygenases or di-oxygenases and are subsequently carboxylated and ultimately hydroxylated. In further assessing the type of metabolites formed, it has been demonstrated that for all the major classes of hydrocarbons, the major metabolites are in most cases less toxic, and always less bioaccumulative than the parent molecule.
Human Health Toxicity Summary[1,2]	
Chronic Repeated Dose Toxicity	Based on the data available, the chemicals in this group are not considered to cause serious damage to health from repeated dermal exposure. In a GLP-compliant study conducted similarly to OECD TG 410, residues, petroleum, vacuum (CAS No. 64741-56-6) was administered at dosages of 200, 1000, or 2000 mg/kg bw three times a week for four weeks. Clinical observations included slight oedema, flaking skin, wheezing and decreased food-intake (qualitative observation), resulting in reduced body weight gain in all dose groups when compared to controls. There were statistically significant reduced body weight gains in males in the high-dose group. There were no significant changes in clinical chemistry, haematology parameters or reproductive organs reported. A no observed adverse effect level (NOAEL) for local effects of 200 mg/kg bw/day was reported based on dermal irritation. A NOAEL for systemic effects of 1000 mg/kg bw/day was reported based on decreased body weight (which was considered to be secondary to the reduced food intake). Based on the data available, the chemicals in this group are not considered to cause serious damage to health from repeated inhalation exposure. The fume condensate from oxidized asphalt (CAS No. 64742-93-4) was tested in rats in a combined repeated dose and reproductive and developmental screening test conducted in accordance with OECD TG 474. Wistar rats were exposed (nose only) to concentrations of approximately 30, 100 or 300 mg/m^3 for 28 days. A no observed adverse effect concentration (NOAEC) was established as 100 mg/m^3 based on slight histopathological changes observed in the lungs observed at the highest dose.

	Asphalt fume condensate collected over a paving asphalt tank was tested in a repeated dose inhalation study conducted in accordance with OECD TG 413. Wistar rats were exposed (nose-only) to concentrations of approximately 5, 28 or 149 mg/m^3 for 90 days. The NOAEC was established as 28 mg/m^3 based on reduced body weights and histopathological changes in the nasal and paranasal cavities observed at the highest dose.
Carcinogenicity	Based on the available data, the chemicals in this group as whole materials are not considered carcinogenic, although dilution in organic solvents may produce some carcinogenic effects following prolonged dermal exposure. Exposure to asphalt emissions during certain occupations has been linked to increased risks of carcinogenicity.
Mutagenicity/ Genotoxicity	Based on the weight of evidence, the chemicals in this group (as whole materials) are not considered to be mutagenic. Asphalt fume condensates are mutagenic, with the level of mutagenic activity related to the temperature at which they are generated and levels of PACs.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	There are no reproductive or developmental toxicity studies available on asphalt or asphalt fumes. Based on the limited data available, and the low concentration of PACs generated in asphalt fumes, a classification for reproductive or developmental effects is not warranted. In a GLP-compliant two-generation reproduction toxicity study conducted in accordance with OECD TG 416, rats were exposed (oral gavage) to the analogue chemical, distillates (Fischer-Tropsch), heavy, C18-50- branched, cyclic and linear (CAS No. 848301-69-9) at dosages of 0, 50, 250 or 1000 mg/kg bw/day. The analogue chemical is mainly comprised of saturated oil components, which may be found in asphalts. There were histopathological lesions in the lungs (chronic interstitial/alveolar inflammation) of the F0- and F1-generations. There were corresponding macroscopic findings and/or increased lung weights, and effects in the kidneys (renal tubular hyaline droplets likely associated with alpha-2μ-globulin) of the F1 males only. The study authors stated that the lung lesions were most likely secondary to aspiration of the chemical and, therefore, not relevant for human risk assessment. The renal effects are specific to male rats. These are induced by hydrocarbons and have no relevance for humans. An equivocal, non-adverse slight decrease in F2 pup brain weights was reported. A NOAEL of 1000 mg/kg bw/day was determined for reproductive and systemic toxicity, based on no adverse effects on the male and female reproductive systems, non-reproductive tissues, and other parameters (such as body weight, feed consumption, and clinical observations).
Acute Toxicity	Oral: Based on the data available, the chemicals in this group have low acute toxicity based on results from animal tests following oral exposure to residues, petroleum, vacuum (CAS No. 64741-56-6). The median lethal dose (LD50) in rats is >5000 mg/kg bw. Observed sub-lethal effects included hypoactivity and diarrhoea. Dermal: Based on the data available, the chemicals in this group have low acute toxicity based on results from animal tests following dermal exposure to residues, petroleum, vacuum (CAS No. 64741-56-6). The LD50 value in rats is >2000 mg/kg bw. Inhalation: Based on the data available, the chemicals in this group have low acute toxicity following inhalation exposure. No mortality or significant signs of toxicity were noted in rats exposed to fumes generated from condensates collected from the headspace of a bitumen storage unit. Mean exposures were estimated to be 182 mg/m^3 for four hours. No mortality or toxic effects have been reported in several other studies in which rats were repeatedly exposed up to 300 mg/m^3.
Irritation	Based on the available data, the chemicals in this group may slightly irritate skin in animal studies, particularly following repeated exposure. Based on the available data, the chemicals in this group may be, at most, slightly irritating to the eye in animal studies.

	Exposure to asphalt vapours was reported to cause only minor, transient conjunctivitis in the eyes of rabbits.
Sensitisation	The negative results observed for residues, petroleum, vacuum (CAS No. 64741-56-6), in several skin sensitisation animal studies conducted in accordance with OECD TG 406 (Buehler test), support a conclusion that the chemicals in this group are not skin sensitisers.
Health Effects Summary	The critical health effects for risk characterisation relate to the use of the chemicals at elevated temperatures. Fumes from asphalts have been associated with carcinogenicity and mutagenicity in humans and animals. There is considered to be an increased risk for fumes containing higher levels of PACs. The levels of PACs are affected by the temperature of fume generation. Exposure to asphalt fumes could also cause irritant effects (skin, eye, nasal and throat) and respiratory effects. Severe burns to the skin have been reported in workers from hot asphalt (usually used at temperatures from 150 to 190°C).
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity in rats via dermal application was considered the most sensitive endpoint with a NOAEL of 200 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	Short term toxicity: LL50 (4 days): 1 g/L (fish) LL50 (48 h): 1 g/L (invertebrates) EL50 (72 h): 1 g/L (algae) Long term toxicity: LL50 (28 days): 1 g/L (fish)
Determination of PNEC aquatic	Based on the lowest endpoint for aquatic toxicity (1 g/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 0.01 g/L.
Current Regulatory Controls[2,3,4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	Asphalt as bitumen fumes, has an occupational exposure limit (OEL) of 5 mg/m^3 time weighted average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica) for asphalt: An OEL of 0.5–10 mg/m^3 TWA and 1.5–10 mg/m^3 short-term exposure limit (STEL) in different countries such as Canada, Chile, China, Germany, Indonesia, Ireland, Malaysia, Mexico, Norway, Singapore, South Africa, Spain, Switzerland, United Kingdom, and USA. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limited value (TLV) of 0.5 mg/m^3 (TWA) as benzene-soluble (or equivalent method) inhalable aerosol. 'This value is intended to minimize the potential for mucous membrane and ocular irritation'.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Based on QSAR modelling, the substance is expected to be readily biodegradable.
B/vB criteria fulfilled?	Not applicable (substance is a UVCB). Calculated BCF for constituents of this substance range between 0.4 and 13300 L/kg.
T criteria fulfilled?	No. Chronic toxicity data >1 g/L in invertebrates, thus the substance does not meet the screening criteria for toxicity.

Overall conclusion	Not PBT. These chemicals are a UVCB. They do not contain PBT constituents included in the Substances of Very High Concern (SVHC) candidate list at concentrations above 0.1%.
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Toxicity Summary - Calcium oxide

Chemical and Physical Properties[1,2,3,4]	
CAS number	1305-78-8
Molecular formula	CaO
Molecular weight	56.08
Solubility in water	1.19 g/L at 20 °C
Melting point	2572°C
Boiling point	2850°C
Vapour pressure	Negligible at 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Greyish yellow, odourless, hygroscopic solid
Overview	Calcium oxide (CaO), is an inorganic compound commonly known as quicklime or burnt lime, is a widely used chemical compound. The chemical is used as a component of a hydraulic fracturing fluid formulation for coal seam gas extraction. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment.
Environmental Fate[5]	
Soil/Water/Air	Calcium oxide reacts immediately upon exposure to water, forming calcium hydroxide, which itself reacts with carbon dioxide to form calcium carbonate. The final reaction products of both limestone and calcium oxide in the environment are therefore essentially the same, although calcium oxide typically has lower concentrations of magnesium and other inorganic chemicals than limestone and produces a higher initial concentration of hydroxide ions. Calcium and carbonate ions occur naturally in all environmental compartments and are important nutrients for various organisms. Calcium is mobile in soil and, if released to the environment, should be expected to experience significant partitioning to the water compartment. However, calcium ions may also form insoluble precipitates with anions present in the environment, such as carbonate ions, and settle out of the aqueous phase.
Human Health Toxicity Summary[2]	
Chronic Repeated Dose Toxicity	Several repeat dose studies using analogues of calcium oxide (calcium hydroxide, calcium carbonate, calcium gluconate) investigating the effect of calcium ions on various metabolic functions in experimental animals are available in the literature. However, all these studies were considered inappropriate for derivation of a No Observed Adverse Effect Level (NOAEL) by the study authors, as they did not follow any international guidelines (ECHA REACH).
Carcinogenicity	No data available. Using a read across study, calcium oxide is considered not likely to be carcinogenic.
Mutagenicity/ Genotoxicity	Calcium oxide is not mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In two developmental toxicity studies conducted according to methods equivalent or similar to the OECD TG 414 (Prenatal Developmental Toxicity Study), calcium oxide was administered by gavage to pregnant female Wistar rats up to 680 mg/kg bw/day and CD-1 mice up to 440 mg/kg bw/day during gestation days 6 to 15 (10 consecutive doses). There were no clear discernible effects on implantation, maternal survival or foetal survival in any species at any of the doses. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not

	differ significantly from those occurring spontaneously in the controls. No NOAEL could be established for maternal toxicity or foetal developmental effects. Based on the available data, calcium oxide is not considered to be a developmental toxicant.
Acute Toxicity	A study on acute oral toxicity of calcium oxide in female rats was conducted by a scientifically accepted method. Different doses of calcium oxide suspended in polyethylene glycol (0.2 g/mL) were administered to rats by gavage. No deaths were observed at 2000 mg/kg bw, indicating that the oral median lethal dose (LD50) for rats is >2000 mg/kg bw. No adverse effects were observed following treatment. No macroscopic findings were observed at necropsy. Calcium oxide has low oral acute toxicity with an oral LD50 of >2000 mg/kg bw. Acute dermal toxicity studies with calcium oxide are not available. An acute dermal toxicity study was conducted in rabbits using moistened calcium hydroxide (Ca(OH)2). As calcium oxide (CaO) is converted to Ca(OH)2 in the presence of moisture, the test results for Ca(OH)2 are also applicable for CaO. No animal deaths were observed at 2500 mg/kg bw Ca(OH)2, indicating that the dermal LD50 for male/female rabbits is >2500 mg/kg bw. No adverse effects were observed following the treatment. Based on the results with Ca(OH)2, calcium oxide is considered to have low acute dermal toxicity.
Irritation	Results from two skin irritation studies with calcium hydroxide (hydrated calcium oxide) indicated that calcium hydroxide causes skin irritation. The US Occupational Health Guideline for calcium oxide states 'calcium oxide causes irritation of the eyes, nose, throat and skin. Severe burns may result from contact with this chemical'. Calcium oxide is also considered to be a severe eye irritant.
Sensitisation	No data available.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	Calcium oxide has low acute oral and dermal toxicity, is a skin and respiratory irritant and a severe eye irritant. Calcium oxide is not genotoxic or carcinogenic and does not have any developmental effects in animals. Given the constituent ions of calcium oxide which are subject to tight homeostatic control in the body, repeated exposure to calcium oxide is regarded to have no significant systemic effects. In an epidemiological study, no significant adverse effects were observed in lime-kiln workers exposed to 1.2 mg/m^3 lime dust. This atmospheric concentration was taken as an overall NOAEC for calcium oxide. This NOAEC will be carried forward for human health risk assessment. The critical health effects of calcium oxide are skin and respiratory irritation and severe eye irritation.
Ecological Toxicity [2,5]	
Aquatic Toxicity	Oncorhynchus mykiss 96-hour LC50: 50.6 mg/L Daphnia magna 48-hour EC50: 49.1 mg/L Pseudokirchneriella subcapitata 72 hour EC10: 79.22 mg/L A 42-day Oncorhynchus mykiss test showed that enhanced Ca2+ diets (60 mg Ca2+) had no effects on survival. Mean fish weights remained constant across all treatments. A 14-day Crangon septemspinosa test showed an EC10 of 32 mg/L.
Determination of PNEC aquatic	A Tier 1 assessment of the environmental risks from the use of substances in the Limestone and its derivatives group is not required.
Current Regulatory Controls[2]	
Australian Hazard Classification	Calcium oxide is listed as hazardous in the Hazardous Substances Information System (HSIS). No risk phrases have been assigned to this chemical.
Australian Occupational Exposure Standards	The chemical has an exposure standard of 2 mg/m^3, Time Weighted Average (TWA)

International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013): Occupational Exposure limit (TWA) of 2 mg/m^3 [Canada, Denmark, Korea, UK, US (NIOSH)] Permissible Exposure Limits (PEL) of 5 mg/m^3 [US (OSHA 1978)].
Australian Food Standards	Calcium oxide is allotted the following International Numbering System of food additives number: INS 529 (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	Calcium oxide is used in water treatment to correct pH and adjust alkalinity, for coagulation optimisation, corrosion control and water softening. Typical calcium oxide concentrations used in drinking water treatment depend on the quality of the water to be treated and the purpose of treatment (e.g. water softening, pH adjustment or alkalinity increase) and can vary from 5 to 500 mg/L.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment).
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and hydroxide ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, calcium oxide does not meet the screening criteria for toxicity.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
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Toxicity Summary - Copper (II) oxide

Chemical and Physical Properties[1,2,3,4]	
CAS number	1317-38-0
Molecular formula	CuO
Molecular weight	79.55
Solubility in water	Insoluble
Melting point	1,326 °C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Black to brownish-black amorphous or crystalline powder or granules
Overview	CuO is an inorganic compound. It is a product of copper mining and is used for the production of other copper-containing products. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	Among the copper species released/transformed, Cu (II) is thus the most environmental relevant species. It is further recognised that Cu (II) ions - commonly named free cupric ions- are the most active copper species and that total Cu or Cu(II) concentrations are usually not directly related to ecological effects since exposure of biota may be limited by processes that render Cu unavailable for uptake. Assessing the species of Cu (II) therefore has ecotoxicological relevance. After being released into the environment, the Cu(II) ions typically bind to inorganic and organic ligands contained within water, soil, and sediments. In water Cu(II) binds to dissolved organic matter (e. g. humic or fulvic acids). The Cu(II) ion forms stable complexes with -NH2, -SH, and, to a lesser extent, -OH groups in these organic acids. Cu(II) will also bind with varying affinities to inorganic and organic components in sediments and soils. For example, Cu(II) binds strongly to hydrous manganese and iron oxides in clay and to humic acids, but much less strongly to aluminosilicates in sand. In all environmental compartments (water, sediment, soil), the binding affinities of Cu(II) with inorganic and organic matter is dependent on pH, the oxidation-reduction potential in the local environment, and the presence of competing metal ions and inorganic anions.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	The chronic toxicity of CuO is based on studies on copper sulphate. The pivotal repeat dose study was a 90-day study by the oral route with copper sulphate pentahydrate. In rats and mice, ingestion of copper sulphate pentahydrate produced forestomach lesions that could be due to the irritant effects of the compound. The no-observed-adverse-effect level (NOAEL) for this effect was 16.7 mg Cu/kg bw/day in rats and 97 and 126 mg Cu/kg bw/day in male and female mice respectively. In rats, inflammation of the liver was observed. The NOAEL for liver and kidney damage were 16.7 mg Cu/kg bw/day in rats.
Carcinogenicity	The carcinogenicity of copper has not been adequately studied. An increase in cancer risk has been found among copper smelters; however, the increased risk has been attributed to concomitant exposure to arsenic. Increased lung and stomach cancer risks have also been found in copper miners. However, a high occurrence of smoking and exposure to radioactivity, silica, iron, and arsenic obscure the association of copper exposure with carcinogenesis. Animal studies have not found increased cancer risks in orally exposed rats or mice.

Mutagenicity/ Genotoxicity	The available genotoxicity studies support the indication that copper compounds have no carcinogenic potential. The studies include Ames assays in Salmonella typhimurium on copper II sulphate pentahydrate; a micronucleus study on copper II sulphate pentahydrate and an unscheduled DNA synthesis ex vivo study in rat liver on copper II sulphate. The Ames tests indicated that copper sulphate had no mutagenic activity. No evidence of an increase in the incidence of micronuclei was detected in the mouse micronucleus study when mice were orally administered two doses of 447 mg/kg copper sulphate, 24 h apart. There was also no evidence of unscheduled DNA synthesis in the rat liver. These studies are consistent and show a lack of in vitro mutagenic activity or in vivo clastogenic potential associated with soluble copper compounds. The results of these studies do not highlight a concern regarding the genotoxic potential of copper compounds.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The two-generation study in the rat indicate that that under the conditions of this study, the NOAEL for reproductive toxicity was 1500 ppm, the highest concentration tested. The NOAEL for P1 and F1 rats and F1 and F2 offspring during lactation was 1000 ppm, based on reduced spleen weight in P1 adult females, and F1 and F2 male and female weanlings at 1500 ppm however the transient reduced spleen weights are not considered a reproductive endpoint as it did not affect growth or fertility.
Acute Toxicity	In a study to assess the acute oral toxicity of copper oxide following a single oral administration by gavage, there were no mortalities or signs of systemic toxicity among any of the animals treated with copper oxide at the test concentration of 2000 mg/kg bw. An LD50 of >2500 mg/kg bw can be estimated using the flow chart in annex 2d of OECD Guidelines for the Testing of Chemicals No. 423 “Acute Oral Toxicity – Acute Toxic Class Method. The acute median lethal dose (LD50) of copper oxide in the Sprague-Dawley CD (Crl: CD (SD) IGS BR) strain of rats study to assess the acute dermal toxicity of copper oxide was found to be >2000 mg/kg bw.
Irritation	Not irritating to the skin and eyes.
Sensitisation	Not sensitising.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The NOAEL of 16.7 mg Cu/kg bw/day for liver and kidney damage in rats is used in the risk characterisation.
Ecological Toxicity [1,3]	
Aquatic Toxicity	Based on copper ecotoxicity data: Fish: 2.6 µg/L (Ptylocheilus oregonensis, from 7-day LC50) 131 µg/L (Pimephales promelas, 7-day LC50) Crustaceans: 1.7 µg/L (D. pulex and G. pulex, NOEC, reproduction & mortality) 12.1 µg/L (Hyalella azteca, from 10 to 14-day LC50). Insects: 2.2 µg/L (Tanytarsus dissimilis, from 10-day LC50) 11 µg/L (Chironomus tentans, 10 to 20-day LC50). Molluscs: 1.64 µg/L (Flumicola virens, from 14-day LC50) 56.2 (Corbicula manilensis, from 7 to 42-day LC50).
Determination of PNEC aquatic	The PNECaquatic for freshwater is determined to be 7.8 µg/L based on the conclusion that the copper concentrations in food items and daily dietary copper dose in fish are unlikely to cause negative effects at this threshold.
Current Regulatory Controls[4]	
Australian Hazard Classification	H410 (Very toxic to aquatic life with long-lasting effects)

Australian Occupational Exposure Standards	No data availanle
International Occupational Exposure Standards	TWA = 1 mg/m^3 (dust & mists) TWA = 0.2 mg/m^3 (fume)
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	Based on health considerations, the concentration of copper in drinking water should not exceed 2 mg/L. Based on aesthetic considerations, the concentration of copper in drinking water should not exceed 1 mg/L.
Aquatic Toxicity Guidelines	A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (ionic species ubiquitous in environment).
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; copper ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Copper is an essential nutrient for all living organisms.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
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Toxicity Summary - Copper

Chemical and Physical Properties[1,2,3,4]	
CAS number	7440-50-8
Molecular formula	Cu
Molecular weight	63.546
Solubility in water	Insoluble
Melting point	1,057 – 1,059 °C
Boiling point	No data
Vapour pressure	1 (1,628 °C)
Henrys law constant	No data
Explosive potential	No data
Flammability potential	No data
Colour/Form	Reddish, solid
Overview	Copper is a reddish metal that occurs naturally in rock, soil, water, sediment, and at low levels in air. Copper's unique chemical and physical properties include high thermal conductivity, high electrical conductivity, malleability, low corrosion, alloying ability, and pleasing appearance. Properties of metallic copper such as electrical conductivity and fabricability vary markedly with purity. A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[3]	
Soil/Water/Air	Copper is released to the atmosphere in the form of particulate matter or adsorbed to particulate matter. Atmospheric copper is removed by gravitational settling, dry deposition, and wet deposition (rain and snow). Much of the copper discharged into waterways is in particulate matter and settles out. In the water column and in sediments, copper adsorbs to organic matter, hydrous iron and manganese oxides, and clay. Copper binds primarily to organic matter in estuarine sediment unless the sediment is low in organic matter content. Most copper deposited on soil from the atmosphere, agricultural use, and solid waste and sludge disposal will be adsorbed with greater concentrations of copper measured in the upper 5 – 10 centimetres of soil in comparison to lower soil depths, except in sandy soils where the lability of bound copper is greater. Copper's movement in soil is determined by a host of physical and chemical interactions of copper with the soil components. In general, copper will adsorb to organic matter, carbonate minerals, clay minerals, or hydrous iron and manganese oxides. Sandy soils with low pH have the greatest potential for leaching. Copper binds strongly to soils with high organic content.
Human Health Toxicity Summary[3,4]	
Chronic Repeated Dose Toxicity	Liver damage (necrosis, fibrosis, abnormal biomarkers of liver damage) have been reported in individuals ingesting lethal doses of copper sulphate. There is some evidence from animal studies to suggest that exposure to airborne copper or high levels of copper in drinking water can damage the immune system. Impaired cell-mediated and humoral-mediated immune function have been observed in mice. Studies in rats, mice, and mink suggest that exposure to high levels of copper in the diet can result in decreased embryo and foetal growth.
Carcinogenicity	The carcinogenicity of copper has not been adequately studied. An increase in cancer risk has been found among copper smelters; however, the increased risk has been attributed to concomitant exposure to arsenic. Increased lung and

	stomach cancer risks have also been found in copper miners. However, a high occurrence of smoking and exposure to radioactivity, silica, iron, and arsenic obscure the association of copper exposure with carcinogenesis. Animal studies have not found increased cancer risks in orally exposed rats or mice. The IARC has classified the pesticide, copper 8-hydroxyquinoline, in Group 3, unclassifiable as to carcinogenicity in humans and EPA has classified copper in Group D, not classifiable as to human carcinogenicity.
Mutagenicity/ Genotoxicity	No data on the genotoxicity of copper in humans were located. The available genotoxicity data suggest that copper is a clastogenic agent. Several studies have also shown that exposure to copper can result in DNA damage.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No studies were located regarding developmental effects in humans and animals following inhalation exposure to copper.
Acute Toxicity	One of the most commonly reported adverse health effect of copper is gastrointestinal distress. Nausea, vomiting, and/or abdominal pain have been reported, usually occurring shortly after drinking a copper sulphate solution, beverages that were stored in a copper or untinned brass container, or first draw water (water that sat in the pipe overnight).
Irritation	Copper is a respiratory tract irritant and causes coughing, sneezing, runny nose, pulmonary fibrosis, and increased vascularity of the nasal mucosa.
Sensitisation	Not sensitising.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The chronic oral reference dose (RfD) of 4 x 10^{-2} mg/kg/day is based drinking water standard of 1.3 mg/L, assuming a water consumption rate of 2 L/day and a body weight of 70 kg.
Ecological Toxicity[1,5]	
Aquatic Toxicity	Based on copper ecotoxicity data: Fish: 2.6 µg/L (Ptylocheilus oregonensis, from 7-day LC50) 131 µg/L (Pimephales promelas, 7-day LC50) Crustaceans: 1.7 µg/L (D. pulex and G. pulex, NOEC, reproduction & mortality) 12.1 µg/L (Hyalella azteca, from 10 to 14-day LC50). Insects: 2.2 µg/L (Tanytarsus dissimilis, from 10-day LC50) 11 µg/L (Chironomus tentans, 10 to 20-day LC50). Molluscs: 1.64 µg/L (Flumicola virens, from 14-day LC50) 56.2 (Corbicula manilensis, from 7 to 42-day LC50).
Determination of PNEC aquatic	The PNECaquatic for freshwater is determined to be 7.8 µg/L based on the conclusion that the copper concentrations in food items and daily dietary copper dose in fish are unlikely to cause negative effects at this threshold.
Current Regulatory Controls[5,6,7,8,9]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	TWA = 1 mg/m^3 (dust & mists) TWA = 0.2 mg/m^3 (fume)
International Occupational Exposure Standards	TWA = 1 mg/m^3 (dust & mists) TWA = 0.2 mg/m^3 (fume)

Australian Food Standards	Tolerable limit = 0.2 mg/kg bw/day
Australian Drinking Water Guidelines	Based on health considerations, the concentration of copper in drinking water should not exceed 2 mg/L. Based on aesthetic considerations, the concentration of copper in drinking water should not exceed 1 mg/L.
Aquatic Toxicity Guidelines	A freshwater high reliability trigger value for copper of 1.4 µg/L was derived using the statistical distribution method with 95% protection. A marine high reliability trigger value for copper of 1.3 µg/L was derived using the statistical distribution method with 95% protection.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (copper is an essential element and is ubiquitous in environment).
B/vB criteria fulfilled?	No. As an essential element, copper is commonly regulated by the organism and do not bioaccumulate or biomagnify.
T criteria fulfilled?	Not applicable. Copper is an essential nutrient for all living organisms.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

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Toxicity Summary - Distillates (petroleum), hydrotreated light naphthenic

Chemical and Physical Properties[1,2]	
CAS number	64742-53-6
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available
Melting point	0°C at 101.325 kPa
Boiling point	207 - 750°C at 101.325 kPa
Vapour pressure	10 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	Non-flammable
Colour/Form	Liquid, petroleum product
Overview	These chemicals are refined distillate base oils derived from crude oil. It undergoes a series of extractive or transforming processes that improve the base stocks' performance characteristics and remove or reduce undesirable components such as polyaromatic compounds (PACs). The chemicals are complex mixtures of straight and branched-chain paraffinic, naphthenic and aromatic hydrocarbons having carbon numbers in the C15–C50 range. The chemical composition of these chemicals depends on both the original crude oil and on the refining process. The toxicity profile of these chemicals is dictated by the levels of PACs. Mineral oils containing <3 % w/w dimethylsulfoxide (DMSO) extractables (as measured by the IP346 assay) are considered highly or severely refined. Only white oils are considered highly refined by definition.
Environmental Fate[1]	
Soil/Water/Air	Hydrocarbons are degraded (under aerobic conditions) via mono-oxygenases or di-oxygenases and are subsequently carboxylated and ultimately hydroxylated. In further assessing the type of metabolites formed, it has been demonstrated that for all the major classes of hydrocarbons, the major metabolites are in most cases less toxic, and always less bioaccumulative than the parent molecule.
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	In separate 4-week single-dose studies, New Zealand White rabbits were dermally exposed to 1000 mg/kg bw/day of the chemicals identified by CAS Nos. 64741-88-4, 64742-56-9 and 64742-65-0. There were no significant signs of systemic toxicity. Signs of irritation were observed both macroscopically (erythema and oedema) and microscopically (inflammation, hyperplasia and hyperkeratosis). In a 13-week study, Sprague Dawley (SD) rats were dermally exposed to 800 or 2000 mg/kg bw/day, for five days a week. The no observed adverse effect level (NOAEL) for systemic effects was reported as 800 mg/kg bw/day based on increased liver weights and histopathological changes observed in high-dose females. Signs of irritation were observed at both dose levels, both macroscopically (erythema and oedema) and microscopically (inflammation, hyperplasia and hyperkeratosis). As application sites were not covered, exposure may have been less than intended. Increased liver weights were also observed in a 3-week dermal study with CAS No. 64742-70-7. In this study, SD rats were dermally exposed to 1720 mg/kg bw/day (five days/week). Effects were observed in both males and females. As application sites were not covered, exposure may have been less than intended.

Carcinogenicity	These chemicals are classified as hazardous, Category 2 carcinogens with the risk phrase 'May cause cancer'. Skin tumours have been observed in mice following exposure to several unrefined or mildly refined base oils. In a dermal carcinogenicity study in mice, the chemical with CAS No. 64742-53-6 increased the incidence of skin tumours. Petroleum substances containing <3 % w/w DMSO extractables (as measured by the IP346 assay), or which are negative in the modified Ames test (mutagenicity index <1) are not carcinogenic to skin.
Mutagenicity/ Genotoxicity	The genetic toxicity of the chemicals is expected to be related to the level of refinement and associated removal of PACs. The results for the chemical CAS No. 64742-53-6 were positive in an in vitro mouse lymphoma mutation assay but the results for CAS No. 64742-52-5 were negative in a similar study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data are available for the chemicals. Certain petroleum streams have been shown to be developmentally toxic from dermal exposure. Effects include increased incidence of resorptions and decrease in foetal body weight. The developmental toxicity of the chemicals is expected to be correlated with the level of refinement of the chemicals.
Acute Toxicity	These chemicals are considered to be of low acute toxicity following oral and dermal exposure. The chemical identified by CAS Nos. 64742-53-6, has a reported median lethal dose (LD50) in rabbits of greater than 2000 mg/kg bw. Signs of skin irritation (slight to severe for erythema and oedema and desquamation) were observed in some studies. Based on data available, the chemicals in this group are expected to have low to moderate toxicity following inhalation exposure. Based on the reported median lethal concentration (LC50) value (2.18 mg/L/4-h) for an insufficiently refined oil, classification is considered appropriate for the chemicals in this group. However, this classification need not apply for highly or severely refined oils, containing <3 % w/w DMSO extractables (as measured by the IP346 assay). In an acute inhalation toxicity study, rats were exposed to an aerosol of the chemical identified by CAS No. 64742-53-6 at concentrations of 1, 1.5, 2.5, 3.5 and 5 mg/L for four hours. All the animals in the two high dose groups, and three males and three females in the 2.5 mg/L dose group died. The LC50 was 2.18 mg/L/4-h. Observed sublethal effects included decreased activity, rapid breathing and congestion, and inflammation of the lungs. The test chemical was reported to have a DMSO extractable content of >3 % as measured by the IP346 assay. Two further acute inhalation studies were available for the chemical identified by CAS No. 64742-53-6. In a single dose study in rats, 80 % mortality was observed at 5.7 mg/L/4-h. The DMSO extractable content was not reported. In another rat study, the LC50 was reported to be 10.5 mg/L/4-h for males and 9.5 mg/L/4-h for females. The cause of death appeared to be associated with lung congestion and/or oedema. The test chemical was reported to be highly or severely refined oils containing <3 % w/w DMSO extractables. Acute inhalation data were available for several highly or severely refined oils containing <3 % w/w DMSO extractables. In general, no mortalities were observed.
Irritation	Animal skin irritation data were available for several highly or severely refined oils containing <3 % w/w DMSO extractables. In general, slight skin irritation effects were considered to be not sufficient for classification. These minimally irritant effects are consistent with irritant responses observed in humans. Very slight irritant effects were observed in four separate repeated insult patch tests in human volunteers with highly or severely refined oils, containing <3 % w/w DMSO extractables. CAS No. 64742-53-6 produced erythema and oedema (mean scores greater than two over 72 hours for both endpoints) following application to intact rabbit skin. Effects were fully reversible within 14 days. The test chemical was reported to have a DMSO extractable content (as measured by the IP346 assay) of >3 %. CAS No. 64742-53-6 also reported to be a slight eye irritant in animal studies. Based on the data available, the chemicals are considered to be, at most, slightly irritating to eyes.
Sensitisation	The limited data available do not indicate a potential for skin sensitisation. CAS No. 64742-53-6 was negative in Buehler-type studies in guinea pigs.

Health Effects Summary	The critical health effects for the chemicals in this group are dependent upon the level of refinement. The critical health effects for less refined base oils (DMSO extractable content > 3 % in the IP346 assay) include carcinogenicity and developmental toxicity, acute effects (acute toxicity by the inhalation route of exposure) and local effects (skin irritation). Exposure to mists may also cause respiratory symptoms such as cough and phlegm.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity via dermal application was considered the most sensitive endpoint with the NOAEL for systemic effects reported at 800 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	Short-term toxicity to fish: In a key static 96-hour short-term fathead minnow (Pimephales promelas) limit test (OECD 203; KS=1), 10 animals/loading were exposed to the WAF of Basestock Solvent Neutral 600 (MRD-94 -981) at a nominal concentration of 100 mg/L. The LL50 was > 100 mg/L and the NOEL was ≥100 mg/L. Long-term toxicity to fish: For other lubricant base oils, read across has been applied for the long-term toxicity in fish endpoint, using the results of long-term toxicity testing on invertebrates (Daphnia magna). Toxic effects of hydrocarbons are primarily caused by narcosis and occur in a narrow range of molar concentrations across aquatic taxa; hence, read across between species is justified. Results of computer modelling to estimate aquatic chronic toxicity of other lubricant base oils in a 28-day freshwater fish study show no chronic toxicity to freshwater fish at or below its maximum attainable water solubility. This supports the applied interspecies read across. Short-term toxicity to aquatic invertebrates: In a key static 48-hour short-term Daphnia magna toxicity test (OECD 202; KS = 2), 10 animals/loading were exposed to the WAF of an other lubricant base oil, MVI(N) 40 base oil (CAS # 64742-53-6 or 64741-97-5), at nominal concentrations of 0, 10, 100, 1000, and 10,000 mg/L. The EL50 was >10,000 mg/L based on mobility and the NOEL was ≥ 1000 mg/L. Long-term toxicity to aquatic invertebrates: In a key semi-static 21-day long-term Daphnia magna toxicity test (OECD 211; KS = 2), 10 animals/loading were exposed to the WAF of other lubricant base oil LVIN 38 (CAS #64742-53-6) at nominal concentrations of 1, 10, 100 and 1000 mg/L. The NOEL was 10 mg/L based on reproduction. The loss of all daphnids in the 100 mg/L WAF was attributed to a non-treatment related effect, the cause of which was unknown. Further testing would be required to clarify the consequences of exposure to a 100 mg/L WAF of the base oil. Toxicity to aquatic algae: In a key static 72-hour algal (Pseudokirchneriella subcapitata) limit test (OECD 201; KS = 2), the freshwater alga was exposed to the WAF of another lubricant base oil (N100DW; CAS # 72623-87-1), at a nominal concentration of 100 mg/L. The NOEL was ≥ 100 mg/L based upon average specific growth rate and cell yield. Toxicity to microorganisms: In a key static 4-day Photobacterium phosphoreum luminescence inhibition study (KS=2) using other lubricant base oils as control substances, no significant luminescence inhibition was observed for Spindle oil (BP 320-400 ºC) and Neutral oil Ro NIII (BP 400-450 ºC), as well as for the n-paraffin dodecane. The actual NOEL for Spindle oil was > 1.93 mg/L and the actual NOEL for Neutral oil Ro NIII was > 2.17 mg/L.
Determination of PNEC aquatic	Based on the lowest chronic endpoint for Daphnia (10 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 0.1 mg/L.
Current Regulatory Controls[2,3,4,5,6]	
Australian Hazard Classification	Acute toxicity – category 4 Carcinogenicity – category 1B

	Skin irritation – category 2 Reproductive toxicity – category 2
Australian Occupational Exposure Standards	No specific exposure standards are available for specific chemicals. The exposure standard for oil mist, refined mineral is 5 mg/m^3 time weighted average (TWA). The applicability of this exposure standard for the chemicals will depend on the level of refinement.
International Occupational Exposure Standards	A number of countries have exposure standards for oil mist mineral including an exposure limit of 0.2–5 mg/m^3 (TWA) in different countries such as the United Arab Emirates, Japan, Austria, United States of America (USA) and Canada; and a short-term exposure limit (STEL) of 3–10 mg/m^3 in countries such as Sweden, Egypt, the USA, Canada, Singapore and Poland. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 5 mg/m^3 (TWA) for pure, highly and severely refined mineral oils. The ACGIH does not recommend application of this TLV to poorly- and mildly-refined mineral oils. No TLV is assigned based on insufficient data, although an A2 suspected human carcinogen classification is assigned.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[3] µg/L (ANZECC, 2000)
PBT Assessment[1]	
P/vP Criteria fulfilled?	Yes. In a supporting biodegradability study, Solvent Neutral 600 Base Oil (MRD-94 -981), was determined to be inherently biodegradable but not readily biodegradable with a mean degradation of 31.13% by day 28. In an additional supporting biodegradability study, an other lubricant base oil (GOHC 1468) was determined not to be readily biodegradable when it attained 2 to 4 % degradation within 28 days.
B/vB criteria fulfilled?	Calculated BCF for constituents of this substance range between 0.4 and 71100 L/kg.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, these chemicals do not meet the screening criteria for toxicity.
Overall conclusion	Not PBT. These chemicals are a UVCB. They do not contain PBT constituents included in the Substances of Very High Concern (SVHC) candidate list at concentrations above 0.1%.
Revised	December 2021

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Toxicity Summary - Distillates (petroleum), straight-run middle

Chemical and Physical Properties[1,2]	
CAS number	64741-44-2
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available
Melting point	-21 - 6°C at 101.325 kPa
Boiling point	150 - 399°C at 101.3 kPa
Vapour pressure	4 hPa at 40°C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Liquid, petroleum product
Overview	Whilst other compositional characteristics could influence toxicity, the toxicity profile of this chemical is expected to be dictated by the levels of polycyclic aromatic compounds (PACs), particularly those composed of 3, 4, 5, 6 and/or 7 fused aromatic rings. Due to the hydrotreating process, the chemicals in this group are expected to contain low levels of these PACs.
Environmental Fate[1]	
Soil/Water/Air	Hydrocarbons are degraded (under aerobic conditions) via mono-oxygenases or di-oxygenases and are subsequently carboxylated and ultimately hydroxylated. In further assessing the type of metabolites formed, it has been demonstrated that for all the major classes of hydrocarbons, the major metabolites are in most cases less toxic, and always less bioaccumulative than the parent molecule.
Human Health Toxicity Summary[1,2]	
Chronic Repeated Dose Toxicity	A key 'read across' 90-day dermal study in rats was identified in which vacuum tower overheads was applied to the shaved skin of rats, 5 days a weeks for 90-days. The NOAEL was 30 mg/kg/day, based on findings in liver, thymus and blood. A 28 day repeated dose toxicity studies in rabbits was identified for dermal exposure, plus a supporting 28 day dermal study in rats. There was one key read-across 90-day repeated dose toxicity study (OECD 413) for inhalation. For the read-across 90-day inhalation study, a NOAEC of 0.88 mg/L for local effects on the lung (increased relative wet weight in the absence of histopathological change) was established in rats expose to aerosol. A NOAEC of greater than or equal to 1.71 mg/L is established for systemic effects, based on no significant findings at this level. For the 28-day dermal study, a LOAEL of 200 mg/kg/day was established based on local irritation. No NOEL was determined for local irritation. The NOAEL for systemic effects in rabbits following repeated dermal exposure was greater than or equal to 2000 mg/kg/day.
Carcinogenicity	Distillates (petroleum), straight-run middle has been reported to produce squamous cell carcinomas and fibrosarcomas (20–25 % incidence) in long-term dermal carcinogenicity studies in mice when applied undiluted. However, data from other straight run gas oils that have been applied in diluted form indicate that the tumorigenic activity of straight-run middle distillates, with low levels of PACs, is likely to be a consequence of a non-genotoxic process associated with frequent cell damage and repair. In these studies, when the irritant effects were reduced, there were no significant increases in tumours relative to controls.

Mutagenicity/ Genotoxicity	In the key in vitro modified bacteria Ames study (similar to OECD 471), there was no evidence of mutagenic activity. This result was supported by other studies with straight run gas oils and related materials, the majority of which were negative. A key in vivo chromosome aberration assay (OECD 475) was identified, in which straight run middle distillate was not found to be mutagenic in male rat bone marrow cells. An additional chromosome aberration assay also showed negative results for mutagenicity (OECD 475).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the expected negligible amounts of PACs with 3–7 rings, the chemicals are not expected to show specific reproductive or developmental toxicity.
Acute Toxicity	The substance is considered to have low acute toxicity following oral and dermal exposure and moderate acute toxicity following inhalation exposure. The reported median lethal dose (LD50) for oral exposure in rats for distillates (petroleum), straight-run middle is >5000 mg/kg bw. Reported signs of toxicity included hypoactivity, diarrhoea and hair loss. In general, gas oils produced from secondary processing are considered to have low acute toxicity following oral exposure. The reported LD50 for dermal exposure in rats for distillates (petroleum), straight-run middle is >2000 mg/kg bw. Whilst no systemic effects were reported slight to moderate dermal irritation was observed. In an acute inhalation study conducted similarly to the Organisation for Economic Co-operation and Development Test Guideline (OECD TG) 403 with distillates (petroleum), straight-run middle, the median lethal concentration (LC50) was determined to be 1.78 mg/L. Reported signs of toxicity included reduced body weight gain, gross necropsy findings and acute histopathological changes in the lung.
Irritation	In general, gas oils are considered to be slightly to moderately irritating to the skin. In a skin irritation study in New Zealand White rabbits, distillates (petroleum), straight-run middle was applied to intact and abraded clipped skin on the back and flank of six rabbits, under occlusion for 24 hours. For intact skin, the mean erythema and oedema scores were 1.80 and 1.58, respectively. Effects were reversible within 14 days. Given that the chemical was tested under occlusive patch conditions and for longer periods of time than specified in the OECD TG 404 conditions, irritant responses might be more pronounced than would be expected in a standard study. Distillates (petroleum), straight-run middle were reported to be non-irritating to the eyes (unrinsed and rinsed) when tested equivalently or similarly to OECD TG 405. The mean conjunctival, iridial and corneal scores at 24-, 48- and 72-hours post-exposure were 0.
Sensitisation	Gas oils produced by secondary processing and distillates (petroleum), straight-run middle were not skin sensitisers in the guinea pig Buehler test.
Health Effects Summary	The critical health effect for risk characterisation is acute toxicity from inhalation exposure. The chemicals also have the potential to cause chemical pneumonitis if aspirated. Due to the hydrotreating process, the chemicals in this group are expected to contain low levels of PACs composed of 3–7 fused aromatic rings and, as such, are not considered to be genotoxic carcinogens. The chemicals are considered unlikely to cause skin tumours in the absence of prolonged skin irritation.
Key Study/Critical Effect for Screening Criteria	The 90-day repeated dose toxicity in rats via dermal application was considered the most sensitive endpoint with a NOAEL of 30 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	The 96h LL50 for freshwater fish is 21 mg/L. The estimated freshwater fish NOEL (No Observed Effect Level) value is 0.068 mg/L based on mortality. The 48 h EL50 for Daphnia was 68 mg/L. The estimated freshwater invertebrate NOEL (No Observed Effect Level) value is 0.167 mg/L based on immobility and numbers of live young produced per adult by Day 21.

	The 72 h ErL50 for algae was 22 mg/L.
Determination of PNEC aquatic	Based on the lowest endpoint for aquatic toxicity (0.167 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 0.001 mg/L.
Current Regulatory Controls[4,5]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[3] µg/L (ANZECC, 2000)
PBT Assessment[1]	
P/vP Criteria fulfilled?	No. Degradation was achieved at varying levels in the available tests. Two tests indicate that the substance is readily biodegradable (ignoring the 10-day window). As the 10-day window is not relevant to UVCB substances, therefore the substance is considered readily biodegradable
B/vB criteria fulfilled?	Gas oils components have log Kow values in the range 3.9 to greater than 6.
T criteria fulfilled?	No. Aquatic toxicity data >1 mg/L, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT. These chemicals are a UVCB. They do not contain PBT constituents included in the Substances of Very High Concern (SVHC) candidate list at concentrations above 0.1%.
Revised	December 2021

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Toxicity Summary - Distillates, petroleum, hydrotreated heavy naphthenic

Chemical and Physical Properties[1,2]	
CAS number	64742-52-5
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	No data available
Melting point	0°C at 101.325 kPa
Boiling point	207 - 750°C at 101.325 kPa
Vapour pressure	10 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	Non-flammable
Colour/Form	Liquid, petroleum product
Overview	These chemicals are refined distillate base oils derived from crude oil. It undergoes a series of extractive or transforming processes that improve the base stocks' performance characteristics and remove or reduce undesirable components such as polyaromatic compounds (PACs). The chemicals are complex mixtures of straight and branched-chain paraffinic, naphthenic and aromatic hydrocarbons having carbon numbers in the C15–C50 range. The chemical composition of these chemicals depends on both the original crude oil and on the refining process. The toxicity profile of these chemicals is dictated by the levels of PACs. Mineral oils containing <3 % w/w dimethylsulfoxide (DMSO) extractables (as measured by the IP346 assay) are considered highly or severely refined. Only white oils are considered highly refined by definition.
Environmental Fate[1]	
Soil/Water/Air	Hydrocarbons are degraded (under aerobic conditions) via mono-oxygenases or di-oxygenases and are subsequently carboxylated and ultimately hydroxylated. In further assessing the type of metabolites formed, it has been demonstrated that for all the major classes of hydrocarbons, the major metabolites are in most cases less toxic, and always less bioaccumulative than the parent molecule.
Human Health Toxicity Summary[1,2,3]	
Chronic Repeated Dose Toxicity	In separate 4-week single-dose studies, New Zealand White rabbits were dermally exposed to 1000 mg/kg bw/day of the chemicals identified by CAS Nos. 64741-88-4, 64742-56-9 and 64742-65-0. There were no significant signs of systemic toxicity. Signs of irritation were observed both macroscopically (erythema and oedema) and microscopically (inflammation, hyperplasia and hyperkeratosis). In a 13-week study, Sprague Dawley (SD) rats were dermally exposed to 800 or 2000 mg/kg bw/day, for five days a week. The no observed adverse effect level (NOAEL) for systemic effects was reported as 800 mg/kg bw/day based on increased liver weights and histopathological changes observed in high-dose females. Signs of irritation were observed at both dose levels, both macroscopically (erythema and oedema) and microscopically (inflammation, hyperplasia and hyperkeratosis). As application sites were not covered, exposure may have been less than intended. Increased liver weights were also observed in a 3-week dermal study with CAS No. 64742-70-7. In this study, SD rats were dermally exposed to 1720 mg/kg bw/day (five days/week). Effects were observed in both males and females. As application sites were not covered, exposure may have been less than intended.

Carcinogenicity	These chemicals are classified as hazardous, Category 2 carcinogens with the risk phrase 'May cause cancer'. Skin tumours have been observed in mice following exposure to several unrefined or mildly refined base oils. In a dermal carcinogenicity study in mice, the chemical with CAS No. 64742-53-6 increased the incidence of skin tumours. Petroleum substances containing <3 % w/w DMSO extractables (as measured by the IP346 assay), or which are negative in the modified Ames test (mutagenicity index <1) are not carcinogenic to skin.
Mutagenicity/ Genotoxicity	The genetic toxicity of the chemicals is expected to be related to the level of refinement and associated removal of PACs. The results for the chemical CAS No. 64742-53-6 were positive in an in vitro mouse lymphoma mutation assay but the results for CAS No. 64742-52-5 were negative in a similar study.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data are available for the chemicals. Certain petroleum streams have been shown to be developmentally toxic from dermal exposure. Effects include increased incidence of resorptions and decrease in foetal body weight. The developmental toxicity of the chemicals is expected to be correlated with the level of refinement of the chemicals.
Acute Toxicity	These chemicals are considered to be of low acute toxicity following oral and dermal exposure. The chemical identified by CAS Nos. 64742-53-6, has a reported median lethal dose (LD50) in rabbits of greater than 2000 mg/kg bw. Signs of skin irritation (slight to severe for erythema and oedema and desquamation) were observed in some studies. Based on data available, the chemicals in this group are expected to have low to moderate toxicity following inhalation exposure. Based on the reported median lethal concentration (LC50) value (2.18 mg/L/4-h) for an insufficiently refined oil, classification is considered appropriate for the chemicals in this group. However, this classification need not apply for highly or severely refined oils, containing <3 % w/w DMSO extractables (as measured by the IP346 assay). In an acute inhalation toxicity study, rats were exposed to an aerosol of the chemical identified by CAS No. 64742-53-6 at concentrations of 1, 1.5, 2.5, 3.5 and 5 mg/L for four hours. All the animals in the two high dose groups, and three males and three females in the 2.5 mg/L dose group died. The LC50 was 2.18 mg/L/4-h. Observed sublethal effects included decreased activity, rapid breathing and congestion, and inflammation of the lungs. The test chemical was reported to have a DMSO extractable content of >3 % as measured by the IP346 assay. Two further acute inhalation studies were available for the chemical identified by CAS No. 64742-53-6. In a single dose study in rats, 80 % mortality was observed at 5.7 mg/L/4-h. The DMSO extractable content was not reported. In another rat study, the LC50 was reported to be 10.5 mg/L/4-h for males and 9.5 mg/L/4-h for females. The cause of death appeared to be associated with lung congestion and/or oedema. The test chemical was reported to be highly or severely refined oils containing <3 % w/w DMSO extractables. Acute inhalation data were available for several highly or severely refined oils containing <3 % w/w DMSO extractables. In general, no mortalities were observed.
Irritation	Animal skin irritation data were available for several highly or severely refined oils containing <3 % w/w DMSO extractables. In general, slight skin irritation effects were considered to be not sufficient for classification. These minimally irritant effects are consistent with irritant responses observed in humans. Very slight irritant effects were observed in four separate repeated insult patch tests in human volunteers with highly or severely refined oils, containing <3 % w/w DMSO extractables. CAS No. 64742-53-6 produced erythema and oedema (mean scores greater than two over 72 hours for both endpoints) following application to intact rabbit skin. Effects were fully reversible within 14 days. The test chemical was reported to have a DMSO extractable content (as measured by the IP346 assay) of >3 %. CAS No. 64742-53-6 also reported to be a slight eye irritant in animal studies. Based on the data available, the chemicals are considered to be, at most, slightly irritating to eyes.
Sensitisation	The limited data available do not indicate a potential for skin sensitisation. CAS No. 64742-53-6 was negative in Buehler-type studies in guinea pigs.

Health Effects Summary	The critical health effects for the chemicals in this group are dependent upon the level of refinement. The critical health effects for less refined base oils (DMSO extractable content > 3 % in the IP346 assay) include carcinogenicity and developmental toxicity, acute effects (acute toxicity by the inhalation route of exposure) and local effects (skin irritation). Exposure to mists may also cause respiratory symptoms such as cough and phlegm.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity via dermal application was considered the most sensitive endpoint with the NOAEL for systemic effects reported at 800 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	Short-term toxicity to fish: In a key static 96-hour short-term fathead minnow (Pimephales promelas) limit test (OECD 203; KS=1), 10 animals/loading were exposed to the WAF of Basestock Solvent Neutral 600 (MRD-94 -981) at a nominal concentration of 100 mg/L. The LL50 was > 100 mg/L and the NOEL was ≥100 mg/L. Long-term toxicity to fish: For other lubricant base oils, read across has been applied for the long-term toxicity in fish endpoint, using the results of long-term toxicity testing on invertebrates (Daphnia magna). Toxic effects of hydrocarbons are primarily caused by narcosis and occur in a narrow range of molar concentrations across aquatic taxa; hence, read across between species is justified. Results of computer modelling to estimate aquatic chronic toxicity of other lubricant base oils in a 28-day freshwater fish study show no chronic toxicity to freshwater fish at or below its maximum attainable water solubility. This supports the applied interspecies read across. Short-term toxicity to aquatic invertebrates: In a key static 48-hour short-term Daphnia magna toxicity test (OECD 202; KS = 2), 10 animals/loading were exposed to the WAF of an other lubricant base oil, MVI(N) 40 base oil (CAS # 64742-53-6 or 64741-97-5), at nominal concentrations of 0, 10, 100, 1000, and 10,000 mg/L. The EL50 was >10,000 mg/L based on mobility and the NOEL was ≥ 1000 mg/L. Long-term toxicity to aquatic invertebrates: In a key semi-static 21-day long-term Daphnia magna toxicity test (OECD 211; KS = 2), 10 animals/loading were exposed to the WAF of other lubricant base oil LVIN 38 (CAS #64742-53-6) at nominal concentrations of 1, 10, 100 and 1000 mg/L. The NOEL was 10 mg/L based on reproduction. The loss of all daphnids in the 100 mg/L WAF was attributed to a non-treatment related effect, the cause of which was unknown. Further testing would be required to clarify the consequences of exposure to a 100 mg/L WAF of the base oil. Toxicity to aquatic algae: In a key static 72-hour algal (Pseudokirchneriella subcapitata) limit test (OECD 201; KS = 2), the freshwater alga was exposed to the WAF of another lubricant base oil (N100DW; CAS # 72623-87-1), at a nominal concentration of 100 mg/L. The NOEL was ≥ 100 mg/L based upon average specific growth rate and cell yield. Toxicity to microorganisms: In a key static 4-day Photobacterium phosphoreum luminescence inhibition study (KS=2) using other lubricant base oils as control substances, no significant luminescence inhibition was observed for Spindle oil (BP 320-400 ºC) and Neutral oil Ro NIII (BP 400-450 ºC), as well as for the n-paraffin dodecane. The actual NOEL for Spindle oil was > 1.93 mg/L and the actual NOEL for Neutral oil Ro NIII was > 2.17 mg/L.
Determination of PNEC aquatic	Based on the lowest chronic endpoint for Daphnia (10 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 0.1 mg/L.
Current Regulatory Controls[2,3,4,5,6]	
Australian Hazard Classification	Acute toxicity – category 4 Carcinogenicity – category 1B

	Skin irritation – category 2 Reproductive toxicity – category 2
Australian Occupational Exposure Standards	No specific exposure standards are available for specific chemicals. The exposure standard for oil mist, refined mineral is 5 mg/m^3 time weighted average (TWA). The applicability of this exposure standard for the chemicals will depend on the level of refinement.
International Occupational Exposure Standards	A number of countries have exposure standards for oil mist mineral including an exposure limit of 0.2–5 mg/m^3 (TWA) in different countries such as the United Arab Emirates, Japan, Austria, United States of America (USA) and Canada; and a short-term exposure limit (STEL) of 3–10 mg/m^3 in countries such as Sweden, Egypt, the USA, Canada, Singapore and Poland. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 5 mg/m^3 (TWA) for pure, highly and severely refined mineral oils. The ACGIH does not recommend application of this TLV to poorly- and mildly-refined mineral oils. No TLV is assigned based on insufficient data, although an A2 suspected human carcinogen classification is assigned.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[3] µg/L (ANZECC, 2000)
PBT Assessment[1]	
P/vP Criteria fulfilled?	Yes. In a supporting biodegradability study, Solvent Neutral 600 Base Oil (MRD-94 -981), was determined to be inherently biodegradable but not readily biodegradable with a mean degradation of 31.13% by day 28. In an additional supporting biodegradability study, an other lubricant base oil (GOHC 1468) was determined not to be readily biodegradable when it attained 2 to 4 % degradation within 28 days.
B/vB criteria fulfilled?	Calculated BCF for constituents of this substance range between 0.4 and 71100 L/kg.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, these chemicals do not meet the screening criteria for toxicity.
Overall conclusion	Not PBT. These chemicals are a UVCB. They do not contain PBT constituents included in the Substances of Very High Concern (SVHC) candidate list at concentrations above 0.1%.
Revised	December 2021

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4. Food Standards Australia New Zealand (FSANZ) 20th Australian Total Diet Survey. Retrieved 2021: https://www.foodstandards.gov.au/publications/pages/20thaustraliantotaldietsurveyjanuary2003/20thaustraliantotaldietsurveyfullreport/partb20thatds/partbmetals.aspx.
5. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
6. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.

Toxicity Summary - Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine

Chemical and Physical Properties[1,2]	
CAS number	68990-47-6
Molecular formula	Unknown or variable composition, complex reaction products or biological materials (UVCB)
Molecular weight	UVCB
Solubility in water	2.17 mg/L
Melting point	No data available
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	No data available
Colour/Form	Solid with a dark colour at room temperature
Overview	This substance is used by consumers, in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
Environmental Fate[1]	
Soil/Water/Air	The substance is not expected to be readily biodegradable. On the basis of the very low water solubility and its chemical nature, the substance is expected to have a high ability to absorb to soil. Due to its complex composition, methods for the experimental measurement of octanol -water partition coefficient (Kow) of Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine are technically not applicable. On the basis of the high solubility in octanol (> 30 mg/L) compared to the solubility in water (2.17 ppm), and the chemical nature, Kow value for the substance is expected to be high. Estimated Log Kow value for the smallest molecule arising from the chemical synthesis is 11.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Test item-related histopathological changes were restricted to the lung. Multifocal subacute bronchopneumonia, characterized by peribronchial foci of prominent fibrosis, with re-epithelialization, infiltration with mononuclear cells, histiocytes and occasional multinucleated cells, was observed in a small proportion of treated males and females of all dose groups, without dose relationship. In addition, a mild amount of intrahistiocytic black material was seen in the lung of each one male treated at 300 or 1000 mg/kg/day. As a conclusion, based on the pathological evaluation, a No-Observed-Effect-Level (NOEL) could not be determined in this study.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	The test item Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine is considered to be non-clastogenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the data generated from this combined repeated dose toxicity and reproduction/ developmental toxicity screening test with Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine, no effects were reported on reproductive/ developmental toxicity parameters measured in this study. There

	were also no effects reported on general toxicity parameters except for the reported macroscopic/microscopic lung changes. Due to the lack of clear dose-response relationship (solely restricted to histopathological lung changes) observed in this study, the suitable NOAEL (No observed adverse effect level) general toxicity could not be determined. However, for reproductive/ developmental toxicity, the NOAEL could be set at 1000 mg/kg bw.
Acute Toxicity	The test substance was assessed for its acute oral toxicity potential when administered to albino rats. The acute oral LD50, as indicated by the data, is greater than 2020 mg/kg in males and females.
Irritation	Not irritating to skin and eye.
Sensitisation	Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine caused reactions identified as sensitisation at the tested concentration.
Health Effects Summary	The substance is expected to have low acute toxicity and is not an irritant. The substance may cause skin sensitisation.
Key Study/Critical Effect for Screening Criteria	The reproductive/ developmental toxicity in rats was considered the most sensitive endpoint with a NOAEL of 1000 mg/kg bw/day.
Ecological Toxicity[1,2,3]	
Aquatic Toxicity	Short term toxicity: LC50 (4 days): 100 mg/L (fish) NOEC (4 days): 100 mg/L (fish) LOEC (4 days): 100 mg/L (fish) IC50 (48 h): 100 mg/L (invertebrates) NOEC (48 h): 100 mg/L (invertebrates) LOEC (48 h): 100 mg/L (invertebrates) EC50 (72 h): 100 mg/L (algae)
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 1000 is applied to the lowest NOEC of 100 mg/L. A PNECaqua of 0.1 mg/L was derived.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Yes. Not inherently biodegradable.
B/vB criteria fulfilled?	Yes. Bioaccumulation of this substance may occur in aquatic organisms based on the estimated Log Kow of 11 (Log Kow > 4.2).
T criteria fulfilled?	No. Acute toxicity data >1 mg/L in fish, invertebrates and algae, thus the substance does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

Revised	December 2021

References

1. ECHA REACH, Fatty acids, tall-oil, reaction products with diethylenetriamine, maleic anhydride, tetraethylenepentamine and triethylenetetramine, Retrieved 2021: https://echa.europa.eu/.
2. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
3. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
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Toxicity Summary - Graphite

Chemical and Physical Properties[1,2]	
CAS number	7782-42-5
Molecular formula	C
Molecular weight	12.011
Solubility in water	Insoluble
Melting point	600°C at 101.3 kPa
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Odourless black solid powder
Overview	Graphite is a naturally-occurring form of crystalline carbon. It is a native element mineral found in metamorphic and igneous rocks. It is extremely soft, cleaves with very light pressure, and has a very low specific gravity. In contrast, it is extremely resistant to heat and nearly inert in contact with almost any other material. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment.
Environmental Fate[1,2]	
Soil/Water/Air	Graphite is a crystal modification of the chemical element carbon, an inorganic substance with negligible water solubility. Therefore, neither hydrolysis, biodegradation, nor adsorption is of relevance for the fate of the molecule. Transport and distribution is of no relevance by the negligible solubility of the substance and as element "C" in its overall availability in different organic and inorganic forms in the environment.
Human Health Toxicity Summary[1,7]	
Chronic Repeated Dose Toxicity	Oral: - One study according to OECD 422 (subacute) was conducted - Concentrations tested were up to the limit dose specified in OECD 422 = 1000 mg/kg bw/day (nominal) - No effects due to Graphite exposure were found, neither on systemic toxicity nor on reproductive/developmental toxicity Inhalation: - Two studies according to OECD 412 (subacute) were conducted - Synthetic Graphite (SG; w/o Quartz) and Expanded Graphite (EG; with Quartz) were compared separately - Testing of SG resulted in a NOAEL of 12 mg/m^3, whereas testing of EG resulted in a NOAEL of 8 mg/m^3 - Both qualities showed effects that were to be expected for a poorly soluble dust with low toxicity, with partly recovery after 28 days - Exposure was generally well tolerated - Despite the respiratory system no other organs were affected at all - No sign of systemic toxicity was observed
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No evidence for any genotoxic potential of Graphite.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	OECD 422 (combined repeated dose toxicity study with the reproductive/developmental toxicity screening test) - Oral administration via food (incl. analytical verification) - Graphite was tested up to the limit dose given in OECD 422 (nominal 1000 mg/kg bw/day) - Result: No signs of systemic toxicity were observed, no signs of any effects on development, reproduction, or fertility - NOAEL based on nominal food intake = 1000 mg/kg bw/day
Acute Toxicity	Oral (OECD 423, conducted as limit test): - None of the animals showed any clinical signs of reaction to the treatment. - LD50 > 2000 mg/kg bw Inhalation (OECD 403, conducted as limit test): - Upon cessation of exposure via inhalation none of the rats exposed to Graphite showed any signs of toxicity. - Only usual signs of discomfort after exposure to particles were observed. Grooming activity started immediately after the end of exposure. - LC50 > 2000 mg/m^3
Irritation	Not irritating to skin and eyes.
Sensitisation	Not sensitising
Health Effects Summary	A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered. Repeated or prolonged inhalation of dusts may cause effects on the lungs. This may result in graphite pneumoconiosis. Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	Nominal doses up to 1000 mg/kg bw/day were well tolerated and did not show any sign for systemic toxicity. Since the study was conducted as a combined repeated dose toxicity study with the reproductive/developmental toxicity screening test, several NOAELs were obtained, all representing the nominal dose of 1000 mg/kg bw/day. However, the actual substance intake varied from about 813 mg/kg bw/day up to 1159 mg/kg bw/day. The derived no effect levels were calculated using the NOAEL of 813 mg/kg bw/day.
Ecological Toxicity[1]	
Aquatic Toxicity	The short-term fish toxicity was determined to be > 100 mg/L for the LC50 and > 100 mg/L for the NOEC. The short-term toxicity for aquatic invertebrates (daphnids) was determined to be > 100 mg/L for the EC50 and > 100 mg/L for the NOEC. Based in the result obtained by a valid GLP-OECD 201 study in algae with graphite as test item, no toxic effects were found up to the highest tested concentration of 100 mg/L.
Determination of PNEC aquatic	A Tier 1 assessment of the environmental risks of graphite is not required.
Current Regulatory Controls[4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	Time Weighted Average (TWA): 3 mg/m^3
International Occupational Exposure Standards	Threshold limit value, TLV: (respirable fraction): 2 mg/m^3, as TWA. Maximum workplace concentration, MAK: (inhalable fraction): 4 mg/m^3. MAK: (respirable fraction): 0.3 mg/m^3; peak limitation category: II(8); pregnancy risk group: C; carcinogen category: 4
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.

Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic mineral, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic, insoluble minerals.
T criteria fulfilled?	No. Acute data >1 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

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Toxicity Summary - Disodium pyrophosphate

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	Na2H2P2O7
Molecular weight	221.94
Solubility in water	170 g/L at 20 °C and pH 3.8 - 3.9
Melting point	449.85 °C
Boiling point	No data available.
Vapour pressure	0 Pa at 20 °C
Henrys law constant	No data available.
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	White crystalline powder
Overview	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [4]	
Soil/Water/Air	Disodium pyrophosphate is an inorganic solid and therefore can be considered to be non volatile. No experimental data on bioaccumulation exist. However due to the hydrophilic nature of the substance, bioaccumulation is not expected as accumulation in fats is not possible. The substance when dissolved in water (and so animal tissues/fluids) will effectively separate into/become simply the two ions "phosphate" and "sodium" which are natural ionic components of blood, cell fluids, etc and therefore no further testing is considered to be necessary.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	One key study is available on an analogous substance for the sub-chronic toxicity endpoint. On the basis of this study the NOAEL was determined to be 500 mg/kg bw/day.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	None of the studies suggest the substance is mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	Acute oral toxicity: The oral LD50 value is derived using a weight of evidence approach. Taking into account the five studies available on disodium dihydrogenpyrophosphate and the available studies on tetrapotassium pyrophosphate and tetrasodium pyrophosphate which are considered to be of similar systemic toxicity, the weight of evidence indicates that the oral LD50 is greater than the classification limit of 2000 mg/kg bw/day. Acute inhalation toxicity: One key study is available to assess the acute inhalation toxicity of disodium dihydrogenpyrophosphate. Disodium dihydrogenpyrophosphate is considered to exhibit a low potential toxicity via the inhalation route and is not expected to be of significant concern. The acute inhalation median concentration (LC50) of disodium dihydrogenpyrophosphate in male and female rats was estimated to be > 0.58 mg/L (the maximum attainable concentration). Acute dermal toxicity: One key study is available to assess the acute dermal toxicity of disodium dihydrogenpyrophosphate. The key study (Bradshaw, 2010) has been conducted according to a current guideline (OECD Method 402) and

	according to the principles of GLP. The acute dermal median lethal dose (LD50) of the test material in the Wistar strain rat was found to be > 2000 mg/kg bodyweight.
Irritation	Disodium pyrophosphate was determined to be a mild irritant to rabbit skin with a primary dermal irritation score of 2.58, mostly the reactions were noted in abraded skin. The test material produced a maximum group mean score of 39.0 and was classified as a moderate irritant (Class 5 on a 1 to 8 scale) to the rabbit eye.
Sensitisation	Disodium pyrophosphate is a non-sensitiser under the conditions of the study.
Health Effects Summary	Disodium pyrophosphate has low acute oral and dermal toxicity and moderate acute toxicity by the inhalation route. The substance is a skin and eye irritant.
Key Study/Critical Effect for Screening Criteria	The NOAEL from the sub-chronic toxicity study of 500 mg/kg bw/day is used for risk characterisation.
Ecological Toxicity [4]	
Aquatic Toxicity	96h LC50 (fish): > 100 mg/l 48h EC50 (invertebrates): 100 mg/L 72h EC50 (algae): 100 mg/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest EC50 100 mg/L (fish, invertebrates, algae). A PNECaqua of 1 mg/L was derived.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	No. The substance is an inorganic compound and is not subject to biodegradation.
B/vB criteria fulfilled?	No. Not expected to bioaccumulate.
T criteria fulfilled?	No. Inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Ethanamine, N-ethyl-N-hydroxy-

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	C4H11NO
Molecular weight	89.14
Solubility in water	8.9 x 10^4 mg/L at 25 °C (estimated)
Melting point	10.0 °C
Boiling point	133.0 °C
Vapour pressure	3.36 mm Hg at 25 °C
Henrys law constant	5.9 x 10^{-8} atm-cu m/mol at 25 °C (estimated)
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Liquid
Overview	Diethylhydroxylamine's is used as photographic developer, antioxidant, corrosion inhibitor and as a short stopping agent in synthetic rubber production.
Environmental Fate [2]	
Soil/Water/Air	If released to air, an extrapolated vapor pressure of 3.36 mm Hg at 25 °C, indicates that diethylhydroxylamine is expected to exist solely in the vapour phase in the ambient atmosphere. Vapour-phase diethylhydroxylamine is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 hours. Diethylhydroxylamine does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to undergo direct photolysis by sunlight. If released to soil, diethylhydroxylamine is expected to have high mobility based upon an estimated Koc of 74. The estimated pKa of diethylhydroxylamine is 5.7, indicating it will partially exist in the protonated form in moist soils. The mobility of diethylhydroxylamine may be overestimated since cations generally adsorb more strongly to soils containing organic carbon and clay than neutral species. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 5.9 x 10^{-8} atm cu m/mol atm-cu m/mole for the free base, and the fact that cations do not volatilize. The potential for volatilization of diethylhydroxylamine from dry soil surfaces may exist based upon the extrapolated vapor pressure. Diethylhydroxylamine was biodegraded between 1-9% in the Japanese MITI test, suggesting it may be slow to biodegrade in the environment. If released to water, diethylhydroxylamine (free base) is not expected to adsorb to suspended solids and sediment based upon the estimated Koc; however, the protonated form (conjugate acid) may be more likely to adsorb to sediment. Volatilization from water surfaces is not expected to be an important environmental fate process based on the Henry's Law constant for the neutral species and the fact that cations do not volatilize. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. An estimated BCF value of 3, suggests the potential for bioconcentration in aquatic organisms is low.
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	1 -Diethylhydroxylamine toxicity was evaluated in a 28-day study in rats performed according to the OECD TG # 412 (Naas, 1996a). The test article was administered via nose-only inhalation to three groups, each comprised of 15 male and 15 female Crl: CDBR rats, for a period of six hours per day, five days per week, for four consecutive weeks (minimum of 20 total exposures). The targeted exposure concentrations were 15, 150 and 1500 ppm. The test atmosphere concentrations were monitored by infrared absorbance and were found to be 15, 150 and 1500

	ppm (54.6, 546.0 and 5481.8 mg/m3). A concurrent control group of identical design received only filtered air, on a comparable regimen. The animals were observed for clinical signs and effects on body weight, food consumption and clinical pathology parameters. Data from detailed physical examinations, including Functional Observational Battery data (handling and open field observations), were recorded during the pre-test period and during weeks 0 through 5. After completion of exposure, 5 rats/sex/group entered an approximate two-week (non exposure) recovery period, after which they were euthanized; necropsies were performed, and selected organs were weighed. The remaining rats in each group were euthanized immediately following the exposure period and necropsied as described above. A microscopic examination was conducted on selected tissues from all groups. In the control, 15, 150 and 1500 ppm groups, 2, 1, 2 and 2 animals, respectively, were found dead during the study. These deaths were noted while the animals were in the exposure tube either prior to exposure, during exposure or at the time of unloading from the exposure tubes. The deaths did not occur in an exposure-related manner and were not related to exposure to the test article. All other animals survived to the scheduled necropsies. The predominant treatment-related clinical signs were dried yellow dorsal posterior and urogenital matting, lack of grooming, eye closure and hypoactivity in males and females in the 1500 ppm group, and ataxia, paleness in colour, walking on tiptoes and hunched posture in the females in this group. The findings of ataxia, paleness in colour, walking on tiptoes, hunched posture, eye closure and hypoactivity were transient in that they occurred only at the post-exposure observation and not prior to exposure or during the Functional Observational Battery. During the recovery period, no significant findings were noted at any exposure level. The only potential test article-related finding noted during the Functional Observational Battery evaluations (handling and open field observations) was an increase in slightly soiled or very soiled fur in the 1500 ppm group males and females during weeks 0 to 2. During the recovery period, no test article-related findings were noted during the Functional Observational Battery evaluations. Reductions in mean body weight gain were noted in males and females in the 1500 ppm group during week 0-1 and in males in this group throughout the remainder of the exposure period. Food consumption was reduced in the 1500 ppm group males and females during week 0-1. During the recovery period, body weights and food consumption in these animals were similar to the control group values. At the week 4 evaluation, the segmented neutrophil count was increased in the 1500 ppm group mates and females, and the lymphocyte count was reduced in the females in this group. Alkaline phosphatase and phosphorous values were increased in the 1500 ppm group males and females at the week 4 evaluation. At the week 4 evaluation, albumin levels were decreased in the 1500 ppm group (both sexes) and the 150 ppm group (females only), and globulin was increased in the 1500 ppm females. These changes corresponded with decreased A/G ratios in the 1500 ppm group (both sexes) and the 150 ppm group females. A slight but statistically significant increase in alanine aminotransferase in the 1500 ppm group females (week 4) may also have been treatment-related. Bile acids were increased in the mates in the 1500 ppm group at the week 4 evaluation. At the week 6 evaluation, the values for all of these parameters were similar to the control group values. (Although bile acids appeared elevated at the week 6 evaluation for 1500 ppm mates, this was due to a low control value and unrelated to the test article.) Other hematology and serum chemistry values and urinalysis parameters were unaffected by exposure to the test article at any exposure level. No test article-related internal findings were noted at the necropsies of animals that died during the study or at the scheduled necropsies. At the week 4 necropsy, thymus gland weights (relative and absolute) were reduced in males and females in the 1500 ppm group. Mean liver weights (absolute and relative) were increased in the 1500 ppm group females at the week 4 necropsy. Organ weights were comparable to the control group values at the week 6 (recovery) necropsy. test article-related microscopic observations were noted. At the week 4 necropsy, reversible test article-related microscopic changes consisting primarily of non suppurative mucosal inflammation, but also including squamous hyperplasia and necrosis in a limited number of animals, were noted in the nasal passages of male and female rats in the 150 and 1500 ppm groups; these effects were considered to be local, not systemic. At the recovery necropsy, only one rat of each sex in the 1500 ppm group had minimal non suppurative mucosal inflammation in the nasal cavity. Medullary plasmacytosis was noted at an increased incidence in the iliac and popliteal lymph nodes in males in the 1500 ppm group. At the recovery necropsy, no exposure-related microscopic effects were noted in males or females at any dose level. In conclusion, toxicity was exhibited in the 1500 ppm group by clinical signs, inhibition of body weight gain

	and food consumption, changes in white blood cell differential counts, various serum chemistry changes, reduced thymus gland weights-and increased liver weights. Medullary plasmacytosis was noted in the iliac and popliteal lymph nodes in males in the 1500 ppm group. Systemic effects in the 150 ppm group were limited to slight decreases in albumin and A/G ratio (females only). Based on data collected following a two-week non exposure (recovery) period, all of these effects were considered to be reversible. Microscopic changes were noted in the nasal passages of male and female rats in the 150 and 1500 ppm groups; these effects were considered to be due to local irritation, not systemic toxicity, and reversible. The hematological, serum chemistry and organ weight (thymus and liver) effects in the 1500 ppm group indicate that the liver and thymus were the target organs, however, no test article related histomorphological changes were seen in these tissues. Based on these results, exposure levels of 150 ppm (546.0 mg/m^3) and 15 ppm (54.6 mg/m^3) were considered to be the NOAEC (no observed adverse effect concentration) and NOEC (no observed effect concentration), respectively, for systemic toxicity and the exposure level of 15 ppm (54.6 mg/m^3) was considered to be the NOEC for nasal irritation.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vitro genotoxicity assays, diethylhydroxylamine appeared to be clastogenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The developmental toxicity of diethylhydroxylamine was evaluated in rats according to OECD Guideline 414. Diethylhydroxylamine was administered by oral gavage on gestation days 6 to 15. Maternal toxicity included decreased body weight and food consumption at 393 and 568 mg/kg/day. No evidence of developmental toxicity was observed at any dose level. No teratogenic effects were detected in mice exposed to 8.9 ppm on days 6-17 of gestation. While negative, this study is compromised by technical and protocol deficiencies.
Acute Toxicity	Oral route In a pre-guideline study, groups of 5 WBS/W rats were administered dose levels of 1400, 2000, 2800, 4000 mg/kg bw of diethylhydroxylamine (undiluted) by stomach tube (Latven, 1977a). The animals were then observed for 7 days following exposure. At 4000 mg/kg, 5/5 rats died, at 2800 mg/kg bw 4/5 rats died, at 2000 mg/kg bw, 2/5 rats died and at 1400 mg/kg bw none died. Clinical observations revealed muscular incoordination and general depression. Autopsy findings were negative. The LD50 was 2190 mg/kg bw. In a pre-guideline study, groups of 2, 5 or 10 male OF1 mice were administered dose levels of 875, 1000, 1300, 1800, 2400, 3200, 4300, 8750 mg/kg bw of diethylhydroxylamine by stomach tube (Latven, 1957). The animals were then observed for 7 days following exposure. No mortality was observed at 875, 1000 and 1300 mg/kg bw, at 1800 mg/kg, 2/10 mice died, at 2400 mg/kg bw 7/10 mice died, at 3200 mg/kg bw, 10/10 mice died and at 4300 and 8750 mg/kg bw 2/2 mice died. Clinical observations revealed decrease motor activity, ataxia, complete inactivity, muscular hypotonicity, loss of righting reflex, muscular spasms, mild clonic convulsions, respiratory depression, cyanosis and death. The LD50 was 2150 mg/kg bw. Inhalation route In an acute inhalation toxicity study performed according to the US EPA guideline (Terrill, 1986), series of groups consisting of five male and five female Sprague-Dawley derived rats was exposed to diethylhydroxylamine vapor for four hours mean analytical levels in the range of 1410 to 4720 parts per million (ppm). At 1410 and 2650 ppm, no rat died, 3240 and 3560 ppm, 1/5 male and 5/5 female rats died, and at 4720 ppm, all rats died. The mortality results indicated the test material was more lethal to female rats than to male rats. Signs attributable to treatment included death, increased incidences of secretory responses, respiratory distress, general signs of poor condition, corneal opacity and loss of body weight. Overall, the time-to-onset and time-to-recovery of these signs were related to exposure concentration. The lungs of numerous animals, both treated and control,

	were discoloured primarily scattered red-grey foci were observed in the animals which were killed at the end of the study, whereas in the animals which died, the lungs were bright to dark red. The toxicologic significance of these findings, if any, cannot be determined on the basis of a gross examination only. The LC50 was determined 4400 ppm for the males, 2620 ppm for the females and 3140 ppm for both sexes combined. Dermal route In a pre-guideline study, groups of 4 albino rabbits were treated dermally under a pre-fitted occluding sleeve with 707, 1000, 1414 and 2000 mg/kg body weight of diethylhydroxylamine (Latven, 1980a). The occluding sleeve was removed 24 hours following exposure and the animals were observed for 7 days. No rabbit died at 707 mg/kg/bw, at 1000 mg/kg bw, 1/4 rabbit died, at 1414 mg/kg bw, 2/4 rabbits died and at 2000 mg/kg bw, all rabbits died. The clinical signs observed were hypersensitivity, mydriasis, and incoordination prior to toxic incapacitation. The acute dermal LD50was 1300 mg/kg bw. In two other pre-guideline studies (Latven, 1977 and 1979), groups of three albino rabbits were treated dermally with a single dose of 2000 mg/kg (2.24 ml/kg) diethylhydroxylamine and three additional rabbits were treated with a single dose of 200 mg/kg (2.0 ml/kg of a 10% W/V aqueous dilution). Individual doses were applied to the fur-clipped skin of the trunk under a pre-fitted impervious sleeve on each of the animals. After a skin-contact period of 24 hours, the sleeves were removed and in one study (Latven, 1979) the treated sites were gently cleansed with a 2% solution of acetic acid. Surviving animals were then observed for seven days. All animals died at 2000 mg/kg bw and none at 200 mg/kg bw.
Irritation	Diethylhydroxylamine is slightly irritating to rabbit skin and eyes and irritating to the respiratory tract. In an in vitro genotoxicity assays, diethylhydroxylamine appeared to be clastogenic.
Sensitisation	Not a skin sensitizer.
Health Effects Summary	Diethylhydroxylamine has moderate chronic toxicity, is a potential skin and eye irritant, and is not a skin sensitiser.
Key Study/Critical Effect for Screening Criteria	The NOEC of 15 ppm (54.6 mg/m^3) for nasal irritation was considered to be key study for risk characterisation.
Ecological Toxicity [1]	
Aquatic Toxicity	96 hr LC50 (fish): 134 mg/L 48 hr EC50 (invertebrates): 8.2 mg/L 72 hr EC50 (algae): 101 mg/L 28 days NOEC (microorganisms): 100 mg/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 48 hr EC50 of 8.2 mg/L (invertebrates). A PNECaqua of 82 µg/L was derived.
Current Regulatory Controls [5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.

Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	Yes. The substance is not readily biodegradable. Therefore, it meets the screening criteria for persistence.
B/vB criteria fulfilled?	No. As the log Pow = -0.17 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 of the substance is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Ethanolamine

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	C_2H_7NO
Molecular weight	61.08
Solubility in water	Miscible in water at 25 °C
Melting point	10.3 °C
Boiling point	170.8 °C
Vapour pressure	0.05 kPa at 20 °C
Henrys law constant	0 Pa m^3/mol at 25 °C
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Colourless viscous liquid (or solid below 10oC), with unpleasant, fishy, ammoniacal smell.
Overview	A Tier 1 Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to the environment.
Environmental Fate [1]	
Soil/Water/Air	According to structural properties, hydrolysis of ethanolamine is not expected. In addition, the substance is readily biodegradable. Adsorption of the substance to the solid soil phase is not expected under environmentally relevant conditions. From the water surface the substance will not evaporate into the atmosphere under environmentally relevant conditions. Over time, the uncharged substance will preferentially distribute into the compartment water (99.9%). At environmentally conditions the substance will be ionized (pKa = 9.25 at 25 °C, experimental data); therefore, the distribution into the compartment water seems to be appropriate.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a 90-day sub-chronic oral study, rats were fed 320, 640 or 1280 mg/kg/day ethanolamine mixed in food. No effects were observed in rats at 320 mg/kg bw/day ethanolamine. At 640 mg/kg/day, liver and kidney weights were altered and at the highest dose of 1280 mg/kg/day, death occurred. No further details of the study were available. The results indicated an oral NOAEL (No Observed Adverse Effect Level) of 320 mg/kg/day. In a reproductive/development toxicity study, pregnant rats were administered 0, 40, 120 and 450 mg/kg bw/day ethanolamine by gavage. Evidence of maternal toxicity such as reduced food consumption, lower mean body weights and impaired body weight gain were reported at 450 mg/kg/day. These observed effects were not sufficient to establish a NOAEL in this study.
Carcinogenicity	No data on the carcinogenicity of ethanolamine are available.
Mutagenicity/ Genotoxicity	Ethanolamine lacked mutagenic potential in the Ames bacterial mutagenicity test when tested in the presence or absence of a metabolic activation system with a variety of Salmonella typhimurium tester strains, namely TA 1535, TA 1537, TA 1538, TA 98, and TA 100. The highest ineffective dose tested in any Salmonella typhimurium strain was 10 000 mg/plate. Ethanolamine also failed to cause mutations in a test organism sensitive to oxidative-type mutagens (Escherichia coli). Assays of the potential of ethanolamine to damage DNA in Bacillus subtilis and to cause chromosomal damage in yeast cells (Saccharomyces cerevisiae gene conversion assay) were negative. Ethanolamine did not induce chromosome damage in rat liver epithelial-type cells or transformation of Chinese hamster cells. It did not induce a mutagenic response

	in the mouse lymphoma forward mutation assay in the absence or presence of metabolic activation. In the only in vivo chromosomal aberration study, the Mammalian Erythrocyte Micronucleus Test, in which mice were fed 375, 750 and 1500 mg/kg ethanolamine dissolved in water, there were no biologically relevant, significant differences in the frequency of erythrocytes containing micronuclei between the solvent control and the three dose groups. The study concluded that, under the experimental conditions chosen, ethanolamine has no chromosome-damaging (clastogenic) effect, nor does it lead to any impairment of chromosome distribution in the course of mitosis. Based on the observations, it is concluded that ethanolamine is not genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The study shows that ethanolamine may affect fertility in rats at very high concentrations (1000 mg bw/day), at which maternal toxicity is also observed. Based on the study observations, ethanolamine is not considered a developmental toxin in rats.
Acute Toxicity	In a study conducted according to the Organisation for Economic Cooperation and Development (OECD) Test Guidelines (TG), Sprague-Dawley rats (five rats per sex) were administered 254, 509, 1018, 2036 and 4072 mg/kg bw/day ethanolamine by gavage, and the animals observed for 14 days. Animals with high doses (2036 and 4072 mg/kg bw) displayed sluggishness and piloerection. All deaths occurred relatively rapidly after dosing (within two days), except for one male rat that died after 12 days following a dose of 509 mg/kg bw. Rats receiving ethanolamine at the maximum dosage died after three hours. The median lethal dose (LD50) values and the estimated LD50 slopes were calculated by the moving average method. An oral LD50 of 1089 mg/kg bw was established in this study. The study shows that ethanolamine has moderate toxicity by the oral route in rats. In the only reported dermal toxicity study, ethanolamine at 1.0, 2.0, or 4.0 mL/kg (1010, 2020 or 4040 mg/kg bw) was applied to the clipped, intact skin of New Zealand White rabbits (five per sex). Gauze was wrapped around the trunk over the sample for the 24 hour exposure period. Observations for toxicity and skin reactions were made at one hour, seven days, and 14 days after the contact period. At death or termination, each animal was subjected to a gross pathologic evaluation. Erythema, oedema, necrosis and ecchymosis were common findings in all dose groups. Nearly all animals in the highest dose group died within 1 to 2 days. The calculated LD50 values for males and females were 2504 mg/kg and 2881 mg/kg, respectively. The study shows that ethanolamine has low acute toxicity by the dermal route in rabbits. In three separate studies that were reliable (with restrictions), rats were exposed to saturated vapour of ethanolamine generated by bubbling 200 l/hour air at 20°C through a column of test material (5 cm) above a fritted glass disc in a glass cylinder. Animals were exposed for eight hours and observed for seven days. No deaths occurred in any of the studies. Based on the atmospheric concentration of ethanolamine (1.3 mg/L air) derived from its theoretical saturated vapour concentrations at room temperature, the median lethal concentration (LC50) for ethanolamine was estimated as >1.3 mg/L. In a sub-acute inhalation study, rats were exposed to 10, 50 or 150 mg/m^3 ethanolamine aerosol, 6 hrs/day, 5 days/wk for 28 days. The aerosol was generated with compressed air mixed with conditioned dilution air into the inhalation system using a two-component atomiser. The control group was exposed to conditioned air only. No deaths were recorded throughout the study. No treatment-related changes in food intake, body weight or adverse changes in haematology or clinical chemistry parameters were observed. There were no gross lesions in treated male or female animals. At 50 and 150 mg/m^3 all the animals developed submucosal inflammation at the base of the epiglottis, characterised by infiltrates of granulocytes and lymphoid cells. In addition, a focal squamous cell metaplasia was observed in some animals at 50 mg/m3 and in all animals of the 150 mg/m^3 group. Some animals in the 150 mg/m^3 group also showed focal epithelial necrosis at the base of the epiglottis. A minimal focal epithelial hyperplasia also occurred in the 150 mg/m^3 group of rats. Histopathological changes such as

	squamous metaplasia in the trachea and mucous cell hyperplasia in the lungs were also noted at 150 mg/m^3. All the findings were considered treatment-related. A NOAEL of 10 mg/m^3 was established for local effects based on the concentration-related lesions in larynx, trachea and lung observed in rats. No adverse systemic effects were reported. A NOAEL for systemic effects could not be established in this study. Repeated inhalation exposure of dogs, guinea pigs and rats to 66 to 102 ppm (160 to 255 mg/m^3) ethanolamine for 24 to 90 days induced behavioural effects and degenerative changes in different organs, especially cloudy swelling in the liver and in the tubular epithelium of the kidneys. The animals also displayed pronounced clinical signs of skin and respiratory irritation, which progressed with time to hair loss, severe skin lesions, moist rales and fever in dogs and breathing difficulties in rats and guinea pigs. There was a decrease in the albumin-globulin ratio and a decrease in haemoglobin and haematocrit values in dogs exposed to 102 ppm ethanolamine. A NOAEL could not be established in this study as the effects were seen at all doses tested. Repeated inhalation of low doses of 30 mg/m^3 ethanolamine for 90 days caused behavioural effects in dogs, such as progressive stages of excitation followed by depression. Rats exposed to 5 ppm (13 mg/m^3) ethanolamine also exhibited skin irritation and lethargy after 2 to 3 weeks exposure. The EU Scientific Expert Group on Occupational Exposure Limits for Ethanolamine considered this LOAEL (5 ppm or 13 mg/m^3) as the best available basis for proposing occupational exposure limits. Based on the observations in the above studies, a NOAEL of 10 mg/m^3 was established for local effects being just below the LOAEL derived by the EU Scientific Expert group. A NOAEL for systemic effects due to repeated inhalation of ethanolamine could not be established in any of the available studies.
Irritation	Based on the available studies, ethanolamine is considered to be corrosive to animal skin and to the rabbit eye. Based on the effects of ethanolamine on the skin and eyes of animals, the chemical is expected to be a respiratory irritant.
Sensitisation	The sensitisation effect of ethanolamine was tested in guinea pigs using the guinea pig maximisation test (GPMT). Groups of 15 animals were induced with 0.6% (intradermal) and 10.3% (epicutaneous) ethanolamine and then challenged after three weeks with 0.41, 2.05 and 4.1% ethanolamine. Prior to the topical induction, the animals were pretreated with 10% sodium dodecyl sulphate. The challenge reactions were read blindly 48 and 72 hours after application of the patches (Finn chambers). Control groups of 12 animals were given the same treatment (Freund's Complete Adjuvant, vehicle, occlusion, etc.). After the challenge with 4.1%, 2.05% and 0.41% ethanolamine, 3/15, 2/15 and 3/15 of the animals, respectively, reacted positively after 72 hours. Two out of 15 animals showed a reaction to the vehicle. The study concluded that ethanolamine is not a skin sensitiser.
Health Effects Summary	Ethanolamine has moderate acute oral and inhalational toxicity and low acute toxicity by the dermal route. The oral and dermal LD50 values in rats are 1089 mg/kg bw and 2504 mg/kg bw, respectively and the inhalation LC50 is >1.3 mg/L. Ethanolamine is corrosive to the skin and eyes. Information on respiratory irritation activity is not available, however based on a repeated dose inhalation study, signs of irritation were reported in the trachea and lungs indicating that it is respiratory irritant. Ethanolamine is not considered to be a skin sensitiser. The most appropriate NOAEL for human health risk assessment purposes is 320 mg/kg bw/day, determined in an oral repeat dose study in rats based on increase in liver and kidney weights. Repeat dose dermal studies for ethanolamine are not available. Ethanolamine is not genotoxic or a carcinogen based on available data. Effects on fertility were observed at a high dose of 1000 mg/kg bw/day at which dose maternal toxicity was also observed. No developmental toxicity effects were noted in rats. Skin and eye irritation is the critical effect for human health risk assessment. Ethanolamine is also harmful by oral and inhalation routes.

Key Study/Critical Effect for Screening Criteria	The NOAEL from the 90-day study, 320 mg/kg bw/day, will be used for human risk assessment.
Ecological Toxicity [1]	
Aquatic Toxicity	Acute toxicity: 96 h LC50 (fish): 105 mg/L 48 h EC50 (invertebrates): 27.04 mg/L 72 h ErC50 (algae): 2.8 mg/L Chronic toxicity: 41 d NOEC (fish): 1.24 mg/L 21 d NOEC (invertebrates): 0.85 mg/L 72 h ErC10 (algae): 0.7 mg/L
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest 21-day NOEC of 0.85 mg/L (invertebrates). A PNECaqua of 85 µg/L was derived.
Current Regulatory Controls [2,3,4,5]	
Australian Hazard Classification	Ethanolamine is classified as hazardous for human health in the Hazardous Substances Information System (HSIS) with the following risk phrases (Safe Work Australia 2013): • C, R34 (Corrosive; causes burns) • Xn, R20/21/22 (Harmful by inhalation, in contact with skin and if swallowed). Mixtures containing ethanolamine are classified as hazardous with the following risk phrases based on the concentration (conc) of the chemicals in the mixtures. The risk phrases are: • Conc ≥25%: C; R34; R20/21/22 (Corrosive, causes burns, harmful by inhalation, in • contact with skin and if swallowed) • 10% ≤Conc <25%: C; R34 (Corrosive, causes burns) • 5% ≤Conc <10%: Xi; R36/37/38 (Harmful, irritating to eyes, respiratory system and • skin).
Australian Occupational Exposure Standards	The occupational exposure standards for ethanolamine are (Safework Australia 2013): • Time Weighted Average (TWA): 7.5 mg/m^3 (5 ppm) • Short-Term Exposure Limit (STEL): 15 mg/m^3 (10 ppm).
International Occupational Exposure Standards	Occupational exposure limits for ethanolamine identified internationally are provided below (Galleria Chemica 2013). TWA: • 7.5 mg/m^3 (5 ppm) [Canada, Colombia, Japan] • 2.5 mg/m^3 (2 ppm) [Bulgaria, UK] • 8 mg/m^3 [US] STEL: • 15 mg/m^3 (10 ppm) [Canada, Colombia, Japan, US] • 7.5 mg/m^3 (5 ppm) [Bulgaria, UK].
Australian Food Standards	No Australian food standards have been identified.
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. The substance is readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is -1.31 at 25 °C (Log Pow < 4.5), it is not expected to be bioaccumulative.

T criteria fulfilled?	No. Chronic toxicity data >0.01 mg/L and substance is readily biodegradable, ethanolamine does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Fatty acids, tall-oil

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	Variable
Molecular weight	Variable
Solubility in water	0.0126 g/L at 20°C
Melting point	No data available
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	
Overview	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [4]	
Soil/Water/Air	Fatty acids, tall oil is readily biodegradable. It is insoluble and will likely strongly adsorb to soil or sediment. Substances in this category have a low potential for bioaccumulation.
Human Health Toxicity Summary	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity [1,2]	
Aquatic Toxicity	Pimephales promelas: 96-hour LL50 >1,000 (WAF) NOEC 1,000 (WAF) Daphnia magna: 48-hour EL50 >1,000 (WAF) NOEL 1,000 (WAF)

	Selenastrum capricornutum: 72-hour EL50 854.90 (WAF) NOEL 500 (WAF)
Determination of PNEC aquatic	Not determined. Fatty acids, tall oil is of low acute toxicity concern to aquatic organisms. Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.
Current Regulatory Controls [5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	No. Fatty acid tall oil is readily biodegradable.
B/vB criteria fulfilled?	No. No experimental data are available for fatty acids, tall oil. Using the bioconcentration factor/bioaccumulation factor (BCFBAF) model in EPISuite™ (USEPA, 2017), the estimated BCF for oleic and linoleic acid, the two major fatty acids, is 56.23 L/kg based on a regression-based estimate. Based on this BCF value, this substance has a low potential for bioaccumulation.
T criteria fulfilled?	No. For fatty acids, tall oil, the NOEC from an algal study and the acute EC50 values in fish, invertebrates and algae are greater than the water solubility of fatty acids, tall oil. Thus, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
2. EHS Support, Mixture of Dimer/Trimer Fatty Acids of Indefinite Composition Derived from Tall Oil (Fatty Acids, Tall Oil. Available at: https://www.santos.com/wp-content/uploads/2021/04/Tall-oil-fatty-acids-March-2021.pdf. Retrieved February 2022.
3. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
5. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Hexanedinitrile, hydrogenated, high boiling fraction

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	$C_6H_8N_2$
Molecular weight	108.14 g/mol
Solubility in water	80 g/L at 20°C
Melting point	-5 °C to 6°C
Boiling point	305.3°C at 99.5 kPa
Vapour pressure	0.091 Pa at 25°C
Henrys law constant	1.21 x 10^{-9} atm-cu m/mole
Explosive potential	Non-explosive
Flammability potential	No information available
Colour/Form	Slightly brown liquid
Overview	Adiponitrile appears as a colourless to light yellow liquid which is fairly soluble and is less dense than water. Contact may irritate skin, eyes and mucous membranes. May be toxic by ingestion, inhalation and skin absorption.
Environmental Fate [3]	
Soil/Water/Air	Hexanedinitrile is expected to readily degrade. It is not expected to bioaccumulate, and it has a low potential to adsorb to soil. Hexanedinitrile is highly soluble in water. Volatilisation from water surfaces or moist soil surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. It is also not expected to volatilise from dry soil surfaces based upon its vapour pressure
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Inhalation subchronic NOAEC (rat): 30.6 mg/m³ air
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	Hexanedinitrile did not exhibit mutagenic or clastogenic effects in either in vivo or in vitro tests systems.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Treatment with adiponitrile did not produce a teratogenic response when administered orally to pregnant Charles River COBS CD rats at a dosage level of 80 mg/kg/day or less.
Acute Toxicity	Oral LD50 for rats is 215 mg/kg Inhalation LC50 for rats of 2.18 mg/L
Irritation	For Skin: The compound was classed as non-irritating when applied to the intact skin of male and female rabbits. No erythema or oedema developed when the compound was applied undiluted for twenty-four hours. For eye: The substance is classified as a slight eye irritant based on Draize test results.
Sensitisation	Not sensitising
Health Effects Summary	Moderately toxic based on acute toxicity.
Key Study/Critical Effect for Screening Criteria	Key study: Inhalation LC50 for rats of 2.18 mg/L

Ecological Toxicity [4]	
Aquatic Toxicity	96 hr LC50 (fish): 670 mg/L 48 hr EC50 (invertebrates): 1189 mg/L 72 hr EC50/NOEC (algae): >97.4 mg/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 72h EC50 of 97.4 mg/L (algae). A PNECaqua of 974 µg/L was derived.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	TLV: 2 ppm as TWA; (skin)
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. The weight of evidence suggests that the substance in readily degradable.
B/vB criteria fulfilled?	No. The substance is not expected to bioaccumulate to a substantial degree based on the low log Kow of -0.32 and predicted low log BCF of 0.5.
T criteria fulfilled?	No. The acute toxicity of hexanedinitrile is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. ECHA REACH, Adiponitrile, Retrieved 2022: https://echa.europa.eu/
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3. EHS Support, Hexanedinitrile. Available at: https://www.santos.com/wp-content/uploads/2021/04/Hexanedinitrile-March-2021.pdf. Retrieved February 2022.
4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Magnesium oxide

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	MgO
Molecular weight	40.305
Solubility in water	Solubility in water: poor
Melting point	2,825 °C
Boiling point	3,600 °C
Vapour pressure	0 mmHg (approximate)
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	White odourless powder
Overview	An inorganic compound that occurs in nature as the mineral periclase. In aqueous media combines quickly with water to form magnesium hydroxide. It is used as an antacid and mild laxative and has many nonmedicinal uses. When fine particles of magnesium oxide are dispersed in air, whether directly or when generated by the burning or cutting of magnesium metal, the resulting magnesium oxide fume is an inhalation hazard. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [3]	
Soil/Water/Air	Magnesium oxide occurs in nature as the mineral periclase. Magnesium oxide is an inorganic substance that is not subject to biodegradation, is not expected to bioaccumulate, and has a low potential to adsorb to soil. As an inorganic substance, magnesium oxide is expected to disassociate in the environment to its respective cation and anion as limited by its aqueous solubility and pH. In soil, as well as in sediment-water systems, magnesium oxide will react and release magnesium ions and hydroxyl ions. Therefore, relevant information on adsorption/desorption of magnesium oxide can be broadened to data on adsorption/desorption of magnesium. The behaviour of hydroxyl ions depends on the pH buffer capacity of the tested medium. The pH buffer capacity is controlled by a whole range of processes (mineral dissolution/precipitation, protonation/deprotonation of pH dependent charge sites, reaction with CO2, biological processes, etc.) and as such, partition coefficients are not relevant for the fate and behaviour of OH- in soils or sediment.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	Not classifiable as a human carcinogen.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	Lowest published toxic concentration: 400 mg/m^3 (inhalation/human)

Irritation	Causes skin and eye irritation. May cause respiratory irritation.
Sensitisation	May cause an allergic skin reaction.
Health Effects Summary	Magnesium oxide can cause irritation of the eyes and nose when inhaled. Chemical identified as low concern to human health by application of expert validated rules under the NICNAS targeted tier I approach.
Key Study/Critical Effect for Screening Criteria	Lowest published toxic concentration: 400 mg/m^3 (inhalation/human)
Ecological Toxicity [1,3]	
Aquatic Toxicity	No studies were available on magnesium oxide. Magnesium oxide is an inorganic substance with low toxicity and/or low bioavailability. Low concern to the environment. The following presents the results of acute aquatic toxicity studies on the hydrated magnesium hydroxide. 96-hour LC50: 306.79 mg/L (Fish) 96-hour EC50: 170.6 mg/L (Invertebrates) 72-hour EC50: >100 mg/L (Algae)
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 72h EC50 of 100 mg/L (algae). A PNECaqua of 1 mg/L was derived.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	TWA: 10 mg/m^3 (fumes)
International Occupational Exposure Standards	TLV: (inhalable fraction): 10 mg/m^3, as TWA; A4 (not classifiable as a human carcinogen). MAK: (inhalable fraction): 4 mg/m^3; pregnancy risk group: C. MAK: (respirable fraction): 0.3 mg/m^3; peak limitation category: II(8); pregnancy risk group: C
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. The substance is an inorganic compound and is not subject to biodegradation.
B/vB criteria fulfilled?	No. There are no bioaccumulation studies on magnesium oxide. Magnesium is an essential element in biological systems
T criteria fulfilled?	No. Low toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.

3. EHS Support, Magnesium Oxide. Available at: https://www.santos.com/wp-content/uploads/2021/04/Magnesium-Oxide-March-2021.pdf. Retrieved June 2022.
4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Methyl alpha-D-glucopyranoside

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	$C_7H_{14}O_6$
Molecular weight	194.18
Solubility in water	1 080 g/L at 20 °C
Melting point	68 °C at 10.13 hPa
Boiling point	200 °C at 26.57 Pa
Vapour pressure	0 Pa at 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Not classified
Colour/Form	Solid white crystals
Overview	Methyl alpha-D-glucopyranoside is an alpha-D-glucopyranoside having a methyl substituent at the anomeric position. It is an alpha-D-glucoside and a methyl D-glucoside. Methyl alpha-D-glucopyranoside is a natural product found in Pseudoceratina purpurea, Forsythia viridissima, and Quassia amara.
Environmental Fate [1,2]	
Soil/Water/Air	The substance is readily biodegradable. Adsorption in the environment is not expected.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Sub-acute (42 d study) combined 28 -day repeated dose toxicity study with reproduction/developmental toxicity screening test according to OECD guideline 422, GLP, RL1, NOAEL > 1000 mg/kg bw/day, read-across. Short-term repeated dose (28 d study) according to OECD guideline 422, GLP, RL2, dose selection for OECD guideline study 422: 50, 150 and 1000 mg/kg bw/day, read-across.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	Not mutagenic
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Reproduction/developmental screening study according to OECD 422, GLP, RL1, administered doses: 50, 150 and 1000 mg/kg bw/d; NOAEL >= 1000 mg/kg bw/d, read across from Isostearic acid, esters with methyl- α-D-glucose
Acute Toxicity	Acute oral toxicity study, LD50 > 2000 mg/kg bw for Isostearic acid, esters with methyl α-D-glucoside in 1% aq. carboxymethyl cellulose, read-across
Irritation	Not irritating to skin or eyes.
Sensitisation	Not sensitising
Health Effects Summary	Low acute and chronic toxicity, not mutagenic, not irritating/sensitising
Key Study/Critical Effect for Screening Criteria	Sub-acute (42 d study) combined 28 -day repeated dose toxicity was considered the key study. The NOAEL was > 1000 mg/kg bw/day.
Ecological Toxicity [1]	
Aquatic Toxicity	LC50 (96 hr) for fish: 1 770 g/L LOEC (48 h) for invertebrates: 100 mg/L LOEC (72 h) for algae: 125.3 mg/L

Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 48h LOEC of 100 mg/L (algae). A PNECaqua of 1 mg/L was derived.
Current Regulatory Controls [3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. The substance has been found to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is -2.5 - -2.19 at 25 °C (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute toxicity of this substance is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. ECHA REACH, Methyl α-D-glucoside, Retrieved 2022: https://echa.europa.eu/
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved June 2022.
3. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
5. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Octan-2-ol

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	C8H18O
Molecular weight	130.23
Solubility in water	986 mg/L @ 20 °C and pH 7.1 - 7.5
Melting point	-38.6 to -27.45 °C @ 101.325 kPa
Boiling point	178.5 - 181.87 °C @ 101.325 kPa
Vapour pressure	64.7 Pa @ 25 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	The substance is clear, colourless liquid.
Overview	2-Octanol is a natural product found in Curcuma aromatica, Curcuma wenyujin, and other organisms. Octan-2-ol is an octanol carrying the hydroxy group at position 2. It has a role as a volatile oil component and a plant metabolite. It is an octanol and a secondary alcohol.
Environmental Fate [2]	
Soil/Water/Air	2-Octanol's production and use as a solvent, in manufacture of plasticizers, wetting and foam control agents, hydraulic oils, petroleum additives, perfume intermediates and in masking of industrial odours may result in its release to the environment through various waste streams. 2-Octanol has been identified as a volatile component from a diverse array of plants. If released to air, a vapor pressure of 0.242 mm Hg at 25 °C indicates 2-octanol will exist solely as a vapor in the atmosphere. Vapor-phase 2-octanol will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 32 hours. 2-Octanol does not contain chromophores that absorb at wavelengths >290 nm and, therefore, is not expected to be susceptible to direct photolysis by sunlight. If released to soil, 2-octanol is expected to have very high mobility based upon an estimated Koc of 32. Volatilization from moist soil surfaces is expected based upon a Henry's Law constant of 3.23X10-5 atm-cu m/mole. 2-Octanol is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Utilizing the Japanese MITI test, 76% of the theoretical BOD was reached in 2 weeks indicating that biodegradation is an important environmental fate process in soil and water. If released into water, 2-octanol is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is expected based upon this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 34 hours and 14 days, respectively. An estimated BCF of 38 suggests the potential for bioconcentration in aquatic organisms is moderate. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions (pH 5 to 9). Occupational exposure to 2-octanol may occur through inhalation and dermal contact with this compound at workplaces where 2-octanol is produced or used. Monitoring data indicate that the general population may be exposed to 2-octanol via inhalation of ambient air, ingestion of food and beverages, and dermal contact with consumer products containing 2-octanol.
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	The test item, was administered daily by oral gavage to male and female Sprague-Dawley rats, for 2 weeks before mating, during mating, and until sacrifice for males, or through gestation and until Day 14 p.p. for females, at dose-levels of 100, 300 and 1000 mg/kg/day. Based on the results, the NOAEL (No Observed

	Adverse Effect Level) was considered to be 300 mg/kg/day for systemic toxicity due to clinical signs observed at the high dose-level and 100 mg/kg/day for local toxicity due to microscopic findings noted in the forestomach of animals of the mid- and high-dose groups.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	The available data from three in vitro assays (reverse gene mutation assay in bacteria, in vitro micronucleus test and mammalian cell gene mutation assay) show that the substance does not have a genotoxic potential.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The test item, was administered daily by oral gavage to male and female Sprague-Dawley rats, for 2 weeks before mating, during mating, and until sacrifice for males, or through gestation and until Day 14 p.p. for females, at dose-levels of 100, 300 and 1000 mg/kg/day. Based on the results, the NOAEL was considered 300 mg/kg/day for systemic toxicity due to clinical signs observed at the high dose-level and 100 mg/kg/day for local toxicity due to microscopic findings noted in the forestomach of animals of the mid- and high-dose groups. The NOAEL for reproductive toxicity of females was 300 mg/kg/day due to the effects on oestrous cycle noted in the high dose females. The NOAEL for reproductive toxicity of males was 1000 mg/kg/day. The NOAEL for pups development was 100 mg/kg/day considering the observed pup loss and reduced litter/pup weights noted in mid- and high dose levels.
Acute Toxicity	One acute study by oral route is available for octan-2-ol with an LD50 > 2000 mg/kg. No mortality was observed indicating that acute toxicity is of low concern. No acute studies are available by dermal route or inhalation.
Irritation	Non-irritating to skin. The substance is considered to have the potential to cause severe ocular irritancy in vivo based on the results of a rabbit enucleated eye test.
Sensitisation	Octan-2-ol was tested in a Local Lymph Node Assay (OECD 429) and showed no sensitizing potential.
Health Effects Summary	Octan-2-ol has low acute oral toxicity, is not a skin irritant, is a potential eye irritant, and is not a skin sensitiser. The NOAEL for reproductive toxicity of males was 1000 mg/kg/day. The NOAEL for pups development was 100 mg/kg/day considering the observed pup loss and reduced litter/pup weights noted in mid- and high dose levels.
Key Study/Critical Effect for Screening Criteria	The developmental toxicity via oral application to pups was considered the key study. The NOAEL for pups development was 100 mg/kg/day.
Ecological Toxicity [1]	
Aquatic Toxicity	96h-LC50 for fish = 18.57 mg/L 48h-EC50 for invertebrates = 30 mg/L 72h-ErC50 for algae = 48 mg/L 72h-NOErC for algae = 8.7 mg/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 72h-NOErC of 8.7 mg/L (algae). A PNECaqua of 87 µg/L was derived.
Current Regulatory Controls [3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.

Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1,2]	
P/vP Criteria fulfilled?	No. The substance has been found to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is 2.86 @ 22 °C and pH 7 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 of sodium carboxymethylcellulose is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. ECHA REACH, Octan-2-ol, Retrieved 2022: https://echa.europa.eu/
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved June 2022.
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6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Oxirane, 2-methyl-, polymer with oxirane, di-(9Z)-9-octadecenoate

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	C41H78O6
Molecular weight	667.1
Solubility in water	No data available
Melting point	No data available
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	No data available
Overview	NICNAS concluded that this substance is a low concern polymer for the environment.
Environmental Fate [4]	
Soil/Water/Air	No data available
Human Health Toxicity Summary	
Chronic Repeated Dose Toxicity	No data available
Carcinogenicity	No data available
Mutagenicity/ Genotoxicity	No data available
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available
Acute Toxicity	No data available
Irritation	No data available
Sensitisation	No data available
Health Effects Summary	No data available
Key Study/Critical Effect for Screening Criteria	No data available
Ecological Toxicity [1]	
Aquatic Toxicity	Polymer of low concern to the environment.
Determination of PNEC aquatic	Not determined
Current Regulatory Controls [3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.

International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No data available.
B/vB criteria fulfilled?	No data available.
T criteria fulfilled?	No. Polymer of low concern to the environment.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.
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4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
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6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Poly(oxy-1,2-ethanediyl), .alpha.-octyl-.omega.-hydroxy-

Chemical and Physical Properties[1,2,3,4]	
CAS number	[redacted]
Molecular formula	(C2H4O)nC8H18O
Molecular weight	174.3
Solubility in water	1.85 g/L @ 20 °C and pH 3.6 - 3.7
Melting point	-20 °C at 101.3 kPa
Boiling point	204 °C at 102 kPa
Vapour pressure	7.72 Pa at 25 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Clear colourless liquid
Overview	Alcohol ethoxylates (AEs) are not expected to be systemically toxic, although some short chain ethylene glycol ethers, e.g. methyl and ethyl homologues are of concern for a range of adverse health effects. They include skin and eye irritation, liver and kidney damage, bone marrow and central nervous system (CNS) depression, testicular atrophy, developmental toxicity, and immunotoxicity. For higher propyl and butyl homologues, the toxicity involves haemolysis (anaemia) with secondary effects relating to haemosiderin accumulation in the spleen, liver and kidney, and compensatory haematopoiesis in the bone marrow. Systemic toxicity was shown to decrease with increasing alkyl chain lengths and/or alkoxylation degrees.
Environmental Fate [4]	
Soil/Water/Air	The substance is readily biodegradable and is expected to be immobile in soil with a calculated Koc of 383.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Based on the available data, the chemicals in this group are not expected to cause serious damage to health from repeated oral exposure. No correlation with ethoxylation or alkyl chain length of the AEs was noted for repeated dose oral toxicity. Based on the available data, the chemicals in this group are not expected to cause serious damage to health (apart from local effects) from repeated dermal exposure. No correlation with ethoxylation or alkyl chain length of the AEs was found for repeated dose dermal toxicity.
Carcinogenicity	Based on the available data, chemicals in this group are not considered carcinogenic.
Mutagenicity/ Genotoxicity	Based on the data available, the chemicals in this group are not considered mutagenic or genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the data available, the chemicals of this group are not considered to cause reproductive or developmental toxicity. The oral NOAELs were determined at 250 mg/kg bw/day for reproductive toxicity, and >50 mg/kg bw/day for maternal and developmental toxicity.
Acute Toxicity	Based on the available animal data and international reviews, the AEs in this group are expected to have low to moderate acute oral toxicity. The toxicity appears to correlate with the degree of ethoxylation (highest for EO5–EO14) and is unlikely to be greatly affected by the alkyl chain length

	The oral median lethal dose (LD50) values in rats ranged from 600 mg/kg bw ($C_{15–16}EO_{10}$, $C_{14–15}EO_{11}$) to 10000 mg/kg bw ($C_xEO_{1–3}$, $C_xEO_{>15}$). Based on the available data, the AEs in this group are expected to have low acute dermal toxicity. No structural relationship was evident between the AEs and acute dermal toxicity. Based on the available data, the AEs in this group are expected to have low acute inhalation toxicity.
Irritation	Not considered skin sensitisers.
Sensitisation	The data generated was not be sufficient to conclude on the absence of skin sensitisation potential of chemicals
Health Effects Summary	The critical human health effects of the AEs for risk characterisation are acute oral toxicity and skin and eye irritation. The irritant effects are similar to those caused by other surfactants. The severity of irritation appears to increase directly with the chemical concentration. Skin irritation, but not eye irritation, generally decreases with an increasing degrees of ethoxylation.
Key Study/Critical Effect for Screening Criteria	The lowest oral median lethal dose (LD50) values in rats of 600 mg/kg bw is chosen for risk characterisation.
Ecological Toxicity [1]	
Aquatic Toxicity	48h EC50 Invertebrates: 40 mg/L 72h EC50 Algae: 14 mg/L
Determination of PNEC aquatic	Data from short-term tests with two trophic levels are available. An assessment factor of 1000 is applied to the lowest 72h EC50 of 14 mg/L (algae). A PNECaqua of 14 µg/L was derived.
Current Regulatory Controls [5,6,7,8]	
Australian Hazard Classification	Acute toxicity (ingestion) - category 4 Eye damage – category 1 Skin irritation – category 2
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. The substance has been found to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is 1.98 - 2.81 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 of sodium carboxymethylcellulose is >1 mg/L in invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

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Toxicity Summary - Poly(oxy-1,2-ethanediyl),alpha-hydro-omega-hydroxy-,mono(2-(4,5-ihydro-2-nortall-oil alkyl-1H-imidazol-1-yl)ethyl) ethers

Chemical and Physical Properties[1]	
CAS number	[redacted]
Molecular formula	Not available
Molecular weight	< 1,000 g/mol
Solubility in water	1,000 g/L
Melting point	24 to 29 °C
Boiling point	> 150 °C at 101.3 kPa
Vapour pressure	≤ 0.537 kPa at 25 °C
Henrys law constant	Not available
Explosive potential	Non-explosive
Flammability potential	Not determined
Colour/Form	Dark brown liquid
Overview	The polymer (at < 10% concentration) functions as a surfactant and will be used as a corrosion inhibitor for drilling completion workovers and for water-based mud drilling processes in the oil and gas industry. The product containing the polymer is used exclusively in off-shore oil and gas wells operations.
Environmental Fate [1]	
Soil/Water/Air	The polymer is not readily biodegradable in seawater (35.1% in 28 days). The polymer is not expected to bioaccumulate in biota based on its high water solubility and surfactant properties. Most of the polymer may remain inside the well holes for one month to two years where it is expected to degrade eventually to form water and oxides of carbon and nitrogen. Based on its high water solubility, the polymer is expected to dissolve in seawater and be dispersed by tidal and ocean currents following mixing of completion fluids with seawater around the discharge point. The polymer is expected to remain dissolved in seawater until it is degraded by biotic/abiotic processes to form water, oxides of carbon and nitrogen.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	May cause eye and skin irritation.
Sensitisation	No data available.
Health Effects Summary	Based on the relatively low molecular weight (Mn < 1,000 g/mol), high water solubility (1,000 g/L) and surface-active properties of the polymer, absorption across the skin or biological membranes may occur. The acute and repeated dose toxicity of the polymer is unknown. The polymer may cause eye and skin irritation.

Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity [1]	
Aquatic Toxicity	Fish (Cyprinodon variegatus) 96 h LC50 > 0.53 mg/L Invertebrate (Acartia tonsa) 48 h LC50 = 3.81 mg/L Invertebrate (Corophium volutator) 10 d LC50 ≥ 13,471 mg/L Algal Toxicity (Skeletonema costatum) 72 h ErC50 = 0.53 mg/L
Determination of PNEC aquatic	The predicted no-effect concentration (PNEC) for marine species has been calculated by using the endpoint of the most sensitive species, namely algae, 72 hours ErC50 = 0.53 mg/L. The PNEC is conservatively predicted based on the acute result from algae and a safety factor of 100. A safety factor of 100 was used since acute endpoints for three trophic levels are available. A PNEC of 5.3 µg/L was calculated.
Current Regulatory Controls [2,3,4,5]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	Yes. The polymer is not readily biodegradable.
B/vB criteria fulfilled?	No. The polymer is not expected to bioaccumulate in biota based on its high water solubility and surfactant properties.
T criteria fulfilled?	Yes. The acute EC50 for the polymer is <1 mg/L in fish algae. Therefore, it meets the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Public Report Poly(oxy-1,2-ethanediyl), α-hydro-ω-hydroxy-, mono[2-(4,5-dihydro-2-nortall-oil alkyl1H-imidazol-1-yl)ethyl] ethers. File No: LTD/2040, June 2018. Retrieved 2022: https://www.industrialchemicals.gov.au/sites/default/files/LTD2040%20Public%20Report%20PDF.pdf
2. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
3. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
4. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
5. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Polyanionic cellulose, low viscosity

Chemical and Physical Properties[1,2,3,4]	
CAS number	[redacted]
Molecular formula	C8H15NaO8
Molecular weight	262.19
Solubility in water	The sodium salt disperses and its solubility in water depends upon the degree of substitution.
Melting point	300°C
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	White or slightly yellowish, almost odourless and tasteless hydroscopic powder, consisting of very fine particles, fine granules or fine fibres.
Overview	Sodium carboxymethyl cellulose (CMC) is used in drilling muds, detergents, resin emulsion paints, adhesives, printing inks, and textile sizes. It is also used as a protective colloid, a stabilizer for foods, and a pharmaceutical additive. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [4]	
Soil/Water/Air	Sodium carboxymethylcellulose is biodegradable, but is not considered to be readily biodegradable. It is not expected to bioaccumulate. All of the polymers in this group are expected to be water soluble. If discharged into natural waters, sodium carboxymethylcellulose is expected to be present as a polyanion as a result of the ionisation of the carboxymethyl substituents. Comparatively complex partitioning behaviour in aquatic systems may occur based on the well-established interactions between colloids and carboxymethylcellulose, which is a key part of the function of this polymer in laundry detergents. No experimental partition coefficient data are available for sodium carboxymethylcellulose. Based on its high water solubility, the substance is likely to be mobile in the environment.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Ten rats received 300 to 500 mg of CMC daily for two months without any adverse effect. Another group of 10 rats received a diet containing 20% of CMC for 63 days. Slight growth retardation and a laxative effect were observed. Organ weights and both gross and microscopic pathological examination revealed no abnormalities. Oral rat TDLo: 227 g/kg/13W (continuous)
Carcinogenicity	Carboxymethyl cellulose sodium salt is a “suspected carcinogen”.
Mutagenicity/ Genotoxicity	Carboxymethylcellulose has been used often as the vehicle control in a number of genotoxicity studies as the control agent or vehicle and as such would not be expected to show activity in these types of studies.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In several studies, carboxymethylcellulose and its sodium salt have been used as the vehicle in developmental, embryotoxic and teratogenic studies on rats, mice or rabbits and as such would not be expected to have any adverse effect.
Acute Toxicity	Rats, guinea pigs and rabbits showed no symptoms after administration by stomach tube of 3000 mg/kg in three divided doses. Rat LD50 (oral): 270000 mg/kg/bw Guinea pig LD50 (oral): 160000 mg/kg/bw

	A 4-hr inhalation LC50 value of 5.8 g/m^3 has been reported for the sodium salt in rats.
Irritation	No data available.
Sensitisation	Suspected skin sensitiser
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The oral rat chronic toxicity TDLo: 227 g/kg/13W (continuous) was considered the most sensitive endpoint.
Ecological Toxicity [4]	
Aquatic Toxicity	Brachydanio rerio 96-hour LC50 >2,500 mg/L Daphnia magna 48-hour EC50 >5,000 mg/L Daphnia magna 48-hour EC50 87.26 mg/L Selenastrum capricornutum 96-hour EC50 500 mg/L
Determination of PNEC aquatic	This compound has a low acute toxicity concern to aquatic organisms and thus required no further assessment.
Current Regulatory Controls [5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	Yes. Sodium carboxymethylcellulose is a water-soluble semisynthetic polymer that is not readily biodegradable. Therefore, it meets the screening criteria for persistence.
B/vB criteria fulfilled?	No. Not expected to bioaccumulate.
T criteria fulfilled?	No. The acute EC50 of sodium carboxymethylcellulose is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	February 2022

References

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6. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Sodium sulphite

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	Na_2SO_3
Molecular weight	126.043 g/mol
Solubility in water	125.4 g/L at 0 °C 283 g/L at 80 °C
Melting point	Decomposes at 150 °C
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	White, hexagonal crystalline or powder
Overview	Sulphites in aqueous solutions involve complex equilibria among the different species of sulphur oxidation state IV. The composition of their mixture in solutions depends on the pH and temperature. Sulphites occur naturally in some foods and beverages as a result of fermentation (e.g. in beer and wine). A small percentage of the population (up to 1 %) is sensitive to sulphites, as sulphur dioxide may be generated from sulphites in the stomach at low pH (Simon, 1986). The sensitivity to sulphur dioxide can cause a wide range of reactions in humans ranging from mild to severe dermatological, pulmonary, gastrointestinal, or cardiovascular symptoms. A Tier 1 Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to the environment.
Environmental Fate [1]	
Soil/Water/Air	The substance has a very low vapour pressure, and also does not sublime. Therefore, the substance will not be present as a gas and no radical reactions can be expected. According to its chemical properties, hydrolysis is not expected/probable. Photodegradation in water is not relevant because it dissociates rapidly into ions and decomposes in water, and it not susceptible to visible light. The substance is an inorganic compound which does not undergo biodegradation. The substance readily dissociates in aqueous solution, as with soil moisture. Bioaccumulation is not to be expected. Due to the ionic salt-character and other physico-chemical properties (negligible vapour pressure, very high water solubility and decomposition in water), the Henry constant is near to zero. Because of its ionic nature, sodium sulphite as well as its dissociation products are not volatile from aqueous solutions. Relevant adsorption onto soils, sediments or suspended matter is not expected.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Wistar rats were administered anhydrous sodium sulphite daily for three months at dietary doses of 0, 620, 1670, or 3230 mg/kg bw/day for males, and 0, 650, 1190, or 3070 mg/kg bw/day for females. At the top dose in males, effects were 9.8% decrease in bodyweight gain, increased relative testis and brain weights, and increased blood urea nitrogen. No treatment-related effects were reported in the females. The NOAEL is 1670 mg/kg bw/day based on systemic effects at the LOAEL of 3230 mg/kg bw/day.

	In a study specifically examining lung response parameters, male Sprague-Dawley rats were exposed to 0, 0.1, 1, 5, or 15 mg/m^3 dry sodium sulphite particles in filtered air for 23.5 hours/day for three consecutive days. The MMAD of the aerosol particles was 0.83 to 1.15 µm. At 15 mg/m^3, effects reported were increased glycoprotein secretion and tracheal epithelium irritation. At concentrations of 1 mg/m3 and higher, a dose-dependent increase of wet to dry weight ratio of lungs, indicative of mild pulmonary oedema, was observed. The No Observed Adverse Effect Concentration (NOAEC) is 0.1 mg/m^3 based on lung responses at the Lowest Observed Adverse Effect Concentration (LOAEC) of 1 mg/m^3. Beagle dogs were exposed to 1 mg/m3 sodium metabisulfite aerosols for 290 days. The dose equivalent in terms of the S(IV) particles was 0.3 mg/m3 (CIR 2003). The MMAD of the aerosol particles was 0.63 µm. Severe epithelial changes were observed with hyperplastic foci in the respiratory region of the nasal cavity. An increase in the non-ciliated cell numbers in the membranous portion of the trachea of the animals was also observed. No other effects were reported.
Carcinogenicity	No data were available for sodium sulphite. The International Agency for Research on Cancer (IARC) reported that sulphites, bisulphites, and metabisulfites are not classifiable as to their carcinogenicity to humans (IARC 1997).
Mutagenicity/ Genotoxicity	Sodium sulphite is not considered to be genotoxic based on the available data.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Increased relative testes weights of Wistar rats was reported at 3230 mg/kg bw/day. No histopathological changes were observed in the testes. There was no indication of male fertility impairment. Sodium sulphite is not considered to be toxic to fertility. Pregnant Wistar rats were fed diets containing 0, 0.32, 0.63, 1.25, 2.5, or 5% sodium sulphite heptahydrate on gestational days 8 to 20. The doses were equivalent to 0, 150, 300, 550, 1050, or 1650 mg/kg bw/day sodium sulphite. Dams showed decreased food consumption and bodyweight gain at 1650 mg/kg bw/day. Foetal bodyweight was reduced at all doses except the female offspring of the 1050 mg/kg bw/day group. There were no significant increases in malformations, skeletal variations, or delayed ossification. The NOAEL for maternal toxicity is 1050 mg/kg bw/day. A NOAEL for developmental toxicity could not be established in this study. Sodium sulphite is not considered to be a developmental toxicant.
Acute Toxicity	Sodium sulphite has an oral LD50 >2000 mg/kg bw in rats (3560 mg/kg bw for females and 3930 mg/kg bw for males). However, the mouse or rabbit oral LD50 is <2000 mg/kg bw (820 mg/kg bw for the mouse and 600–700 mg/kg bw for rabbits). The studies show that sodium sulphite has low acute oral toxicity in rats and moderate acute oral toxicity in mice and rabbits.
Irritation	In a study conducted in accordance with OECD Technical Guideline (TG) 404, semi-occlusive application of 500 mg sodium sulphite to clipped intact skin of male New Zealand White rabbits produced no signs of irritation. Thirty-eight per cent sodium sulphite solution, applied by semi-occlusive patches to the shaved skin of male New Zealand albino rabbits, was not irritating based on the conditions of the test conducted in accordance with OECD TG 404. The chemical is not a skin irritant in rabbits. Three eye irritation tests, all conducted in accordance with OECD TG 405, were available. There were no signs of irritation after a 24-hour instillation of 100 mg of the chemical (concentration not specified) into the eyes of male New Zealand rabbits. A 38% sodium sulphite and sodium bisulphite solution was instilled into the conjunctival sac of New Zealand White rabbits. No effects were seen on the cornea and iris. Slight erythema and oedema were observed at the 24 hour observation period only and was considered reversible. In another study, a 38% solution of sodium sulphite (without crystal water) and sodium bisulphite was instilled in the eyes of male Vienna White rabbits. Slight, at observation day 8, to severe, at observation day 15, changes in the cornea and iris were reported. Slight to moderate conjunctival effects, such as erythema and

	oedema, were also reported up to the end of the observation periods. Based on the persistency of effects, the chemicals were considered severe eye irritants. The chemical is a severe eye irritant in rabbits. There were no effects on respiratory rates in mice treated sodium sulphite aerosol for 10 minutes at concentrations up to 1603 mg/m^3 or 1834 mg/m^3. In guinea pigs exposed to the aerosolised chemical for one hour, bronchoconstriction was observed at concentrations of 0.204 mg/m^3 and higher. Respiratory tract irritation was observed in guinea pigs at ≥0.204 mg/m^3 while no respiratory effects were seen in mice at concentrations up to 1834 mg/m^3.
Sensitisation	Sulphites (including sulphite, bisulphite and metabisulfite), which are used widely in cosmetic products, are rarely contact allergens and were not found to be potent primary sensitisers. The chemical is not a skin sensitiser.
Health Effects Summary	Sodium sulphite has low acute oral toxicity in rats, is not a skin irritant, is a severe eye irritant, and is not a skin sensitiser. The critical health effect of the chemical is severe eye irritation. Irritation of the human stomach from sodium sulphite ingestion is possible from the liberation of SO_2 in highly acidic environments. A NOAEL of 1670 mg/kg bw/day was established from repeated exposures to the chemical, with systemic effects reported at the LOAEL of 3230 mg/kg bw/day. The chemical is neither genotoxic, carcinogenic, nor a reproductive toxicant.
Key Study/Critical Effect for Screening Criteria	The most appropriate NOAEL for risk assessment, determined from the developmental toxicity study, is 1050 mg/kg bw/day based on maternal systemic toxicity at the LOAEL of 1650 mg/kg bw/day.
Ecological Toxicity [1]	
Aquatic Toxicity	Acute toxicity: 96h LC50 Fish: 149.6 mg/L 48h EC50 Invertebrate: 74.9 mg/L 72h EC50 Algae: 36.8 mg/L Chronic toxicity: NOEC Algae: 28 mg/L NOEC Invertebrates: ≥8.41 mg/L NOEC Fish: 50 mg/L
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest NOEC of 8.41 mg/L (algae). A PNECaqua of 841 µg/L was derived.
Current Regulatory Controls [2,3]	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013).
Australian Occupational Exposure Standards	No specific exposure standards were available.
International Occupational Exposure Standards	The following exposure standards are identified for chemicals in this group (Galleria Chemica): An exposure limit (OEL, TWA, STEL, PEL or STV) of 5–10 mg/m^3 in different countries such as USA, United Kingdom, Canada, Ireland, Spain, Norway and Switzerland.
Australian Food Standards	The chemical is listed in Standard 1.3.3 of the Australia New Zealand Food Standards Code as permitted processing aid in packaged water and water used as an ingredient in other foods under conditions of Good Manufacturing Practice (GMP), and as a dough conditioner at a maximum permitted level of 60 mg/kg (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).

Aquatic Toxicity Guidelines	Inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
PBT Assessment [1,3]	
P/vP Criteria fulfilled?	No. The substance is an inorganic compound and is not subject to biodegradation.
B/vB criteria fulfilled?	No. As the Log Pow is -4 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, sodium sulphite does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Starch, carboxymethyl ether, sodium salt

Chemical and Physical Properties[1,2,4,6]	
CAS number	[redacted]
Molecular formula	(C6H10O5)n
Molecular weight	UVCB
Solubility in water	In cold water, starch absorbs water reversibly and swells slightly. In hot water, irreversible swelling occurs, producing gelatisation.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Combustible
Flammability potential	No data available.
Colour/Form	White powder, tasteless and has no smell
Overview	Starch is a high –polymeric carbohydrate material primarily composed of amylopectin and amylose. It is usually derived from cereal grains such as corn, wheat and sorghum and from roots and tubers such as potatoes and tapioca. It includes starch which has been pregelatinized by heating in the presence of water. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[7]	
Soil/Water/Air	Based on information from NICNAS (2006): In a ready biodegradation test, the notified polymer (Potato Starch Modified) showed an 86.87% degradation during a Modified Sturm Test (OECD Test Guideline 301B) indicating that it was readily biodegradable. The test was verified using a sodium benzoate standard which showed 93.77% degradation at the end of the study. In addition a toxicity control consisting of a mixture of the test substance and sodium benzoate showed 83.49% degradation at the end of the study period, indicating that the test material did not inhibit the microbial activity. The notified polymer does potentially contain cationic and anionic functional groups, however based on the typical dissociation constants for the functionalities and their ratio within the polymer it is expected to have a net anionic charge throughout most of the environmental pH range, becoming slightly cationic only at the low end of the range. In landfill and the sewer, the notified chemical is expected to be relatively readily degraded by biotic and abiotic pathways to ultimately yield water and oxides of carbon and nitrogen and salts of chlorine and sodium. Any incineration of the notified polymer would result in its destruction and the formation of carbon dioxide and water and ash containing salts of chlorine and sodium. The notified polymer has a high molecular weight not expected to bioaccumulate.
Human Health Toxicity Summary[2,3]	
Chronic Repeated Dose Toxicity	A long-term study was carried out on the effects of inoculating 1.5 g of starch powder into the peritoneal cavity of rats. After an initial considerable inflammatory reaction, the intense vascular reaction subsided, leaving firm adhesions that were still present in animals sacrificed at 18 months (Ell90). Feeding of unmodified cornstarch and potato starch to groups of rats at dietary levels up to 30% (equivalent to 27.4-33.6 g/kg bw/d) in a 2-year test and 10% (food intake not indicated) in a 3-generation test did not result in distinct toxicologically

	significant effects (Gro74). Rats fed a cooked diet containing 62% unmodified maize starch (equivalent to 51.1 g/kg bw/d*) for 2 years also did not show significant toxicological effects, including reproductive effects over 3 generations (Tru79). Slight growth retardation was seen in rats exposed for 4 weeks to raw potato starch at a dietary level of 40% (equivalent to 46.0-52.8 g/kg bw/d) (Fer73).
Carcinogenicity	Not classifiable as a human carcinogen (A4)
Mutagenicity/ Genotoxicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Acute Toxicity	Toxicity of starch given orally to albino rats were studied. Experiments were performed upon CBL albino rats weighing 140 ± 15 (mean ± S.D.). Starch was given daily for 14 consecutive days in total daily oral doses of 36, 72, 120 and 168 g/kg and in animals which did not succumb to gastric rupture in doses gradually increasing to 204, 240 and 288 g/kg. Gastric rupture appeared in 50 – 75% of rats given starch in amounts of 168 g/kg and over. Of the survivors of gastric rupture, 5% died of pneumonia and 20% from bowel obstruction during the 14 days of starch administration. Doses of one tenth body weight and above produced some inhibition of growth, doses of one fifth body weight and above increased the susceptibility to pneumonia and bowel obstruction owing to the inability of the animal to evacuate the starch calculi. It was noted that doses of this order could not readily be taken by humans and smaller doses had insignificant toxicity. Acute respiratory effects after exposure to dust from the refining process of potato starch have been described (personal sampling: 3.9-56.0 mg/m^3, total dust). The responsible agent could not be identified although the authors suspected endotoxin to be the causative agent (Hol94). Millers and bakers occupationally exposed to grain and flour dusts (personal sampling: 1.1-14.3 mg/m^3, total dust) showed significantly higher incidences of coughing and chronic bronchitis compared to a non-exposed reference group (Mas95, Mas96). A dose-response relationship was observed between dust exposure levels and chronic respiratory symptoms (Mas95). Although flour is a complex product that is mainly made up of starch (70%) and gluten (12%), it may also contain mite dust and endotoxins. The causative role of starch in the observed respiratory symptoms is therefore not clear. The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).
Irritation	Skin contact with a total dose of 300 µg of starch, intermittently applied over a 3-day period, resulted in a mild erythema and slight oedema of the skin in humans (ACG99).
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).
Ecological Toxicity[7]	
Aquatic Toxicity	Based on QSAR modelling: Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L
Determination of PNEC aquatic	Based on the lack of ecotoxicity data, PNECaquatic was not determined.
Current Regulatory Controls[2,4]	
Australian Hazard Classification	No data available.

Australian Occupational Exposure Standards	TWA = 10 mg/m^3
International Occupational Exposure Standards	TLV: 10 mg/m^3, as TWA The current administrative occupational exposure limit (MAC) for starch in the Netherlands is 10 mg/m^3, 8-hour TWA, equal to the occupational exposure limit for nuisance dust.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. This substance is expected to be readily biodegradable.
B/vB criteria fulfilled?	No. This substance is not expected to be bioaccumulative.
T criteria fulfilled?	Based on QSAR modelling, this substance is not expected to meet the toxicity criteria.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Calcium chloride

Chemical and Physical Properties [1,4]	
CAS number	[redacted]
Molecular formula	$CaCl_2$
Molecular weight	110.98
Solubility in water	81.3 g/100 g water at 25 °C
Melting point	775 °C
Boiling point	1935 °C
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	No data found
Flammability potential	No data found
Colour/Form	Odourless white powder
Overview	Calcium chloride is easily dissociated into calcium and chloride ions in water. Both ions are essential elements in animals and humans. Calcium is essential for the formation of skeletal structure, neural transmission, muscle contraction, coagulation of the blood, and a range of other physiological functions. Chloride is required for regulating intracellular osmotic pressure and buffering.
Environmental Fate [2,3]	
Soil/Water/Air	Calcium chloride is soluble in water and its vapour pressure is negligible. When released into the environment calcium chloride is distributed into the water in the form of calcium and chloride ions. Calcium chloride is not expected to be absorbed in soil due to its dissociation properties and high water solubility. The chloride ion is mobile in soil and eventually drains into surface water because it is readily dissolved in water. Calcium chloride is not expected to undergo photolysis or biodegradation. Considering its dissociation properties, calcium chloride is not expected to accumulate in living organisms.
Human Health Toxicity Summary [4]	
Chronic Repeated Dose Toxicity	No reliable repeated dose oral studies are available. In one study, which was not conducted according to OECD guidelines, 40-day-old rats were fed 20 mg/g of anhydrous calcium chloride for 12 months (Pamukcu, Yalciner & Bryan, 1977). No differences in mortality, weight gain, or daily food consumption were observed between the test and the control groups. No neoplastic lesions were observed in the gastrointestinal tract, urinary tract, liver, heart, brain or spleen of the animals. Based on food consumption, the daily intake of calcium chloride was estimated to be 440 mg. Considering that 1 mg/g in the diet is equivalent to 100 and 50 mg/kg bw/day for young and old rats, respectively, the dose used in this study corresponded to 1000 to 2000 mg/kg bw/day.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vitro study, conducted according to OECD guidelines, doses of calcium chloride up to 5 mg/plate were examined in a Salmonella typhimurium mutation test using strains TA92, TA94, TA98, TA100, TA1535 and TA1537 with metabolic activation (Ishidate et al., 1984). In another reverse mutation test, doses up to 10 mg/plate were examined using S. typhimurium strains TA97 and TA102 with or without metabolic activation (Fujita & Sasaki, 1987). No significant increases in mutation frequencies were observed in either study. In two additional bacterial genotoxicity studies, which were not conducted according to OECD test guidelines, no DNA damage was reported at calcium chloride concentrations of up to 0.5 molar (Kanematsu et al., 1980; Olivier & Marzin, 1987). An in vitro chromosome aberration test comparable to OECD test guidelines, using Chinese hamster lung cells (CHL), has also been reported. Cells were exposed to

	calcium chloride at doses up to 4 mg/mL for 48 hours without metabolic activation. No significant increases in polyploid formation or structural chromosome aberration were observed (Ishidate et al., 1984).
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data are available on the effects of calcium chloride on fertility. In a series of developmental toxicity studies conducted comparably to OECD TG 414, the effects of calcium chloride on embryo-lethality and teratogenicity were studied in mice, rats and rabbits at different dose levels. The maximum doses of calcium chloride were 189, 176, and 169 mg/kg bw/day in mice, rats and rabbits, respectively. Calcium chloride had no discernible effect on implantation or on maternal or foetal survival. There were no differences in numbers of abnormalities in soft or skeletal tissues between test and control animals. The studies concluded that calcium chloride up to 189 mg/kg bw/day in the mouse, 176 mg/kg bw/day in the rat and 169 mg/kg bw/day in the rabbit had no developmentally toxic effects (Food and Drug Research Laboratories, 1974).
Acute Toxicity	Calcium chloride has low acute toxicity following oral exposure in animal tests. Acute oral toxicity of calcium chloride has been tested in several mice, rat and rabbit studies. The oral lethal median doses (LD50s) values range from 2120–3798 (male) and 2361–4179 (female) mg/kg bw in rats to 2045 (male) and 1940 (female) mg/kg bw in mice (Akatsuka, 1997). Calcium chloride has low acute toxicity from dermal exposure. An acute dermal toxicity study was conducted in rabbits by a scientifically accepted method (Carreon et al., 1981). No adverse effects were observed and no deaths occurred up to 5000 mg/kg bw, the highest applied dose. No significant change was found either at gross necropsy examination or at the site of application except for some skin lesions (see Skin irritation). The dermal LD50 from this study was >5000 mg/kg bw. Reliable studies on acute inhalation toxicity of calcium chloride are not available. In one study, rats were exposed to 40 and 160 mg/m^3 anhydrous calcium chloride (CAS No. [redacted]) for four hours. Signs of irritation of the trachea were observed in the animals. No deaths were reported (Sukhanov et al., 1990). However, the reliability of this study is questioned due to insufficient information on the form of calcium chloride and methodology used.
Irritation	No data are available. However, signs of irritation of the trachea were observed in animals in an acute inhalation study (Sukhanov et al., 1990), indicating that calcium chloride is likely to be a respiratory irritant. In studies conducted according to OECD test guidelines, no or only slight skin irritation were observed in rabbits from four-hour exposures to anhydrous calcium chloride (CAS No. [redacted]), calcium chloride dihydrate (CAS No. [redacted]), and/or calcium chloride hexahydrate (CAS [redacted] (Koopman and Pot, 1986b-e). Rabbits exposed for 24 hours to anhydrous calcium chloride and solid or 38 % calcium chloride dihydrate solution had slight to moderate irritation on intact skin and more severe irritation on abraded skin (Norris, 1971a, b; Carreon, Yano & New, 1981). Anhydrous calcium chloride was a severe irritant to rabbit eyes. The cornea and conjunctivae were moderately to severely irritated from one hour until 14 days after treatment, and were still moderately irritated 21 days after treatment. Hydrated forms of calcium chloride were less irritating to the eyes. With the dihydrate form, the cornea and conjunctivae were moderately irritated from one hour to 72 hours post application, and in one rabbit for up to 14 days. The hexahydrate caused slight to moderate irritation of the cornea and conjuntivae, which persisted for up to 48 hours, and in one rabbit, for up to 14 days. The 33 % and 38 % solutions of calcium chloride were slight to moderate eye irritants causing diffuse corneal opacity and slight to moderate conjunctival redness. Slight to moderate chemosis was also observed in some, but not all, rabbits (Norris, 1971a, b; Koopman & Pot, 1986f-i).

Sensitisation	No data available
Health Effects Summary	The critical health effects for risk characterisation are local effects (severe eye irritation). Observations in humans suggest that calcium chloride may be a slight respiratory irritant.
Key Study/Critical Effect for Screening Criteria	The drinking water guidelines for chloride and hardness (as calcium carbonate) may apply to calcium chloride.
Ecological Toxicity [2,3]	
Aquatic Toxicity	Several studies on acute toxicity to fish have been reported. The lowest 96-hr LC50 value was 4,630 mg/L in fathead minnow (Pimephales promelas). No chronic toxicity studies on fish conducted under standard guidelines have been reported. There are seven acute toxicity data available for Daphnia. Two of these studies were conducted according to international or national guidelines, giving the 48-hr EC50 of 2,400 mg/L for Daphnia magna and the 48-hr LC50 of 1,830 mg/L for Ceriodaphnia sp. The lowest 48-hr EC50 was 1,062 mg/L for Daphnia magna. The chronic effect of 21-day exposure on reproduction of Daphnia magna has been investigated as a long-term study. The concentration required for 16% and 50% inhibition of reproduction (EC16 and EC50) were 320 and 610 mg/L, respectively. The NOEC = EC16/2 = 320/2 = 160 mg/L. There is one study with fresh water algae, Selenastrum capricornutum, which was conducted according to OECD TG 201. The 72-hr EC50 and EC20 obtained on the basis of growth rate from the study were >4,000 and 2,700 mg/L, respectively. The 72-hr EC50 and EC20 obtained on the basis of biomass from the study were 2,900 and 1,000 mg/L, respectively. The NOECs are calculated as EC20/2, which corresponds to 1,350 and 500 mg/L for growth rate and biomass, respectively.
Determination of PNEC aquatic	Experimental results are available for three trophic levels. Acute E(L)C50 values are available for fish (4,630 mg/L), Daphnia (1,062 mg/L), and algae (2,900 mg/L). Results from a chronic Daphnia study (NOEC = 160 mg/L) and algae study (NOECs = 1,350 and 500 mg/L for growth rate and biomass, respectively) are also available. On the basis that the data consists of short-term results from three trophic levels and chronic studies on Daphnia and algae, an assessment factor of 50 has been applied to the lowest reported NOEC of 160 mg/L for Daphnia.
Current Regulatory Controls [4]	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): • an occupational exposure limit (OEL) of 5 mg/m^3 for calcium chloride (CAS [redacted] in Canada; and • an OEL of 2 mg/m^3 for calcium chloride (CAS No. [redacted]) in Latvia.
Australian Food Standards	No data available
Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
T criteria fulfilled?	No chronic toxicity data exist on calcium chloride; however, the acute EC(L)50s are >0.1 mg/L in fish, invertebrates and algae. Thus, calcium chloride does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

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Toxicity Summary - 1-Dodecene, dimer

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	(C12H24)2
Molecular weight	UVCB
Solubility in water	100 - 400 µg/L at 19.5 - 24 °C and pH 6.4 - 7
Melting point	-73 - -20.15 °C at 101.3 - 101.325 kPa
Boiling point	144.85 - 596 °C at 101.3 - 103 kPa
Vapour pressure	0 - 258 205.43 Pa at 20 - 400 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Clear liquid
Overview	Dodecene, dimer is a petroleum product.
Environmental Fate [1]	
Soil/Water/Air	Members of this category do not contain any hydrolysable functional groups, so will not undergo hydrolysis. Data for various category members indicate that they cannot be considered to be readily biodegradable. Members of this category are expected to adsorb strongly to soil and sediment.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	Three read-across 28-day oral exposure studies (OECD 407) and three 90-day oral exposure studies (OECD 408/OECD 415) were identified either within category or from a structural analogue. There were no key dermal or inhalation repeated dose studies identified. Overall, the 28-day exposure studies found no toxicity when the respective poly alpha olefins were administered orally. Results were as follows. • The NOAEL is 6245 mg/kg/day in male rats and 6771 mg/kg/day in female rats for the 28-day oral repeated dose study from 1-decene, homopolymer, hydrogenated. • The NOAEL is 1000 mg/kg/day in male and female rats for the 28-day oral repeated dose study from 1-dodecene dimer with 1-decene, hydrogenated. • The NOAEL is 1000 mg/kg/day in male and female rats for the 28-day oral repeated dose study from Alkane 4. For the 90-day oral exposure studies, results were as follows. • The NOAEL is 4145.4 mg/kg bw in male rats and 4619.9 mg/kg bw in female rats for the 90-day exposure study from 1-decene, homopolymer, hydrogenated. • The NOAEL is 1000 mg/kg bw in male and female rats for the 91-day exposure study from 1-decene, homopolymer, hydrogenated. • The NOAEL is 1000 mg/kg bw in male and female rats for the 90-day one-generation reproduction study with subchronic toxicity from Alkane 4.
Carcinogenicity	No data available
Mutagenicity/ Genotoxicity	All read-across in vitro genetic toxicity studies (i. e., gene mutation studies in bacteria; cytogenicity studies in mammalian cells; and gene mutation studies in mammalian cells) from substances within category or from structural analogues showed negative results.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Two read-across studies were identified for poly alpha olefins and its structural analogues: a 91-day study which assessed the systemic toxicological effects of treatment with 1-decene, homopolymer, hydrogenated (Ethylflo 166) on rats previously treated in utero with the same chemical and a 90-day study with Alkane 4 which assessed fertility and developmental effects in a one-generation study

	(OECD 415). Neither study showed any treatment-related effects on fertility or reproductive endpoints in rats. Both studies reported a NOAEL of 1000 mg/kg bw.
Acute Toxicity	The oral LD50 was > 5000 mg/kg bw in male and female rats for dec-1-ene, dimers, hydrogenated. The dermal LD50 was > 3000 mg/kg/bw in male and female rabbits for dec-1-ene, dimers, hydrogenated.
Irritation	Not irritating
Sensitisation	Not sensitising
Health Effects Summary	Expected to have low acute and chronic toxicity based on read across data.
Key Study/Critical Effect for Screening Criteria	The 28-day oral repeated dose study from 1-dodecene dimer with 1-decene, hydrogenated with a NOAEL of 1000 mg/kg/day in male and female rats is selected as the key study.
Ecological Toxicity [1]	
Aquatic Toxicity	LL50 (96 hrs) for fish: 1 g/L EL50 (48 h) for invertebrates: 1 g/L EL50 (48 h) for algae: 1 g/L 21 day NOELR for invertebrates: 125 mg/L WAF.
Determination of PNEC aquatic	Data from short-term tests with three trophic levels and one long-tern test are available. An assessment factor of 10 is applied to 21 day NOELR for invertebrates: 125 mg/L WAF. A PNECaqua of 12.5 mg/L was derived.
Current Regulatory Controls [3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	Yes. Not considered readily biodegradable.
B/vB criteria fulfilled?	No. Members of this category are not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute and chronic toxicity of this substance is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

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Toxicity Summary - Acetic acid

Chemical and Physical Properties[1,6]	
CAS number	[redacted]
Molecular formula	$C_2H_4O_2$
Product name	Acetic Acid 60%
Molecular weight	60 g/mol
Solubility in water	1000 g/L at 25°C
pH	1.38
Melting point	16.6 °C
Boiling point	117.9 °C
Vapour pressure	1.5 kPa at 20°C
Henrys law constant	0.0101 Pa m^3/mol
Explosive potential	Above 39°C explosive vapour mixtures may be formed. Risk of fire and explosion on contact with strong oxidants.
Flammability potential	Flammable. Flashpoint = 39°C
Colour/Form	Clear colourless liquid with a pungent vinegar smell
Overview	Acetic acid is naturally occurring as the acid in apple cider vinegar and other fruit derived products. Acetic acid is recognised by Food Standards Australia New Zealand (FSANZ) and the US Food and Drug Administration (FDA) as safe as a food additives (e.g. flavouring agent, preservative).
Environmental Fate[1]	
Soil/Water/Air	When released into the environment, acetic acid is not expected to adsorb onto suspended solids or sediments. Acetic acid dissociates in aqueous media to H+ and the acetate anion ($CH_3CO_2^-$). The compound is expected to be present in the dissociated form, where volatilisation is not an important process. Based on the range of expected Koc values, acetic acide is expected to have a very high to moderate mobility in soil. In air acetic acid will exist soley in the vapour phase where it is degraded with photochemically produced hydroxyl radicals with a half-life for this reaction in air of approximately 22 days. Acetic acid is readily biodegradable, and biodegrades rapidly under aerobic and anaerobic conditions. Based on an estimated bioconcentration factor of 3.2, the potential for bioaccumulation is low.

Human Health Toxicity Summary [1,2,5,6]	
Chronic Repeated Dose Toxicity	In a six-month repeat dose oral toxicity study (Lamb and Evard 1919), pigs were initially fed acetic acid at 155 mg/kg bw/day with the dose was raised every 10 to 30 days until a final dose of 380 to 450 mg/kg bw/day was reached after 60 days. There was no mortality and no effects on body weight or acid-base balance noted in this study (REACH 2013). A NOAEL was not established in this study. Repeated intra-gastric administration of the chemical at 3% concentration in animals (unspecified) for six months resulted in chronic inflammation of the oesophageal mucosa (HSDB 2013). Similarly, intra-gastric administration to rats of 3 mL of a 10% solution for 90 days produced a drop in haemoglobin concentration and erythrocyte count (HSDB 2013). In another similar study, pigs were fed daily diets containing the chemical at 0, 240, 720, 960 and 1200 mg/kg bw/day for successive 30-day periods for a total of 150 days (HSDB 2013).There were no significant differences in growth rate, weight gain, early morning urinary ammonia and terminal blood pH between controls and test groups. A NOEL or NOAEL was not indicated by the authors. Based on the available information and taking a conservative approach, the NOAEL in the study is considered to be 1200 mg/kg bw/day, the highest tested dose with no adverse effects. This NOAEL will be used for human health risk assessment. In the only available dermal repeat dose toxicity study (Slaga et al. 1975), acetic acid was applied dermally to mice at doses of 1 to 40 mg/animal, one to three times/week for 32 weeks. Single dermal applications of acetic acid at doses of up to 40 mg/animal did not induce mortality. However, more than one application per week of 10 mg acetic acid or more caused excessive mortality. 33% of mice died when 10 mg acetic acid/animal was applied dermally three times/week and approximately 50% of mice died when 20 mg was applied twice a week. No biochemical or histopathological effects were reported. A LOAEL of 10 mg/animal was suggested by the authors, however it was expressed in terms of ‘mg/animal’ rather than ‘mg/kg bw/day’ and it therefore cannot be adopted. Dermal NOAEL or LOAEL for acetic acid are not available. Repeated oral, inhalation and dermal exposure of humans to pure acetic acid has been reported to have effects on the gastrointestinal tract and to cause digestive disorders including heartburn and constipation, chronic inflammation of the respiratory tract, pharyngitis, catarrhal bronchitis, darkening of skin, skin dermatitis and erosion of the exposed front teeth enamel. In addition, skin on the palms of hands can become dry, cracked and hyperkeratotic. These observed effects were not associated with any systemic findings, suggesting the effects observed could be due to its corrosive action (EC 2012; HSDB 2013).

Carcinogenicity	In a carcinogenicity study (Slaga et al. 1975), acetic acid was tested as the promoter for tumour development in mice. Acetic acid was applied dermally to mice initiated with a carcinogenic agent, dimethylbenz(a)anthracene (DMBA) at doses of 1 to 40 mg/animal, one to three times/week for 32 weeks. Control animals received acetic acid dermally once per week. No further details were provided about the exposure duration. Single dermal application of acetic acid at doses of up to 40 mg/animal did not induce mortality. However, more than one application per week of 10 to 40 mg acetic acid caused excessive mortality. Thirty three per cent of mice died when 10 mg acetic acid/animal was applied dermally three times/week and approximately 50% of mice died when 20 mg was applied twice a week. No biochemical or histopathological effects were reported. Acetic acid did not produce any carcinogenic effects in mice (REACH 2013). In another study, oral administration of the chemical as a 3% solution in rats, three times/week for eight months did not induce tumours in the oesophagus and fore-stomach, although epithelial hyperplasia was observed. When dosed in combination with the known carcinogen, N-nitrososarcosine ethyl ester (positive control), there was an increase in oesophageal/stomach tumour formation (REACH 2013). Based on the limited available data, acetic acid is not likely to be a carcinogen.
Mutagenicity/ Genotoxicity	Acetic acid was not mutagenic in bacterial reverse mutation assays using Salmonella typhimurium strains TA100, TA1535, TA97 and TA98 with and without metabolic activation (Ishidate et al. 1984). Acetic acid was negative in the chromosome aberration assay using Chinese hamster lung fibroblasts at concentrations of up to 1 mg/mL with or without metabolic activation. In one study using Chinese hamster ovary Kl cells, acetic acid induced chromosomal aberrations at the initial pH of 6.0 or below (about 10 to 14 mM of acid) both with and without S9 mix (REACH 2013). However, when the culture medium was neutralised to pH 7.2 with sodium hydroxide, no clastogenic activity was observed. Moreover, pH lower than 6.0 (pH 5.7 or below) were also found to be cytotoxic. Chromosomal aberrations induced at these high concentrations were therefore considered to be artefacts due to acidification of the culture medium. Acetic acid was concluded not to be clastogenic when tested in cultured Chinese hamster K1 cells (REACH 2013; HSDB 2013). It was concluded that acetic acid is not mutagenic.
Reproductive Toxicity	No data available
Developmental Toxicity/Teratogenicity	In two developmental toxicity studies conducted according to the EU Method B.31 (prenatal developmental toxicity study), acetic acid was administered by gavage to pregnant female Wistar rats and CD-1 mice at 16, 74.3, 345, and 1600 mg/kg bw/day during gestation days 6 to 15 (10 consecutive doses) (REACH 2013). In a similar study, the chemical was administered by gavage to female Dutch rabbits at 16, 74.3, 345, and 1600 mg/kg bw/day during gestation days 6 to 18 (13 consecutive doses) (REACH 2013). There were no clearly discernible effects on implantation, maternal survival or foetal survival in any species at any of the doses. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not differ significantly from those occurring spontaneously in the controls. No NOAEL could be established for maternal toxicity or foetal developmental effects. Based on the available data, the chemical does not show developmental toxicity.

Acute Toxicity	Acetic acid was of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) observed in two rat studies is greater than 2000 mg/kg bw (REACH2013). In one study, groups of unfasted rats were fed 2239, 2512, 2859, 3100, 3500, 4000, 4467 mg/kg bw sodium acetate and observed for six days (REACH 2013). The acute oral median lethal dose (LD50) of the sodium salt of acetic acid was found to be 3310 mg/kg bw for rats. Acetic acid was of moderate acute toxicity in rabbits following dermal exposure. The LD50 in rabbits was 1060 mg/kg bw (HSDB 2013). Details regarding the concentration of the administered test substance were not provided. The moderate acute dermal toxicity is believed to be due to its local corrosive effects rather than any systemic toxicity. Acetic acid was of low acute toxicity in animal tests following inhalation exposure. In an acute inhalation study, mice were exposed to various concentrations of acetic acid (experimental details and concentration range not provided) (HSDB 2013). Clinical signs of respiratory irritation were evident at concentrations of 2.46 mg/L and higher. Animals exposed to concentrations higher than 11.07 mg/L died within 27 hours of exposure. Surviving mice recovered quickly and showed no abnormalities three days after exposure. The median lethal concentration (LC50) was determined by the Weil's method and was estimated to be 13.8 mg/L in the mouse. Severe health effects have been reported in humans following accidental exposure to acetic acid by different routes, mainly due to the local corrosive effects of the chemical leading to systemic effects (HSDB 2013).
Irritation	Pure acetic acid is corrosive to skin. In animal studies, severe skin burns were reported in guinea pigs following application to intact or abraded skin of patches of 80% solution of the chemical, moderate to severe burns at 50 to 80% solution, mild injury at 50% solution, and no effect at 10% solution (HSDB 2013). In a study with rabbits, the chemical was considered to be slightly irritating at concentrations of 3.3% and 10% (REACH 2013). In another study with rabbits, a concentration of 2.5% of the chemical was not irritating while concentrations of 10 to 25% caused moderate to severe erythema, slight to severe oedema, skin lesions over the application site and eschar formation (REACH 2013). A 10% solution was therefore considered a skin irritant. As part of a study to select the optimum testing conditions for predicting hazard to the human eye, 3%and 10% aqueous acetic acid were tested in rabbit eyes (REACH 2013). Materials were applied directly to the central corneal surface. Irritation was followed for up to 21 days and scored according to the Draize scale. The 3% acetic acid gave moderate irritation and 10% acetic acid was severely irritating or corrosive. In other studies, instillation of 0.5 mL of a 1% acetic acid solution in the eyes of rabbits caused a severe burn (Smyth et al. 1951). Solutions of 5% induced injury in eyes of rabbits which healed by 14 days, while a 10% solution resulted in severe permanent damage (Henschler 1973). Based on the results of the studies pure acetic acid is considered to be corrosive to eyes. In an acute inhalation study in mice, clinical signs of respiratory irritation were evident at concentrations of 2.46 mg/L and higher (see Section A28.5.2.3). Acetic acid vapours were reported to cause damage to nose, throat and lungs in humans (SCOEL 2012). Acetic acid is considered to be a respiratory tract irritant. Chemical burns and eye and nasal irritation have been reported in humans following exposure

Sensitisation	No experimental data were available, however the US National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards mentions skin sensitisation as one of the symptoms of acetic acid exposure (NIOSH 2010). A 1994 report (Kivity et al. 1994) describes a late asthmatic response to inhaled glacial acetic acid by an asthma patient. Based on reports of patients with bronchial asthma reacting to acetic acid challenge, it is believed that acetic acid may cause allergic reactions in humans (HSDB 2013). Some researchers consider acetic acid capable of causing a syndrome known as 'reactive airways dysfunction', which resembles bronchial asthma. Symptoms include dyspnoea, wheezing, and cough.
Health Effects Summary	Acetic acid has low acute oral and inhalation toxicity but moderate dermal toxicity. LD50 for oral, dermal and inhalation routes were >3100 mg/kg bw, 1060 mg/kg bw and 13.8 mg/L, respectively in laboratory animals. It is corrosive to skin, eyes and respiratory tract. Acetic acid has low repeat dose toxicity by oral and dermal routes. Information on toxicity by the inhalation route is not available. It is not genotoxic or carcinogenic and does not have any developmental effects in animals. Information on effects on fertility is not available. The critical health effect of acetic acid for risk characterisation is its corrosivity.
Key Study/Critical Effect for Screening Criteria	A NOEL or NOAEL was not established in any of the repeat dose studies. Based on the available information and taking a conservative approach, the highest tested dose with no adverse effects in the repeat dose oral study (1200 mg/kg bw/day) was taken as the NOAEL for human health risk assessment.
Ecological Toxicity [2]	
Aquatic Toxicity	Acute endpoints: Fish = 75 mg/L (measured), Daphnia EC50 = 32 mg/L (Dept. Env. (2013a) in LMC, 2012 Chronic endpoints: Daphnia = 150 mg/L (measured)
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 10 has been applied to the lowest reported effect concentration of 150 mg/L. The PNECaquatic is determined to be 15 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	Acetic acid is classified as hazardous, with the following risk phrase for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013): C; R35 (Corrosive, causes severe burns). Mixtures containing the chemical are classified as hazardous with the following risk phrases based on the concentration (Conc) of the chemical in the mixtures: Conc >=90%: C; R35 (Corrosive, causes severe burns) ≥25% Conc <90%: C; R34 (Corrosive, causes burns) ≥10% Conc <25%: Xi; R36/38 (Irritant, Irritating to eyes and skin).
Australian Occupational Exposure Standards	The chemical has an exposure standard of 25 mg/m³ (10 ppm) Time Weighted Average (TWA) and 37 mg/m³ (15 ppm) Short-Term Exposure Limit (STEL) (Safe Work Australia 2013).
International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013). Occupational Exposure limit (TWA): 10 to 25 mg/m^3 [China, Canada, Denmark, Germany, Ireland, South Africa, Spain, Sweden, Switzerland, and the US]. An exposure limit (STEL): 15 to 50 mg/m^3 [China, Canada, France, Ireland, Singapore, South Africa, Spain, Sweden, Switzerland, and the US].
Australian Food Standards	Acetic acid is allotted the following International Numbering System of food additives number: INS 260 (Food Standards Australia New Zealand 2013).

Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	No. The acetate ion of acetic acid is readily biodegradable and thus it does not meet the screening criteria for persistence.
B/vB criteria fulfilled?	The log Kow for acetic acid is reported to be -0.136. Acetate is also found in the body and is metabolized as part of the body's biochemical pathways. Thus, acetic acid (specifically, the acetate ion) does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The NOECs from the chronic aquatic toxicity data on acetic acid are >1 mg/L, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

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Toxicity Summary - Citric acid

Chemical and Physical Properties[2,3,5]	
CAS number	[redacted]
Molecular formula	C6-H8-O7
Product name	--
Molecular weight	192.124
Solubility in water	1000000 mg/L
pH	2 to 2.2
Melting point	Decomposition > 175 C
Boiling point	152 to159 C
Vapour pressure	White powder or granules
Henrys law constant	1.7 x10^{-8} mm Hg at 25 deg C
Explosive potential	4.39 x 10^{-09} Pa.m^3/mol
Flammability potential	Dust explosion possible if powder or granular form, mixed with air
Colour/Form	Melts and decomposes in fire, a non-hazardous reaction.
Overview	Citric acid is a water soluble organic solid. It is a natural substance that appears as an intermediate in the basic physiological citric acid or Krebs cycle in every eukaryote cell. Citric acid has been produced for many years in high volumes. It has wide dispersive use, being added to processed food and beverages, used in pharmaceutical preparations and in household cleaners as well as in special technical applications. Citric acid is recognised by Food Standards Australia New Zealand (FSANZ) and the WHO JECFA as safe as a multipurpose food additive. No upper limit of concentrations has been established in food products. This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[2,5]	
Soil/Water/Air	Citric acid is highly mobile in the environment and is extremely soluble in water. The pKa of citric acid is 2.79, indicating that this compound will exist almost entirely in the anion form in the environment. The compound does not sorb to soil or particles in the water column and is readily and rapidly degraded in surface waters and in soil. (OECD, hsdb)

Human Health Toxicity Summary [1,2,4,5]	
Chronic Repeated Dose Toxicity	A 2-year chronic oral study in rats being given 5% or 3% citric acid in feed (approx. 2 resp. 1.2 g/kg/d) found slightly decreased growth in the higher dosage group but no tissue abnormalities in the major organs. From the lower dosage a NOAEL of 1200 mg/kg/d results. Similarly, NOAELs of 1500 mg/kg/d (rabbit) and of 1400 mg/kg/d (dog) have been determined. In general, citric acid is a strong chelating agent, the dietary uptake of which may interfere with biological availability, absorption and excretion of metals. Further, loss of superficial enamel and erosion of teeth as well as local irritation result from frequent ingestion of citric acid in beverages including natural fruit juices; citric acid fumes were reported to apparently affect the teeth of exposed workers. The average daily intake of citric acid from natural sources in the diet and food additives was estimated at about 40 mg/kg for women, 130 mg/kg for infants and 400 mg/kg for individuals on slimming diets; maximum daily intake is reported to reach levels of 500 mg/kg. No formal ADI (acceptable daily intake) level has been specified for citric acid and its common salts by the Joint FAO/WHO Expert Committee on Food Additives nor by the EC Scientific Committee for Food.
Carcinogenicity	Citric acid has not been classified by the IARC.
Mutagenicity/ Genotoxicity	In several in vitro and in vivo tests citric acid was not mutagenic. The substance was not mutagenic either in bacterial tests with Salmonella typhimurium (Ames test, 2 studies) and Escherichia coli, with and without metabolic activation.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a two-generation 90 days study with male and female rats fed 1.2 % citric acid no adverse effect on reproductive parameters nor any teratogenicity of dietary citric acid was seen. There were no indications of teratogenic or other adverse effects in three shorter term reproductive studies in rats with dietary dosage of either 5% citric acid (approx. 2.5 g/kg/d) previous, during and after mating (NOEL = 2500 mg/kg/d), or 295 mg/kg/d (route unspecified) during days 6–15 of pregnancy
Acute Toxicity	Citric acid has a low acute toxicity by oral application in both rat (LD50 = 3,000–12,000 mg/kg, 3 different values) and mouse (LD50 = 5,400 mg/kg). General effects comprised physiological disturbances (acidosis and calcium deficiency), while “high” doses caused nervous system effects as well as severe damage to the stomach mucosa.
Irritation	Local effects of citric acid to the skin (rabbit) are reported as slightly irritating in two studies and as not irritating in a third study using a 30% aqueous solution. In an acute eye irritation/corrosion test in rabbits according to OECD 405 citric acid was highly irritating.
Sensitisation	The sensitising potential is low.
Key Study/Critical Effect for Screening Criteria	A 2-year chronic oral study in rats being given 5% or 3% citric acid in feed resulted in a NOAEL of 1200 mg/kg/d. Uncertainty factors: 10 (interspecies variability) and 10 (intraspecies variability). Drinking water guideline = 4.7 ppm
Ecological Toxicity [1,5]	
Aquatic Toxicity	The 96-hour LC50 values for citric acid to fish are from 440 to 1,516 mg/L. The acute toxicity 24 hour EC50 value for invertebrates is 85 mg/L. The 7 day toxic limit concentration (TLC) values for algae range from 300 to 640 mg/L. In an 8 day freshwater static test for the algae Scenedesmus quadricauda, the NOEC is 425 mg/L. In freshwater, citric acid appears to be of low toxicity to aquatic acute test standard organisms, fish, daphnia and algae, with consistent LC50/EC50 values of several hundred milligrams per litre.

Determination of PNEC aquatic	$PNEC_{aquatic}$: Experimental results are available for three trophic levels. Acute $E(L)C_{50}$ values are available for fish (440 mg/L), Daphnia (85 mg/L). A TLC value of 300 mg/L was obtained for algae from which no dependable EC50 can be derived. Even though a NOEC was obtained from the algae study, there were no chronic studies conducted on fish or Daphnia. On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 85 mg/L for Daphnia Magna. The $PNEC_{aquatic}$ was calculated to be 0.085 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	
Australian Occupational Exposure Standards	
International Occupational Exposure Standards	
Australian Food Standards	
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
Australian Hazard Classification	
PBT Assessment[1]	
P/vP Criteria fulfilled?	Citric acid is expected to be readily biodegradable and does not persist in the environment
B/vB criteria fulfilled?	Based on the low Log Kow and widespread natural occurrence, citric acid is not expected to have potential for bioaccumulation.
T criteria fulfilled?	Long term data not available (acute data >0.1 mg/L); potentially not toxic.
Overall conclusion	Not a PBT substance (based on screening data).

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Toxicity Summary - Crystalline silica-cristobalite, crystalline silica-quartz, tridymite

Chemical and Physical Properties[1,3]	
CAS number	Crystalline Silica (Cristobalite) : [redacted] Crystalline Silica (Quartz): [redacted] Diatomacous Earth (Calcined silica): [redacted] Tridymite: [redacted]
Molecular formula	Crystalline Silica (Cristobalite): SiO_2 Crystalline Silica (Quartz): SiO_2 Diatomacous Earth (Calcined silica): SiO_2
Molecular weight	60.09 g/mol
Solubility in water	Insoluble/negligible
pH	-
Melting point	1713◦C (Cristobalite) 1610◦C (Quartz)
Boiling point	2230 ◦C
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	Transparent crystals
Overview	Silica is an off-white granule that occurs naturally in various crystalline and amorphous or other non-crystalline forms. Crystalline silica is characterized by silicon dioxide (SiO2) molecules oriented in fixed, periodic patterns to form stable crystals. The primary crystalline form of silica is quartz. Other crystalline forms of silica include cristobalite, tripoli and tridymite. Particle size is a key determinate of silica toxicity, since toxicity is restricted to particles that are small enough to be deposited into the target regions of the respiratory tract. Uncalcined diatomaceous earth typically contains around 1%crystalline silica. When diatomaceous earth is subjected to pressure or is processed ("calcined") at temperatures above 1000°C some of the amorphous silica is converted to crystalline silica in the form of cristobalite. Calcined diatomaceous earth can contain anywhere from 1% to 75% cristobalite.
Environmental Fate [1,2]	
Soil/Water/Air	Crystalline Silica consists of diatomaceous earth, a naturally occurring material. Its primary component, silica, is found in common materials like quartz, sand and agate. The materials are ubiquitous and unlikely to react chemically with any other substance in the environment.

Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	A number of animal studies have found that cristobalite is more toxic to the lung than quartz, and more tumorigenic (e.g., King et al. 1953; Wagner et al. 1980). However, several other authors concluded that this is not the case (Bolsaitis and Wallace 1996; Guthrie and Heaney 1995). OSHA (2013) has examined evidence on the comparative toxicity of the silica polymorphs (quartz, cristobalite, and tridymite) and found no difference in toxicity effects between cristobalite and quartz. Furthermore, no difference in toxicity between cristobalite and quartz has been observed in epidemiologic studies (NIOSH 2002). There is no information on the repeat dose oral, inhalation or dermal effect of calcined silica. However, since calcined diatomaceous earth contains varying amounts of crystalline silica in the form of cristobalite, and may also contain small amounts of quartz and tridymite, it is expected that any long-term health hazards associated with diatomaceous earth would mainly be due to the effects of crystalline silica. In humans, the most prevalent effect identified from long term exposure in occupational settings is silicosis, a diffused nodular pulmonary fibrosis (US EPA 1996).
Carcinogenicity	IARC (2012) concluded that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources. There is sufficient evidence in experimental animals for the carcinogenicity of quartz and cristobalite. The IARC has also concluded that inhaled crystalline silica in the form of cristobalite or quartz from occupational sources is carcinogenic to humans (Group 1) (IARC 2012).
Mutagenicity/ Genotoxicity	Conflicting results have been reported in genotoxicity studies with crystalline quartz or cristobalite, and a direct genotoxic effect for crystalline silica has not been confirmed or ruled out. Studies on genotoxicity of calcined diatomaceous silica are not available.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	No data available. Most acute toxicity studies for quartz or cristobalite were conducted using intratracheal instillation. Single intratracheal instillation of quartz caused inflammatory effects and formation of discrete silicotic nodules in rats, mice and hamsters (IARC 2012; WHO 2000). Other effects like oxidative stress, cellular proliferation and increases in water, protein, and phospholipid content of rat lungs, apoptosis (programmed cell death) and lung cancer were also noted. In general, exposure to high concentrations of dust may cause coughing and mild, temporary irritation (CCOHS 2001).
Sensitisation	No data available. However, based on the structure and physico-chemical properties, the three forms of crystalline silica or the calcined diatomaceous silica are not expected to cause skin sensitisation.
Health Effects Summary	The substances are not skin or eye irritants but acute inhalation of dust may cause discomfort and stress as well as signs of local irritation to nasal, bronchiolar and ocular mucous membranes. Based on the evaluation of the epidemiological data it is concluded that inhalation exposure to crystalline silica results in lung cancer. This conclusion is also supported by animal studies in which inhalation and intratracheal exposure to crystalline silica resulted in lung tumours. The most common types of lung tumour observed in rats were lung adenocarcinomas.
Key Study/Critical Effect for Screening Criteria	Not applicable.

Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Aquatic toxicity studies performed at saturation concentrations of synthetic amorphous silica showed no acute toxicity to fish, Daphnia, or algae, though some physical effects were observed with loading rates of greater than or equal to 10 g/L (OECD 2004). Any harmful effects to aquatic ecosystems are therefore not ecotoxicological in nature. No chronic toxicity data were identified.
Determination of PNEC aquatic	Not applicable.
Current Regulatory Controls [3]	
Australian Hazard Classification	Quartz and cristobalite are listed in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2014a) as hazardous substances. Calcined silica is not listed in the HSIS.
Australian Occupational Exposure Standards	Time Weighted Average (TWA) occupational exposure standard of 0.1 mg/m³ for quartz and cristobalite are recommended in Australia (Safework Australia 2013). A Short-Term Exposure Limit (STEL) is not recommended for any of the compounds.
International Occupational Exposure Standards	TWA for quartz, cristobalite: Canada: 0.025 mg/m³ France: 0.05 mg/m^3 Japan: 0.03 mg/m³ Sweden: 0.05 mg/m^3 US (ACGIH): 0.025 mg/m^3 US (NIOSH): 0.05 mg/m^3 US (OSHA): 0.1 mg/m^3 US: 0.3, 0.9, 1.5, 500 mg/m^3 Temporary Emergency Exposure Limits (TEEL) (Diatomaceous silica, calcined)
Australian Food Standards	No data found.
Australian Drinking Water Guidelines	The Australian Drinking Water Guidelines state: 'To minimise an undesirable scale build up on surfaces, silica (SiO¬2) within drinking water should not exceed 80 mg/L' (National Health and Medical Research Council (NHMRC) 2001).
Aquatic Toxicity Guidelines	No data found.
PBT Assessment [3]	
P/vP Criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
T criteria fulfilled?	No. Long term data not available (acute data >0.1 mg/L).
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment (UNECE 2007; US EPA 2007). Further assessment of the environmental risks from the use of this chemical is not required as identified by DoEE
Revised	April 2018

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Toxicity Summary - 2,2`,2"- Nitrilotriethanol

Chemical and Physical Properties [1,2, 3,6]	
CAS number	[redacted]
Molecular formula	C6H15NO3
Molecular weight	149.19 g/mol
Solubility in water	Miscible with water.
pH	10.5
Melting point	17-21.6 °C
Boiling point	153 °C at 0.1007 kPa 192.87 °C at 0.7996 kPa 236.69 °C at 5.01 kPa 320 °C at 101 kPa
Vapour pressure	$3.59x10^{-6}$ mm Hg at 25 °C
Henrys law constant	$7.05x10^{-13}$ atm-cu m/mole at 25 °C
Explosive potential	No data found.
Flammability potential	Combustible, when exposed to heat or flame. Gives off irritating or toxic fumes (or gases) in a fire.
Colour/Form	Pale yellow to colourless viscous liquid with a slight ammonia odour.
Overview	Triethanolamine is a member of the ethanolamines family that combines the properties of amines and alcohols. Triethanolamine is typically supplied as a pale colourless to yellow liquid with an ammonia-like odor. Triethanolamine is primarily used in detergents, personal-care products, and textile finishing. Triethanolamine may also be used as in other applications including adhesives, agricultural products, concrete additives, gas treating processes, rubber, surfactants, photographic chemicals, and urethane foams. Contact with triethanolamine may cause slight to severe eye irritation. Brief contact is essentially nonirritating to the skin, but repeated exposure may cause irritation and burns. Skin contact may cause an allergic skin reaction. At room temperature, exposure to vapour is minimal due to low volatility; single exposure is not likely to be hazardous. This product has very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts, but swallowing larger amounts may cause injury. This product has been toxic to the fetus in laboratory animals at doses toxic to the mother. Findings from a study by the National Toxicology Program suggest an increased incidence of liver tumors in mice, but their relevant to humans is not clear. Triethanolamine is water soluable and biodegradable according to the OECD 301A test for biodegradation. It is not expected to bioaccumulate or persist in the environment. Triethanolimine is practically non-toxic to aquatic organisms on an acute basis. However large releases may increase the pH of aquatic systems to levels that may be toxic to aquatic organisms.

Environmental Fate [1,3,4,6]	
Soil/Water/Air	If released to soil, triethanolamine is expected to have very high mobility based upon an estimated Koc of 7. However, the pKa of triethanolamine is 7.8, indicating that this compound will primarily exist in cation form; and cations generally adsorb to organic carbon and clay more strongly than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 7.1X10-13 atm-cu m/mole. If released into water, triethanolamine is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Triethanolamine biodegraded in a biochemical oxygen demand (BOD) test at an initial concn 50 ppm. After 10 days, the ThOD (theoretical oxygen demand) was 70% using acclimated water as seed and sewage as inoculum. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions

Human Health Toxicity Summary [1,2,3,4,5,6]	
Chronic Repeated Dose Toxicity	Fischer 344 rats and B6C3F1 mice were administered 0, 500, 1000, 2000, 4000 or 8000 mg/100 mL triethanolamine in drinking water (NTP 1990). Water consumption was reduced at the top two doses. No other details were provided. In a 91-day study conducted in accordance with OECD TG 408, Cox CD rats were administered 88.5% triethanolamine in the diet at doses of 0, 250, 500 or 1000 mg/kg bw/day (REACH 2013). There were no significant dose-dependent changes in bodyweight, organ weight, histopathology, pathology and haematology. No Lowest Observed Adverse Effect Level (LOAEL) or No Observed Adverse Effect Level (NOAEL) can be established for this study. In a 90-day study, rats (strain not specified) were administered doses of 5 to 2610 mg/kg bw/day triethanolamine in the diet (Smyth et al. 1951). The study reported microscopic lesions and mortality at doses of 730 mg/kg bw/day and above. The authors indicated the NOAEL as 80 mg/kg bw/day. No other details were provided. In 60- and 120-day studies in rats (strain not specified) given 200 to 1800 mg/kg bw/day triethanolamine, effects observed included liver changes at all treatment doses after 60 and 120 days administration, kidney changes at 400 mg/kg bw/day after 60 and 120 days administration, and kidney damage at >800 mg/kg bw/day after 60 and 120 days administration (Kindsvatter 1940). The specific changes in the liver and kidney were not described. No other details were provided. The LOAEL for this study was 200 mg/kg bw/day. Repeated dermal dose toxicity with triethanolamine application was consistently associated with inflammation at the treatment site. Systemic effects included changes in bodyweight and organ to bodyweight ratios. The critical study for determining the effects of repeated dermal exposures to the chemical is the 90-day study cited in REACH (2013) conducted similarly to OECD TG 411. The NOAELs for this study are 125 mg/kg bw/day for males and 250 mg/kg bw/day for females. In an inhalation study, Fischer 344 rats were exposed to 0, 125, 250, 500, 1000 or 2000 mg/m3 triethanolamine for 16 days (NTP 1985b). The effects observed included decreased bodyweight at 2000 mg/m3 for both sexes, increased liver weight in males at 2000 mg/m3, increased kidney weight in males at concentrations ≥500 mg/m3, and increased kidney weight in females at concentrations ≥250 mg/m3. Minimal to slight acute inflammation of the larynx was reportedbut the doses for which this effect was seen were not specified. The LOAECs are 500 mg/m3 in males and 250 mg/m3 in females. The NOAECs are 250 and 125 mg/m3 in males and females, respectively. Wistar rats were exposed through the head and nose to 0, 0.02, 0.1 or 0.5 mg/L aerosolised triethanolamine in a 28-day study conducted in accordance with OECD TG 412 (Gamer et al., 2008). There were no treatment-related effects seen on bodyweight, haematology, clinical chemistry and neurobehavioural parameters. Local effects, such as minimal to moderate focal inflammation in the submucosa of the larynx region, were reported at all treatment concentrations. The LOAEC and NOAEC for systemic effects cannot be established. The LOAEC for local effects is 0.02 mg/L. B6C3F1 mice exposed to 0, 125, 250, 500, 1000 or 2000 mg/m3 triethanolamine for 14 days showed minimal acute inflammation of the laryngeal submucosa (NTP 1985a). The doses for which this effect was seen were not specified.
Carcinogenicity	The International Agency for Research on Cancer (IARC) has classified the chemical as ‘not classifiable as to its carcinogenicity to humans’ (Group 3), based on inadequate evidence for carcinogenicity in humans and experimental animals (IARC, 2000). There was no evidence of carcinogenicity by oral (up to 1000 mg/kg/day for 104 weeks, and up to 3334 mg/kg/day for 82 weeks amongst rats and mice respectively) or dermal routes (dose unknown) in studies of 14-18 months duration using rats and mice. No inhalation data were available.

Mutagenicity/ Genotoxicity	Triethanolamine was not genotoxic in a number of in vitro studies (bacterial reverse mutation, mammalian cell cytogenetics, and unscheduled DNA synthesis). On the basis of the negative results observed in a range of in vitro studies, in vivo genotoxicity is not anticipated.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	Triethanolamine is not considered to be toxic to fertility and not considered to be a developmental toxicant. There were no effects observed in the reproductive organs of the animals treated with the chemical from repeated oral, dermal and inhalation toxicity studies. In a reproduction/developmental toxicity screening test conducted in accordance with OECD TG 421, Wistar rats were administered 0, 100, 300 or 1000 mg/kg bw/day triethanolamine by gavage (REACH 2013). The animals were treated during pre-mating (two weeks for both sexes), mating (maximum of two weeks for both sexes), post-mating (one week in males), and the entire gestation period and four days of lactation in females. There were no parental systemic effects reported in all of the treated animals. Most of the animals treated at the top dose showed transient salivation, which could be attributed to the unpalatability of the chemical or local irritation of the upper digestive tract. There were no effects on fertility observed in any of the treated animals. The parental LOAEL and NOAEL for local effects are 1000 and 300 mg/kg bw/day, respectively. The developmental LOAEL and NOAEL are 1000 and 300 mg/kg bw/day, respectively. The LOAEL and NOAEL for fertility cannot be established. A dye formulation containing 0.15, 1.5 or 2% triethanolamine was applied to the shaved skin of CD-1 rats (Burnett et al. 1976). The application occurred seven times during the gestation period. There were no systemic or local effects observed. No developmental effects were reported.
Acute Toxicity	The chemical was of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in experimental rats studies ranged from is 4190–11300 mg/kg bw triethanolamine. Two studies in mice (strain not specified), two studies in rabbits (strain not specified), and three studies in guinea pigs (strain not specified) reported acute oral LD50s of 5400 to 7800, 2200 to 5200, and 2200 to 8000 mg/kg bw, respectively.Observed sub-lethal effects included agitation, elevated respiration and reduced grooming (NIWL, 2003; CIR, 2011). The chemical was of low acute toxicity in animal tests following dermal exposure. The median lethal dose (LD50) in rabbits is greater than 2000 mg/kg bw. Observed sublethal effects included mild erythema 24 hours after exposure, resolving after 6 –10 days (REACH; CIR, 2011). Due to the low vapour pressure of the chemical, the highest attainable vapour concentration is 1.8 mg/m³. In a study conducted in rats (strain not specified) exposed to the chemical (1.8 mg/m³), no deaths were reported. One out of 12 rats exposed showed signs of chronic bronchitis (REACH).

Irritation	Based on the available data, the chemical is considered a respiratory and eye irritant. In two studies conducted similarly to OECD TG 405 the average Draize scores for corneal opacity, redness of the conjunctivae and chemosis were 1, 2 and 1.75 respectively (REACH). In one study, the corneal opacity in one animal had not fully resolved by day eight of the observation period. However, based on the results seen in the other animals, it is expected that the corneal opacity would fully resolve had the observation period continued for 21 days. The chemical was not irritating to skin in studies that were performed in accordance with OECD Test Guideline (TG) 404 (REACH). In one study, three Vienna White Rabbits were dermally exposed to the chemical (85 % concentration of triethanolamine and 15 % diethanolamine) through a occlusive patch for four hours. Neither oedema nor erythema was observed throughout the observation period (REACH). In animal studies with repeated exposures, the chemical was applied to rabbit ears over 10 open applications, with 10 unoccluded applications to abdominal intact skin, or with three semi-occluded 24-hour applications to abraded skin. These exposures resulted in slight to moderate irritation (CIR, 2013). In a two-year repeated dose dermal study, the chemical caused lesions consisting of acanthosis (thickened skin), ulceration and chronic active inflammation at the application site. In the repeated dose inhalation studies, minimal to slight acute inflammation of the larynx was observed in rats and mice (NTP 1985a, 1985b). In a more recent 28-day inhalation study, minimal to moderate focal inflammation in the submucosa of the larynx was observed in rats (Gamer et al. 2008).
Sensitisation	Triethanolamine is not a skin sensitizer in animals. The negative results observed for the chemical in several guinea pig maximisation tests and one local lymph node assay support a conclusion that the chemical is not a skin sensitiser (REACH; CIR, 2013).
Health Effects Summary	Triethanolamine has low acute oral and dermal toxicity but may cause eye and respiratory irritation. Triethanolamine was non-irritating to the skin in rabbit studies, whilst studies in humans indicate that the chemical can cause skin irritation. The chemical is not a skin sensitiser. The chemical is neither genotoxic, carcinogenic nor a reproductive toxicant.
Key Study/Critical Effect for Screening Criteria	The most appropriate NOAELs for risk assessment, determined from the 90-day repeat dermal dose toxicity study cited in REACH (2013) are 125 (males) and 250 (females) mg/kg bw/day based on systemic effects. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability); 10 (subchronic to chronic) Oral RfD = 125/1000 = 0.125 mg/kg/day Drinking water guideline value = 0.49 ppm

Ecological Toxicity [1,3, 4,6]	
Aquatic Toxicity	Triethanolamine is of low acute toxicity to fish and aquatic invertebrates. The most sensitive fish species tested was the fathead minnow Pimephales promelas for which a 96h-LC50 of 11,800 mg/l was determined. Triethanolamine was slightly more toxic to Daphnia, which had a 24h-EC50 of 1,390 mg/l. In a 21 day reproduction test with Daphnia magna, a NOEC of 16 mg/l and an EC50 of 2,038 mg/l were determined in a semi-static test (concentrations measured twice during the test). Triethanolamine appears to be more toxic to algal species. Toxicity tests have been carried out at both constant pH and allowing the pH to increase with increasing triethanolamine concentration. In two cases triethanolamine appears to be more toxic when the test is carried out allowing the pH to increase. In one case, using the green algae Scenedesmus quadricauda, the 7-8 day toxicity threshold (defined as the concentration which just caused an effect of cell multiplication of around 3% compared with controls - can be considered as a NOEC) for triethanolamine was found to be much lower at constant pH (toxicity threshold = 1.8 mg/l) than when the pH was allowed to vary (toxicity threshold = 715 mg/l). The EC50 was reported as 910 mg/l for Scenedesmus subspicatus (algae) for 96 hour exposure under test conditions where the test media was neutralised.
Determination of PNEC aquatic	PNECaquatic: On the basis that the data consists of short-term and long-term results from three trophic levels, an assessment factor of 10 has been applied to the lowest reported NOEC of1.8 mg/L for Scenedesmus quadricauda mg/L for invertebrates. The PNECaquatic is 0.18 mg/L.
Current Regulatory Controls[2]	
Australian Hazard Classification	Triethanolamine is listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013) with a recommended Exposure Standard.
Australian Occupational Exposure Standards	Time Weighted Average (TWA) of 5 mg/m^3 (Safe Work Australia 2013).
International Occupational Exposure Standards	TWA: 5 mg/m^3 [Belgium, Finland, Iceland, New Zealand, Peru] 0.5 mg/m^3 [Denmark].
Australian Food Standards	Triethanolamine is listed as a permitted processing aid in bleaching agents, washing and peeling agents, water used as an ingredient in other foods, and miscellaneous functions under the conditions of Good Manufacturing Practice (GMP) (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment [1,3,4,6]	
P/vP Criteria fulfilled?	There are conflicting findings from standard ready biodegradability tests regarding the rate of biodegradation of triethanolamine. Some studies indicate relative rapid biodegradation, whereas some closed bottle studies indicate slow biodegradation under the test conditions (OECD 1995). However, the chemical is inherently biodegradable. The results of a test using OECD test guideline 302B showed that 89% of the chemical is degraded after 14 days (OECD 1995). Thus, Triethanolamine is categorised as Persistent.
B/vB criteria fulfilled?	Based on the measured log Kow of -1.0 and a measured BCF of <3.9 L/kg in fish, triethanolamine has low bioaccummulation potential and is considered not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of triethanolamine is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data). Further assessment of the environmental risks from the use of this chemical is not required as identified by DoEE.

Ecological Toxicity [1,3, 4,6]	
Aquatic Toxicity	Triethanolamine is of low acute toxicity to fish and aquatic invertebrates. The most sensitive fish species tested was the fathead minnow Pimephales promelas for which a 96h-LC50 of 11,800 mg/l was determined. Triethanolamine was slightly more toxic to Daphnia, which had a 24h-EC50 of 1,390 mg/l. In a 21 day reproduction test with Daphnia magna, a NOEC of 16 mg/l and an EC50 of 2,038 mg/l were determined in a semi-static test (concentrations measured twice during the test). Triethanolamine appears to be more toxic to algal species. Toxicity tests have been carried out at both constant pH and allowing the pH to increase with increasing triethanolamine concentration. In two cases triethanolamine appears to be more toxic when the test is carried out allowing the pH to increase. In one case, using the green algae Scenedesmus quadricauda, the 7-8 day toxicity threshold (defined as the concentration which just caused an effect of cell multiplication of around 3% compared with controls - can be considered as a NOEC) for triethanolamine was found to be much lower at constant pH (toxicity threshold = 1.8 mg/l) than when the pH was allowed to vary (toxicity threshold = 715 mg/l). The EC50 was reported as 910 mg/l for Scenedesmus subspicatus (algae) for 96 hour exposure under test conditions where the test media was neutralised.
Determination of PNEC aquatic	PNECaquatic: On the basis that the data consists of short-term and long-term results from three trophic levels, an assessment factor of 10 has been applied to the lowest reported NOEC of1.8 mg/L for Scenedesmus quadricauda mg/L for invertebrates. The PNECaquatic is 0.18 mg/L.
Current Regulatory Controls[2]	
Australian Hazard Classification	Triethanolamine is listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013) with a recommended Exposure Standard.
Australian Occupational Exposure Standards	Time Weighted Average (TWA) of 5 mg/m^3 (Safe Work Australia 2013).
International Occupational Exposure Standards	TWA: 5 mg/m^3 [Belgium, Finland, Iceland, New Zealand, Peru] 0.5 mg/m^3 [Denmark].
Australian Food Standards	Triethanolamine is listed as a permitted processing aid in bleaching agents, washing and peeling agents, water used as an ingredient in other foods, and miscellaneous functions under the conditions of Good Manufacturing Practice (GMP) (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found
Aquatic Toxicity Guidelines	No data found
PBT Assessment [1,3,4,6]	
Revised	April 2018

References

1. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2016, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
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3. OECD (1995) SIDS Initial Assessment Report for Triethanolamine, CAS Number [redacted]
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5. International Agency for Research on Cancer (IARC) – Summaries & Evaluations, Triethanolamine, 2000

6. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - Non Crystalline Silica

Chemical and Physical Properties [1]	
CAS number	[redacted]
Molecular formula	SiO_2
Molecular weight	60.1 g/mol
Solubility in water	Insoluble
Melting point	1710 °C
Boiling point	2230 °C
Vapour pressure	NA
Henrys law constant	NA
Explosive potential	NA
Flammability potential	NA
Colour/Form	Amorphous powder
Overview	Non crystalline silica (silica gel/amorphous silica) is silicon dioxide, an inorganic compound which is ubiquitous in the environment. Amorphous silica is incorporated in a variety of food products as anti-caking agent and as an excipient in pharmaceuticals.
Environmental Fate [2,3]	
Soil/Water/Air	Silicon oxides are the most abundant compounds in the earth's crust mass. Synthetic amorphous silica and silicates are released into the environment are expected to be distributed mainly into soils and sediments, weakly into water and probably not at all in the air due to their physico-chemical properties, particularly low water solubility and very low vapour pressure. Synthetic amorphous silica and silicates released into the environment are expected to combine indistinguishably with the soil or sediment due to their similarity with inorganic soil/sediment matter and will be subjected to natural processes under environmental conditions (cation exchange, dissolution, sedimentation). Biodegradation is not applicable to these inorganic substances. The bioavailable form of synthetic amorphous silica and silicates is the dissolved form which exists exclusively as monosilicic [Si(OH)4] acid under environmental pH. In analogy to the general chemical reaction of weak acids and salts of weak acids with water, the water-soluble fraction of silica acts as a weak acid and, therefore, will tend to lower the pH value, while that of a silicate acts as a base tending to bind protons and, thus, raise the pH value by forming hydroxyl ions. But pH shifts which are measurable at high loadings under laboratory conditions are not expected to occur from the anthropogenic deposition in the aquatic environment of synthetic amorphous silicas due to low aquatic releases and sufficient natural buffer capacities. Finally, these materials are supposed to combine indistinguishably with the soil layer or sediment due to their chemical similarity with inorganic soil matter. Dissolved silica can be actively assimilated by some marine and terrestrial organisms as normal natural processes mainly related to structural function.
Human Health Toxicity Summary [4]	
Chronic Repeated Dose Toxicity	<u>Inhalation:</u> Based on the available data in animals and humans, the chemicals are considered to have repeated dose inhalation toxicity, warranting hazard classification. The reported lowest observed adverse effect concentration

	(LOAEC) for adverse pulmonary effects in various rat and mice studies ranged between 1–5 mg/m^3 (US EPA, 1996). Non-neoplastic adverse effects specific to the lungs of rodents included granulomatous lesions in the walls of the large bronchi, pulmonary fibrosis, hyperplasia of the alveolar compartment and increases in lung collagen content. Dermal (in humans): Long-term (3–34 years) occupational dermal exposure to silica dusts are reported to be associated with connective tissue diseases with a potential to produce progressive systemic scleroderma. While there is debate about a true cause and effect relationship, there is evidence to show a link between scleroderma and lung silicosis in occupational settings (Thomas et al., 2000). Inhalation (in humans): In humans, inhaled particles of crystalline silica can be transported to other parts of the body through the lymphatic system (US EPA, 1996; Thomas et al., 2000). Two forms of silicosis—accelerated (develops 5–10 years after initial exposure) and chronic (develops 10 years after initial exposure)—have been reported after repeated occupational exposure to crystalline silica dust, mainly that from quartz (US EPA, 1996; WHO, 2000). In a study of 67 gold mine workers in Canada, there was a significant linear relationship between lung quartz concentration and the severity of silicosis. While there were other particles detected in the lung tissue, quartz was the only significant indicator of silicosis severity (WHO, 2000).
Carcinogenicity	The International Agency for Research on Cancer (IARC) has classified the chemical as 'Carcinogenic to humans' (Group 1), based on sufficient evidence for carcinogenicity in humans and experimental animals.
Mutagenicity/ Genotoxicity	In vitro studies with chemicals in this group gave both positive and negative results. The majority of positive genotoxicity assay results can be explained by the generation of reactive oxygen species (OECD, 2011) resulting in DNA damage. Since DNA damage is secondary to crystalline silica-induced oxidative damage, a direct genotoxic effect is not expected. Based on this information, it is not expected that chemicals in this group directly induce heritable mutations in human germ cells. Therefore, the available data do not warrant hazard classification.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	An early limited one-generation study on rats gave no evidence of adverse effects on reproduction performance at 500 mg/kg/day, the highest dose tested (NOAEL). But the reliability is poor due to the small group size of animals. SAS was examined for embryotoxic and developmental effects during the gestation phase in various animals' species, rat, mouse, rabbit and hamster, at oral doses up to 1,600 mg/kg/day. There were no significant signs of maternal or embryotoxic/developmental toxic effects in any species tested. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not differ from the frequencies occurring spontaneously in the control animals.
Acute Toxicity	No guideline studies have been conducted to assess the acute inhalation exposure to crystalline silica. Studies conducted using a single intratracheal instillation of crystalline silica in rodents have shown significant lung pathology such as the formation of silicotic nodules and lung fibrosis (WHO, 2000). However, these studies are not directly relevant for human exposure. A single intratracheal instillation of quartz (50 mg, particle size <5 mm in diameter) in male rats (strain unspecified) resulted in a three-fold increase in water, protein and phospholipid content in lungs within 28 days of administration (WHO, 2000). In another study, 12 mg of quartz (particle size <5 mm in diameter) was administered to male and female rats (strain unspecified) using a single intratracheal instillation. Discrete silicotic granulomas in the lungs of both sexes were observed 21–30 days after instillation (WHO, 2000).
Irritation	Synthetic amorphous silicas are not irritating to the skin of rabbits exposed to 0.19 g (one case) or 0.5 g of dry or moistened test item under occlusive conditions for 4 or 24 hours. All products tested as a powder (0.1 g) have shown no or only

	weak and transient irritating effects on the conjunctivae of the eyes of rabbits with the iris and cornea not affected at all.
Sensitisation	No experimental data are available on the synthetic amorphous silicas. Medical surveillance records on workers gave no evidence of skin sensitization over decades of practical experience.
Health Effects Summary	The critical health effects for risk characterisation include local long-term effects (carcinogenicity) and harmful effects following repeated exposure through inhalation (silicosis). According to NICNAS, A Tier III assessment might be necessary to provide further information whether the current exposure controls are appropriate to offer adequate protection to workers. All other risks are considered to have been sufficiently assessed at the Tier II level, subject to implementing any risk management recommendations, and provided that all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.
Key Study/Critical Effect for Screening Criteria	The lowest NOAEL from the two-year dietary study was 2,500 mg/kg/day for rats. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability)
Ecological Toxicity [2,3]	
Aquatic Toxicity	Studies on fish, Daphnia and algae using excess loadings of SAS or NAS showed no acute toxicity, although physical effects on Daphnia were observed in tests using unfiltered test medium. Test results, based on loading rates, are as follows: 96hr-LL0 *(Brachydanio rerio)* is 10,000 mg/L for SAS and NAS; 24hr-EL50 *(Daphnia magna)* >10,000 mg/L for SAS; 72hr-NOEL *(Scenedesmus subspicatus)* is 10,000 mg/L for NAS. There are no chronic aquatic toxicity data, but due to the known inherent physico-chemical properties, absence of acute toxic effects as well as the ubiquitous presence of silica/silicates in the environment, there is no evidence of harmful long-term effects arising from exposure to synthetic amorphous silica/silicates.
Determination of PNEC aquatic	Not applicable
Current Regulatory Controls [4,5]	
Australian Hazard Classification	Not specifically listed on the HSIS (Safe Work Australia)
Australian Occupational Exposure Standards	Silica (CAS No. [redacted]) is listed as 'Fumed silica (respirable dust)' with an exposure standard of 2 mg/m3 TWA – although the CAS No. used for this entry is the same as the crystalline form, it refers to the amorphous form of the chemical.
International Occupational Exposure Standards	No data available
Australian Food Standards	Silica is regarded as GRAS (generally recognised as safe) for food use (FDA, 2013)
Australian Drinking Water Guidelines	To minimise an undesirable scale build up on surfaces, silica (SiO2) within drinking waters should not exceed 80 mg/L.
Aquatic Toxicity Guidelines	No data available
PBT Assessment	
P/vP Criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	No. Not applicable, inorganic substance, ubiquitous in environment.
T criteria fulfilled?	No. Chronic toxicity data not available. Acute data >0.1 mg/L in fish, invertebrates and algae, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

Revised	December 2018

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2. IUCLID (2004) IUCLID Data Set for Synthetic Amorphous Silica and Silicates: Silicon Dioxide (CAS No. [redacted]; Silicic Acid, Aluminum Sodium Salt (CAS No. [redacted]); Silicic Acid, Calcium Salt (CAS No. [redacted]), UNEP Publications.
3. OECD-SIDS (2004) Screening Information Dataset (SIDS) Initial Assessment Report for Synthetic Amorphous Silica and Silicates: Silicon Dioxide (CAS No. [redacted]; Silicic Acid, Aluminum Sodium Salt (CAS No. [redacted]); Silicic Acid, Calcium Salt (CAS No. [redacted]), UNEP Publications.
4. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Crystalline silica: Human health tier II assessment, Retrieved 2018: https://www.nicnas.gov.au
5. NHMRC, 2011. Australian Drinking Water Guidelines 6. Volume 1. National Water Quality Management Strategy. National Health and Medical Research Council.

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Toxicity Summary - Sodium chloride

Chemical and Physical Properties [1,4]	
CAS number	[redacted]
Molecular formula	NaCl
Molecular weight	58.44 g/mol
Solubility in water	3.57 x 10 5 g/m3 at 25oC
pH	In aqueous solution is neutral
Melting point	1 mm Hg at 865oC
Boiling point	1670 ºC
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	Not explosive
Flammability potential	Not flammable
Colour/Form	light brown liquid or colourless crystals
Overview	Sodium, together with potassium is an essential mineral for the regulation of body fluid balance. Sodium is the most abundant cation in the extracellular fluid and sodium salts account for more than 90% of the osmotically active solute in the plasma and interstitial fluid. Consequently, sodium load is the major determinant of extracellular volume. Chloride is also important in maintaining the fluid balance and is an essential component of the gastric and intestinal secretions Sodium chloride occurs naturally as rock salt which comprises 95% to 99% NaCl. It is also widely used in food products. The NHMRC has established dietary guidelines for the intake of sodium per day (adults should consume less than 2300 mg sodium per day). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate [2,3]	
Soil/Water/Air	Due to its high solubility, sodium chloride is highly mobile in the environment. Once dissociated, chloride ions will migrate readily, however sodium ions will sorb to clay-rich materials limiting mobility. If released into the environment, sodium chloride is not likely to sorb to solid particles in the water column, is readily dissociated to form chloride and sodium ions, is not bioaccumulative in aquatic species or the food chain.

Human Health Toxicity Summary [2,3]	
Chronic Repeated Dose Toxicity	High sodium chloride intakes increase calcium excretion and may increase the risk of kidney stone formation. There is evidence for a causal relationship between the consumption of sodium (mainly from common salt) and both blood pressure and the age-related rise in blood pressure. Data suggest that30% of a normotensive population may be salt sensitive. Sodium chloride has been demonstrated to be a gastric tumour promoter in experimental animals and high sodium chloride intakes have been associated with incidence of stomach cancer in human populations with traditional diets of highly concentrated, salted foods.
Carcinogenicity	Not listed with IARC.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	No data available.
Irritation	Although rare, acute toxicity may be caused by ingestion of 500 – 1000 mg sodium chloride/kg body weight. Symptoms include vomiting, ulceration of the gastrointestinal tract, muscle weakness and renal damage, leading to dehydration, metabolic acidosis and severe peripheral and central neural effects.
Sensitisation	No data available.
Health Effects Summary	Sodium is an essential mineral for the regulation of body fluid balance. This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water guideline value for sodium and chloride may apply.
Ecological Toxicity [2,3,4]	
Aquatic Toxicity	A large number of studies are available in relation to the aquatic toxicity of sodium chloride with the USEPA ECOTOX database identifying 1712 records. The evaluation of ecological effects of sodium chloride has been evaluated in detail for the assessment of the use of rock salt in the US on roadways during the winter months. The following has been summarised from the US review: The presence of sodium chloride may result in the increased mobilisation of other contaminants (metals, nutrients etc) and a shift in the acid buffering capacity may compromise aquatic ecosystems. Most sensitive species are birds where a safe concentration of 1000 mg/L sodium chloride can be established. Salt tolerance of aquatic species varies significantly with EC50 concentrations ranging from 400 to 30000 mg/L. The measured acute endpoint for Fish was reported at 1290 mg/L. The measured NOEC for Daphnia is 314 mg/L.
Determination of PNEC aquatic	PNECaquatic: On the basis of the chronic results for Daphnia, an assessment factor of 100 has been applied to the lowest reported effect concentration of 314 mg/L. The PNECaquatic is determined to be 3.14 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available
Australian Occupational Exposure Standards	No data available
International Occupational Exposure Standards	No data available
Australian Food Standards	No data available

Australian Drinking Water Guidelines	No data available
Aquatic Toxicity Guidelines	No data available
PBT Assessment [4]	
P/vP Criteria fulfilled?	Sodium chloride is an organic salt that dissociates completely to sodium and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both sodium and chloride ions are also ubiquitous and are present in most water, soil and sediment. The persistent criteria is not considered applicable to this inorganic salt.
B/vB criteria fulfilled?	Sodium and chloride ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, sodium chloride is not expected to bioaccumulate.
T criteria fulfilled?	The measured chronic toxicity data for sodium chloride was 314 mg/L for Daphnia Thus, sodium chloride does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2018

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4. Department of the Environment and Energy 2017 , National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme

Toxicity Summary - Sodium hydroxide

Chemical and Physical Properties	
CAS number	[redacted]
Molecular formula	Na-O-H
Product name	40 g/mol
Molecular weight	1.11E+06 mg/L at 20C
Solubility in water	13
Melting point	318 °C
Boiling point	1388 °C
Vapour pressure	Negligible at 25 deg C
Henrys law constant	No data found.
Explosive potential	No
Flammability potential	No
Colour/Form	Anhydrous (pure) NaOH is a solid – *refer melting point above*. However it is a hygoscopic, ionic solid, and will absorb water from air and is highly soluble
Incompatibility	Avoid contact of solid NaOH with water due to strong exothermic reaction, leather, wood, acids, organic halogen compounds or organic nitro compounds. Carbon monoxide gas can form upon contact with reducing sugars, food and beverage products in enclosed spaces. NAoH is neither explosive, flammable, nor oxidising.
Overview	Vegetable oil refining, regenerating iron exchange resins, organic fusions, peeling of fruits and vegetables in the food industry, etching and electroplating.
Environmental Fate[1]	
Soil/Water/Air	Sodium hydroxide is highly soluble, not volatile and unlikely to materially adsorb to soil and is therefore predominately found in the aquatic environment if released to the environment. NaOH will readily dissociate to be present in the environment as sodium and hydroxyl ions, both being ubiquitous in the environment. NaOH is a strong alkali, so it's dissolution in water may locally raise the pH of the affected environment. The dissolution reaction is also strongly exothermic.

Human Health Toxicity Summary [1,2,,3]	
Chronic Repeated Dose Toxicity	No animal data are available on repeated dose toxicity studies by oral or dermal routes for sodium hydroxide. In a repeat dose inhalation study, twenty seven white rats died within a month, mostly from bronchopneumonia, after being exposed twice weekly to an aerosol of unknown airborne concentration of sodium hydroxide, generated from an aqueous 40% sodium hydroxide solution (NIOSH 1975). When exposed to an aerosol generated from a 20% sodium hydroxide solution, the bronchi were dilated, the epithelial cover was thin and frequently desquamated, and the septa were dilated and cracked. A light round cell infiltration of the sub-mucus membrane tissue was also observed. Few changes occurred in a group of rats exposed to aerosols from 10% sodium hydroxide, but rats exposed to an aerosol of 5% sodium hydroxide had dilation of the bronchi and a slight degeneration of the mucus membrane and thickened strata of lymphadenoid tissue surrounding the bronchi. A NOAEL could not be established in this study. Workers exposed to 0.24 to 1.86 mg/m^3 sodium hydroxide for 2 to 15 minutes reported throat irritation and watery eyes (NIOSH 1975). Based on the observations of the irritant effects on workers exposed to 1 to 40 mg/m^3 sodium hydroxide, it was concluded that 2 mg/m^3 represented a concentration that is 'noticeably but not extensively irritant' (NIOSH 1975). Obstructive airway disease has been reported following chronic occupational exposure to sodium hydroxide mist (IPCS 1996). The patient developed cough, dyspnoea and tachypnoea after a 20-year exposure to sodium hydroxide.
Carcinogenicity	IARC Category 3 - not classifiable as to human carcinogenicity
Mutagenicity/ Genotoxicity	In vitro and vivo genetic toxicity testing reported no evidence of mutagenic activity.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No valid studies were identified regarding reproduction toxicity after oral, dermal or inhalation exposure to NaOH. Sodium hydroxide is not expected to be systemically available to the body under normal handling and use conditions.
Acute Toxicity	Exposure to the solid or concentrated liquid can cause severe burns to the eyes, skin and gastrointestinal tract which may cause death. An oral LD50 of a 1-10% solution of NaOH in rabbits was 325 mg/kg bw (as 100% NaOH). An oral LD50 of 140 to 340 mg/kg in rats has also been reported (National Research Council 2011), however details of the study are not available. In an acute dermal study, mice were treated dermally with 50% sodium hydroxide, and the treated area was irrigated with water at various intervals (OECD 2002). The mortality of mice was 20, 40, 80 and 71% when they were irrigated at 30 minutes, one hour, two hours or not at all after the application. All animals developed rapidly progressive burns. No mortality or burns were observed when the treated area was irrigated immediately after the application. A 5% aqueous solution of sodium hydroxide produced severe necrosis when applied to the skin of rabbits for four hours (Clayton and Clayton 1993). A dermal LD50 of 1350 mg/kg has been reported in rabbits (National Research Council 2011), however details of the study are not available. Caustic dusts are irritating to the upper respiratory system. Prolonged exposure to high concentrations may cause discomfort and ulceration of nasal passages. Cases of fatality due to ingestion of liquid sodium hydroxide have been reported in humans.
Irritation	Sodium hydroxide is a corrosive irritant to skin, eyes and mucous membranes. A NaOH solution of 8% can be considered corrosive based on animal data. Human data indicate that concentrations of 0.5 to 4% were irritating.
Sensitisation	Sodium hydroxide has no skin sensitisation potential.

Health Effects Summary	An oral LD50 of 325 mg/kg in rats and a dermal LD50 of 1350 mg/kg in rabbits were reported for sodium hydroxide. Lethality has been reported in animals at oral doses of 240 mg/kg bw. Inhalational LC50 is not available. Sodium hydroxide is corrosive to skin, eyes and gastrointestinal and respiratory tracts. Based on human data, concentrations of 0.5 to 4.0% are irritating to the skin, while a concentration of 8.0% is corrosive. Sodium hydroxide is not a skin sensitiser. No animal data were available on repeated dose toxicity by oral or dermal routes for sodium hydroxide. In the single reported repeat dose inhalation study, a NOAEL could not be established. Both in vitro and in vivo genetic toxicity tests indicated no evidence of a mutagenic activity. Information is not available on reproductive and developmental toxicity and carcinogenicity of sodium hydroxide. Due to dissociation into ions which are subject to homeostatic controls in the human body, systemic effects from repeated exposures to sodium hydroxide are not expected. The critical health effect of sodium hydroxide is its corrosive effect.
Key Study/Critical Effect for Screening Criteria	No oral TRV apply. Acute toxicity only (irritant and corrosive), not systemically available in body. The Australian drinking water guideline value for pH may apply to sodium hydroxide.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Measured acute endpoints were available for fish (196 mg/L). Measured chronic endpoint were available for Daphnia (240 mg/L)
Determination of PNEC aquatic	An assessment factor of 10 has been applied to the lowest reported NOEC of 240 mg/L for Daphnia. The PNECaquatic is 24 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	C: R35 (Corrosive, causes severe burns)
Australian Occupational Exposure Standards	Sodium hydroxide has an exposure standard of 2 mg/m³, Time Weighted Average (Safe Work Australia 2013).
International Occupational Exposure Standards	Occupational Exposure Limit (OEL) or limit values in working environment of 2 mg/m³ [Argentina, Belgium, Bulgaria, Canada, China, India, Japan and the US (NIOSH 1975)]. Occupational exposure standard: 2 mg/m³ [Korea] Occupational exposure limit values: 0.5 mg/m³ [Latvia] Short Term Exposure Limit (STEL): 2 mg/m³ [UK] US Department of Energy Temporary Emergency Exposure Limits (TEELs) = 0.5 mg/m³ (TEEL-0 and TEEL-1), 5 mg/m³ (TEEL-2) and 50 mg/m³ (TEEL-3).
Australian Food Standards	Processing aids - Generally permitted - permitted for use as acidity regulator (FSANZ 2013). Sodium hydroxide is allotted an International Numbering System (INS) of food additives number: INS 524 (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No data found. However, since sodium hydroxide readily dissociates in water into sodium and hydroxyl ions, the Australian Drinking Water Guidelines for sodium state that, based on aesthetic considerations (taste), the concentration of sodium in drinking water should not exceed 180 mg/L (National Health and Medical Research Council (NHMRC) 2011). No health-based guideline value is proposed for sodium.
Aquatic Toxicity Guidelines	No data found.
Occupational Exposure Limits	Peak limitation – 2 mg/m³
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)

B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and hydroxide ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L in invertebrates, thus sodium hydroxide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

References

1. OECD SIDS Sodium Hydroxide, UNEP Publications, March 2002
2. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved March 2015, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
3. European Commission (EC) Joint Research Centre (JRC) Institute for Health and Consumer Protection - European Chemical Substances Information System (ESIS), Sodium Hydroxide, Summary Risk Assessment Report, 2008
4. Safe Work Australia, Hazardous Substances System, sodium hydroxide

Toxicity Summary - Sodium sulphate

Chemical and Physical Properties[1,3,4,5]	
CAS number	[redacted]
Molecular formula	Na2SO4
Product name	142.04 g/mol
Molecular weight	161 g/l at 20 °C
Solubility in water	No data found.
Melting point	884 °C
Boiling point	Decomposition occurs above 884°C.
Vapour pressure	Solid
Henrys law constant	Expected to be extremely low
Explosive potential	No data found.
Flammability potential	No data found.
Colour/Form	Not combustible. Gives off irritating or toxic fumes/gases in a fire.
Overview	Sodium sulfate is widely distributed in nature; it occurs as mineral salts (e.g. thenardite, mirabilite), it is present in almost all fresh and salt waters and sulfate as such is normally present in almost all natural foodstuffs. Both sodium and sulfate ions are among the most common ions found in all living organisms. In mammals, sulfate is an normal metabolite of sulfur-containing amino-acids, it is normally incorporated in a variety of body compounds and it plays an important role in detoxification/ excretion processes due to sulfoconjugation Sodium sulfate has been produced for many years in high volumes for use in detergents, glass and paper manufacture and a variety of smaller industrial uses National Industrial Chemicals Notification and Assessment Scheme (NICNAS) has performed an IMAP environment Tier 1 summary which concluded that sodium sulphate is an inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
Environmental Fate[1,4,5]	
Soil/Water/Air	Sodium sulphate is a solid inorganic salt well soluble in water. In water solutions it is fully dissociated to sodium and sulfate ions. In anaerobic environments sulfate is biologically reduced to (hydrogen) sulphide by sulfate reducing bacteria, or incorporated into living organisms as source of sulphur, and thereby included in the sulphur cycle. The BCF of sodium sulfate is very low (0.5) and therefore bioconcentration is not expected. Sodium and sulfate ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. However some plants (e.g. corn and *Kochia Scoparia*), are capable of accumulating sulfate to concentrations that are potentially toxic to ruminants.
Human Health Toxicity Summary [1,2,4,5]	
Chronic Repeated Dose Toxicity	Valid oral repeated dose toxicity studies with 21, 28 and 35 day studies in hens and pigs are available. Toxicity was confined to changes in bodyweight, water and feed intake and diarrhoea. These changes occurred only at very high doses of sodium sulfate. In ruminants, high concentrations of sulfate in food may result in the formation of toxic amounts of sulfites by bacterial reduction the rumen, leading to poly-encephalomalacia. The available data do not allow the derivation of a NOAEL. Based on available consumer data, a daily dose of around 25 mg/kg/day is well tolerated by humans

Carcinogenicity	There is no valid oral carcinogenicity study. Limited data from experimental studies support the notion that a substance that is abundantly present in and essential to the body is unlikely to be carcinogenic.
Mutagenicity/ Genotoxicity	Sodium sulfate has been shown to be without effect in the Ames test using various strains of *S. typhimurium* (TA1535, TA1537, TA100, TA98) both with and without S9 activation in a GLP standardised test Based on the natural intra- and extracellular occurrence of the substance it can be concluded that sodium sulfate is highly unlikely to be mutagenic
Reproductive Toxicity	Limited data of poor validity did not provide an indication of toxicity to reproduction.
Developmental Toxicity/Teratogenicity	No data were found.
Acute Toxicity	The acute toxicity (LD50) of sodium sulfate has not been reliably established but is probably far in excess of 5000 mg/kg. In an inhalation study with an aerosol, no adverse effects were found at 10 mg/m3. Also human data indicate a very low acute toxicity of sodium sulfate. Human clinical experience indicates that very high oral doses of sodium sulfate, 300 mg/kg bw up to 20 grams for an adult, are well tolerated, except from (intentionally) causing severe diarrhoea. WHO/FAO did not set an ADI for sodium sulfate. There is no data on acute dermal toxicity, but this is probably of no concern because of total ionisation in solution.
Irritation	Sodium sulfate is not irritating to the skin and slightly irritating to the eyes. Respiratory irritation has never been reported.
Sensitisation	Sodium sulphate is not a skin or respiratory sensitiser
Key Study/Critical Effect for Screening Criteria	The Australian Drinking Water Guidelines for sodium and sulphate may apply to sodium sulphate.
Ecological Toxicity [3,4,5]	
Aquatic Toxicity	Algae were shown to be the most sensitive to sodium sulfate; EC50 120h = 1,900 mg/l. For invertebrates *(Daphnia magna)* the EC50 48h = 4,580 mg/l and fish appeared to be the least sensitive with a LC50 96h = 7,960 mg/l for *Pimephales promelas*. No data were found for long term toxicity. The acute studies all show a toxicity of sodium sulfate higher than 100 mg/l, no bioaccumulation is expected
Determination of PNEC aquatic	An assessment factor of 1000 has been applied to the lowest reported effect concentration of 1900 mg/L for Daphnia. The PNEC aquatic is 1.9 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substance Information System (HSIS) (Safe Work Australia 2013).
Australian Occupational Exposure Standards	No data found
International Occupational Exposure Standards	No data found
Australian Food Standards	No data found
Australian Drinking Water Guidelines	The Australian Drinking Water Guideline for sulphate is 250 mg/L (aesthetic) and sodium is 180 mg/L (aesthetic).
Aquatic Toxicity Guidelines	No data found
PBT Assessment	
P/vP Criteria fulfilled?	Sodium sulphate is an inorganic salt that dissociates completely to sodium and sulphate ions in aqueous solutions. The persistent criterion is not considered applicable to this inorganic salt.

B/vB criteria fulfilled?	The BCF of sodium sulfate is very low (0.5) and therefore bioconcentration is not expected.
T criteria fulfilled?	The acute aquatic toxicity of sodium sulfate is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).

References

1. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved 2017, from Toxnet, Toxicology Data Network, National Library of Medicine: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
2. National Health and Medical Research Council, Natural Resources Management Ministerial Council, national Water Quality Management Strategy, Australian Drinking Water Guidelines 6, 2011, Version 3.3 Updated November 2016.
3. National Industrial Chemicals Notification and Assessment Scheme (NICNAS), IMAP Environment Tier I Summary all tranches, 2016.
4. OECD (2005a) Screening Information Dataset (SIDS) Initial Assessment Report for Sodium Sulfate, CAS Number [redacted], UNEP Publications
5. OECD (2005b) SIDS Initial Assessment Profile for Sodium Sulfate, CAS Number[redacted], UNEP Publications

Toxicity Summary - Calcium Carbonate (Limestone)

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	Not applicable
Molecular weight	Not applicable
Solubility in water	No data available
Melting point	Approximately 900°C (Oates 1998).
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Solid
Overview	Limestone is the name given to a type of rock mostly composed of calcium carbonate. It also contains minor impurities of iron, magnesium, quartz, clay, pyrite, phosphate, and organic matter (Pohl 2011). It is used widely in agriculture to increase calcium concentrations and the pH of soils (Upjohn et al. 2005). Limestone is used industrially on a very large scale as an ingredient in concrete production and in metallurgy (Oates 1998; Pohl 2011). In the Australian coal seam gas industry, it is used as a bridging agent in drilling fluid formulations. A Tier 1 Human Health Assessment for these chemicals has been conducted by NICNAS which concluded that these chemicals were identified as low concern to human health by application of expert validated rules.
Environmental Fate[2]	
Soil/Water/Air	Limestone dissolves slowly in water, releasing calcium and carbonate ions as well as other trace elements, such as iron and magnesium (Deer et al. 1992; Clair and Hindar 2005; Pohl 2011). These trace elements are naturally ubiquitous in the environment and are subject to natural biogeochemical processes. Calcium oxide reacts immediately upon exposure to water, forming calcium hydroxide, which itself reacts with carbon dioxide to form calcium carbonate. The final reaction products of both limestone and calcium oxide in the environment are therefore essentially the same, although calcium oxide typically has lower concentrations of magnesium and other inorganic chemicals than limestone and produces a higher initial concentration of hydroxide ions (Upjohn et al. 2005). Calcium and carbonate ions occur naturally in all environmental compartments, and are important nutrients for various organisms. Calcium is mobile in soil (ANZECC and ARMCANZ 2000) and, if released to the environment, should be expected to experience significant partitioning to the water compartment. However, calcium ions may also form insoluble precipitates with anions present in the environment, such as carbonate ions, and settle out of the aqueous phase. Carbonate is an important component of the global carbon cycle (Wetzel 2001).
Human Health Toxicity Summary[3]	
Chronic Repeated Dose Toxicity	No systemic toxicological findings could be detected in rats after repeated administration of uncoated nano calcium carbonate by the oral route for a period of 90 days. The results of this study are read across to bulk calcium carbonate. Several potential adverse effects have been reported following calcium supplementation e.g. effects on kidney function, milk-alkali syndrome, kidney stones and interactions with minerals. However, these effects are more prevalent in those people suffering from renal insufficiency and following the ingestion of high doses of calcium. No systemic toxicity was observed in a 90-day inhalation study where rats were exposed to uncoated calcium carbonate at a maximum concentration of 0.399 mg/L, stated as the NOEC. The local effects observed at this level were limited to

	increased lung weights accompanied by increases in BAL-derived inflammation and cytotoxicity biomarkers, which were reversible in males but were not fully reversible in females within a 4-week recovery period. Hence the NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L. The results of this study are read across to bulk calcium carbonate.
Carcinogenicity	Uncoated nano calcium carbonate is not expected to pose a risk of carcinogenicity.
Mutagenicity/ Genotoxicity	Uncoated nano calcium carbonate was negative in the following assays: In vitro gene mutation study in bacteria (OECD TG 471) using Salmonella typhimurium strains TA 98, TA 100, TA 1535 and TA 1537 and Escherichia coli WP2 uvrA with and without metabolic activation (S9). In vitro chromosome aberration study in mammalian cells (OECD TG 473) using human lymphocytes in the presence and absence of metabolic activation. In vitro gene mutation study in mammalian cells (OECD TG 476) using mouse lymphoma L5178Y cells in the presence and absence of metabolic activation. The results of these studies are read across to bulk calcium carbonate.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of the OECD TG 422 study, uncoated nano calcium carbonate administered to male and female rats up to a dose level of 1000 mg/kg bw/day for a period of up to 48 days is not toxic to reproduction and has no effect on fertility or development. No treatment-related effects were observed for reproduction; hence, a NOEL for reproductive toxicity was considered to be 1000 mg/kg bw/day. The results of this study are read across to bulk calcium carbonate. The prenatal developmental toxicity study also demonstrated that calcium carbonate was neither foetotoxic nor teratogenic at the concentrations used. Since no adverse effects were noted at the highest dose level tested (1.25% Ca in diet), the NOAEL for teratogenic and maternal toxic effects in rats is in excess of 1.25% Ca, equivalent to approximately 1963 - 2188 mg/kg bw/day of calcium carbonate.
Acute Toxicity	Bulk calcium carbonate is not considered to be acutely harmful by the oral, dermal or inhalation routes.
Irritation	Bulk calcium carbonate is not considered to be irritating to the skin or eyes.
Sensitisation	Based on the results of an OECD TG 429 study performed using nano calcium carbonate and read across to bulk calcium carbonate, where the Stimulation Index was < 3, bulk calcium carbonate is considered to be a non-sensitiser
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	In the repeated dose toxicity study, NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L.
Ecological Toxicity[2]	
Aquatic Toxicity	Calcium carbonate has low toxicity to aquatic and terrestrial organisms. Ecotoxicological endpoint values for aquatic organisms generally greatly exceed 100 mg/L (LMC 2014), indicating very low toxicity.
Determination of PNEC aquatic	Experimental results are available for three trophic levels. Acute LC50 values are available for fish, invertebrates, and algae. On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 310 mg/L for invertebrates. The PNEC aquatic is 0.3 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.

Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic chemical, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	Not applicable. Expected to have low toxicity to aquatic organisms.
Overall conclusion	Not PBT
Revised	October 2019

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
2. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
3. ECHA REACH, Calcium carbonate, Retrieved 2019: https://echa.europa.eu/

Toxicity Summary - Diethanolamine

Chemical and Physical Properties [1,2,4]	
CAS number	[redacted]
Molecular formula	C4H11NO2
Molecular weight	105.14
Solubility in water	1,000 g/L @ 20 °C
Melting point	27 °C at 101.3 kPa
Boiling point	269.9 °C at 101.325 kPa
Vapour pressure	0.0028 hPa (25 °C)
Henrys law constant	3.97 x 10-6 Pa*m^3/mol
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Colourless crystals or a white syrupy liquid with a mild ammonical odour.
Overview	2,2'-Iminodiethanol (diethanolamine, DEA) belongs to the ethanolamines group that includes monoethanolamine (MEA), diethanolamine (DEA) and triethanolamine (TEA). Large-scale production of DEA is carried out by the reaction of ethylene oxide and excess ammonia, followed by fractionation of the three ethanolamines (mono-, di- and triethanolamine). Ethanolamines are used widely as intermediates in the production of anionic and non-ionic surfactants, which have become commercially important as detergents, textile and leather chemicals, and emulsifiers. Their uses range from drilling and cutting oils to medicinal soaps and high-quality toiletries. DEA is an important additive of corrosion inhibitors, particularly in coolants for automobile engines. DEA is also employed as an additive in lubricants and in cement/concrete production. Large amounts of DEA are used as such in closed systems for absorptive gas purification to remove weakly acidic components. In the production of detergents, cleaners, fabric softeners and metalworking fluids DEA is used for acid neutralization and to prevent soil deposition. DEA is also used as an intermediate in the production of morpholine, photographic chemicals and polyurethanes. In addition, DEA is used as a building block for agrochemicals.
Environmental Fate[4]	
Soil/Water/Air	The colourless solid DEA is completely miscible with water at ambient temperature and has a negligible vapour pressure of 0.0028 hPa (25 °C). The measured log KOW of -2.18 (25 °C) and the calculated BCF of 3.16 indicate a low potential for bioaccumulation. The Henry's law constant of 3.97 x 10-6 Pa*m^3/mol (uncharged) is considered as an indication for low volatility. The calculated Koc of uncharged DEA is 1 (corrected log Koc = 0). Thus, the potential for adsorption to soil, sediment, and suspended solid may be low. However, binding of the substance to the matrix of soils (and sediments) with high capacities for cation exchange (e.g. clay) cannot be excluded for the charged molecule. The measured pKa value of 8.92 (23 °C) indicates that at environmentally relevant conditions of pH 6 – 8, the molecule will predominantly occur in the charged (cationic) form. At pH values > 9, DEA will predominantly be present as the uncharged species. According to Mackay Level I modelling, uncharged DEA will distribute almost completely into water (99.99 %). DEA is readily biodegradable according to OECD criteria. Potential for anaerobic degradation of DEA was also observed. In the atmosphere, it will be photodegraded by reactions with OH radicals (calculated half-life of the uncharged molecule for a 12-hour day and 1.5E06 OH/cm^3: 2.4 hours = 0.1 day; for a 24-h day and 0.5E06 OH/cm^3: 4.2 hours = 0.2 days). At environmental pH conditions hydrolysis is not expected to be a relevant degradation process due to the absence of hydrolysable groups
Human Health Toxicity Summary [1,2]	

Chronic Repeated Dose Toxicity	In a 90 day oral gavage study conducted similarly to OECD TG 408 in F344 rats, lowest observed adverse effect levels (LOAEL) of 320 and 160 ppm (equivalent to 25 and 14 mg/kg bw/day, respectively) was reported in male and female rats, respectively. These were the lowest doses tested. Mortality was observed in males (2/10 animals) at the highest dose (5000 ppm) before the completion of the study (REACH; OECD, 2008). Signs of toxicity were observed across all dose groups (160 - 2500 ppm), and included tremors, extreme weight loss, abnormal posture and a dose dependent increase in microcytic anaemia. Dose related (≥ 320 ppm in males and ≥ 160 ppm in females) changes in kidney weights were associated with an increase in nephropathy and renal cell necrosis. Dose related (≥ 320 ppm in males and ≥ 630 ppm in females) increase in liver weight was associated with a moderate increase in serum bile acid concentration (REACH; OECD, 2008). Based on treatment-related effects reported with a LOAEL of 32 and 80 mg/kg bw/day in rat and mouse studies, respectively, the chemical is considered to cause serious damage to health from repeated oral exposure. In a 90 day dermal application study conducted similarly to OECD TG 411 in F344 rats, a LOAEL of 32 mg/kg bw/day was reported in male and female rats. Mortality occurred in one male and two female rats administered the highest dose of 500 mg/kg bw/day (REACH; OECD, 2008). Ulceration, inflammation, hyperkeratosis, and acanthosis occurred at all administered doses (32 - 500 mg/kg bw/day). Other signs of toxicity included reductions in body weight gain, anaemia, renal function changes and liver weight increases. Demyelination in the brain, nephropathy and renal tubular necrosis were also observed (REACH; OECD, 2008). In a similar study conducted similarly to OECD TG 411 in B6C3F1 mice, a LOAEL of 80 mg/kg bw/day was reported in male and female mice. Effects on the skin were noted at all doses (80 - 1250 mg/kg bw/day) and consisted of acanthosis at the lower doses and a dose-dependent increase in ulcerations, inflammation and hyperkeratosis at higher dose levels (630 and 1250 mg/kg bw/day in males and females, respectively) (REACH; OECD, 2008). Further signs of toxicity included dose dependent increases in liver and kidney weights. The increase in liver weight was associated with hepatocellular changes consisting of enlarged hepatocytes and, at the higher dose levels, the presence of multinucleated, giant hepatocytes. Liver damage (hepatocellular necrosis) was observed in male mice only (REACH; OECD, 2008). Based on the available data no adverse systemic toxicity was evident. Local effects were observed at a lowest observed adverse effect concentration (LOAEC) of 0.15 mg/L in one study. The available data do not warrant a hazard classification for repeated dose inhalation toxicity. However, a classification for respiratory irritation is warranted. In a 90 day inhalation study conducted according to OECD TG 413 in Wistar rats, a LOAEC of 0.15 mg/L was reported in male and female rats. Local inflammation (focal squamous metaplasia and hyperplasia) was evident in the larynx (0.15 mg/L) and trachea (0.4 mg/L) in a concentration dependent manner (REACH, SIDS, 2008). Marginal increases in liver weight and serum alkaline phosphatase levels occurred at the mid - high doses (0.15 and 0.4 mg/L, respectively), although, no histopathological changes were noted. In females, erosions of the glandular stomach occurred in a dose dependent manner (0.15 mg/L and 0.4 mg/L) (REACH; OECD, 2008). A further study conducted according to OECD TG 413 in male and female Wistar rats using lower doses (0.0015, 0.003 or 0.008 mg/L) showed similar local irritation effects (focal squamous metaplasia) after 90 days of exposure. After 90 days of exposure to the chemical, a group of 10 animals were given three months of recovery. At the end of the recovery period, no treatment related systemic effects were observed, indicating reversibility in the laryngeal epithelium up to the highest dose administered (0.008 mg/L) (REACH, OECD, 2008).
Carcinogenicity	Limited data are available on the carcinogenicity of DEA. A two-year carcinogenicity study was conducted by the United States National Toxicology

	Program (NTP, 1999). Based on the pattern of occupational and consumer exposure, dermal administration was considered the most appropriate route for the carcinogenicity study in rats and mice. Groups of 50 male F344/N rats were administered dermal doses of 0, 16, 32, or 64 mg/kg bw DEA in ethanol solutions, 5 days per week for 103 weeks. Female rats were administered 0, 8, 16, or 32 mg/kg bw, and male and female B6C3F1 mice were administered 0, 40, 80, or 160 mg/kg bw DEA dermally, 5 days per week for 103 weeks. Mean body weights of treated rats were generally lower than those of the control rats. The only clinical finding attributed to DEA administration was irritation of the skin at the site of application. This effect was dose-related. Exudate, consisting of focal accumulations of serum and cellular debris on the epidermal surface, occurred at significantly increased incidences in 64 mg/kg bw males and in all dosed female groups. In rats, the main histopathological effects were noted in kidneys of female rats with nephropathy, renal tubular epithelial cell necrosis and/or mineralisation, which increased in incidence and/or severity in a dose-dependent manner. The incidence of nephropathy in dosed female groups was significantly greater than that in the vehicle controls; but no such effects were seen in male rats. There was no neoplastic response in the skin or any organ associated with DEA exposure during the two-year study. The incidence of basophilic foci was significantly decreased in all dosed groups of males and females. The incidence of fibroadenoma in mammary glands in female rats occurred with a negative trend, being lower in all dosed groups compared to the historical control range. In mice, mean body weights of treated groups were depressed, more so in female mice than in male mice. The liver was clearly the most affected organ, and female mice were more sensitive than males. Exposure to diethanolamine for two years produced a marked neoplastic response in the liver characterised by significant increases in the incidences and multiplicity of hepatocellular adenomas (males: 31/50, 42/50, 49/50, 45/50 and females: 32/50, 50/50, 48/50, 48/50) and hepatocellular carcinoma (males: 12/50, 17/50, 33/50, 34/50 and females: 5/50, 19/50, 38/50, 42/50) at 0, 40, 80 and 160 mg/kg bw/day, respectively. The microscopic appearance of these liver neoplasms was typical of those usually observed spontaneously in B6C3F1 mice. There was a morphologic continuum from adenoma to carcinoma, with less differentiation and typical trabecular formations in the carcinomas. Increased mortality was noted in female mice and this, along with reduced body weights, was considered to be a consequence of the presence of liver neoplasms. The incidence of hepatoblastomas, uncommon phenotypic variants of hepatocellular carcinoma, was significantly increased in male mice, but not in females. In addition, the incidence of syncytial alteration, a non-neoplastic lesion characterised by the presence of hepatocytes containing multiple (three or more) nuclei, was increased in all groups of dosed mice; this lesion was not present in the controls. Centrilobular cytoplasmic alteration was increased in treated males but was not present in females. There were no neoplasms of the skin in mice. Effects in the kidneys included increased organ weights and increased incidence of tubular epithelial cell necrosis. The incidences of renal tubule adenoma and renal tubule adenoma or carcinoma (combined) occurred with a positive trend in male mice, but renal tubule carcinoma did not follow the same pattern. Detailed evaluation of the renal neoplasms indicated a treatment- and dose-related increase in the incidences of renal tubule adenoma (1/50, 4/50, 6/50 and 6/50) and adenoma or carcinoma (combined) (3/50, 5/50, 6/50 and 8/50 at 0, 40, 80 and 160 mg/kg, respectively). Diethanolamine is eliminated in urine as the parent compound. The data on the mode of action are insufficient to conclude that diethanolamine-induced tumours in mice are relevant for humans and, therefore, based on the available information, diethanolamine is not classified for carcinogenicity.
Mutagenicity/ Genotoxicity	The chemical tested negative in several in vitro (Ames test with and without metabolic activation, reverse mutation assay, cytogenic assay and the mouse lymphoma assay) and in vivo (micronucleus assay and the alkaline elution assay) tests for gene mutation and clastogenicity (NICNAS; OECD, 2008).

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No reproductive toxicity studies are available for diethanolamine. Repeated dose studies were conducted in F344/N rats and B6C3F1 mice of both sexes for 13 weeks (10/sex/species/dose) to characterise the effects of oral and dermal exposure (NTP, 1992). No reproductive toxicity in male or female rats was reported following dermal administration of the chemical for 13 weeks. There were no morphological effects on male or female reproductive organs or in sperm parameters (NTP, 1992). It is likely that testicular degeneration in a 90-day drinking water study is a direct toxic effect of diethanolamine. However, no effect on the reproductive organs of the female rats was noted. The NOAEL for reproductive effects in males is 630 ppm (48 mg/kg bw/day). In an inhalation study, conducted according to OECD TG 413, male and female Wistar rats were exposed to the chemical via inhalation (0.015, 0.15 or 0.4 mg/L), five times a week for 90 days. Reproductive effects in males were reported at the highest concentration (0.4 mg/L) and these included testicular atrophy and slight atrophy of the prostate. No changes were observed in female rats (OECD, 2008). The effects of diethanolamine on the male reproductive system are indicative of a potential to impair reproductive capability. However, more detailed reproductive toxicity studies are needed to confirm the potential effects on fertility observed in male rats. The current information is insufficient to classify diethanolamine for reproductive toxicity. Developmental effects were tested following exposure of dams to diethanolamine by oral, dermal and inhalation routes. In almost all the rodent studies, developmental effects were seen only at higher doses, at which maternal effects were also noted. In a dermal study in rabbits, the overall incidence of malformation was similar to the incidence seen in control animals. The current data therefore do not allow for a clear delineation of reproductive and developmental toxicity of diethanolamine in experimental animals. Classification of diethanolamine for reproductive and developmental toxicity is, therefore, not recommended at this stage.
Acute Toxicity	The reported oral median lethal dose (LD50) values in rats ranged from 780 - 3540 mg/kg bw (OECD, 2008). In one study male Sprague Dawley (SD) rats administered a single oral dose of aqueous DEA (100 – 6400 mg/kg bw) resulting in 90 % mortality at the highest dose. Doses greater than 100 mg/kg bw resulted in an increase in liver weight. An increase in the relative kidney weight was observed at doses greater than 1600 mg/kg bw. Clinical chemistry changes were reported for the liver at doses greater than 200 mg/kg bw and for the kidney at greater than 400 mg/kg bw (OECD, 2008). The chemical was of low acute toxicity in animal tests following dermal exposure. The median lethal dose (LD50) in rabbits is greater than 12000 mg/kg bw (IUCLID, 2000). The chemical was of low acute toxicity in animal tests following inhalation exposure. The median lethal concentration (LC50) in rats is 6.4 mg/L. The available data do not warrant hazard classification. Acute inhalation exposure to the chemical for 1.5 – 4 hours at concentrations between 30 – 1476 ppm (0.13 - 6.4 mg/L) caused mortality in 5/8 rats after 105 minutes of exposure to 6.4 mg/L. Exposure to 3.35 mg/L (768 ppm) for up to 4 hours resulted in no mortality. It was reported that the exposure was to vapours or aerosols (most likely at the higher concentration). Observed sub-lethal effects included lethargy, increased breathing, increased blood pressure, congestion in the lung and discolouration in the kidney and thymus (REACH; OECD 2008).
Irritation	The chemical on unabraded rabbit skin produced skin irritation after 1 - 15 minutes and marked irritation after 20 hours. Over 72 hours, erythema increased and oedema decreased (REACH). After 20 hours of exposure the mean Draize

	scores for erythema and oedema formation were 2 and 1.33, respectively. While the Draize scores for erythema and oedema returned to normal after 8 days, severe desquamation of the skin persisted. The chemical is also reported to cause ulceration, inflammation and hyperkeratosis following repeated exposure. In an eye irritation study in Vienna White rabbits, 0.05 mL of the chemical was instilled into the rabbit's eyes and observed for eight days. The chemical caused signs of severe irritation consisting of superficial corrosion, corneal opacity, conjunctival bleeding, conjunctivitis and oedema (OECD, 2008; REACH). Extensive corrosion was evident at the end of the observation period. In a further study, 0.1 g of the chemical was applied into the conjunctival sac of New Zealand White rabbits. This resulted in strong irritation of the cornea, iris and conjunctiva, which did not completely resolve over seven days of observation (OECD, 2008).
Sensitisation	The chemical was not found to induce dermal sensitisation in the Guinea pig maximization test conducted according to OECD Test Guideline (TG) 406 (OECD, 2008).
Health Effects Summary	The critical health effects for risk characterisation include systemic acute effects (acute toxicity by the oral route of exposure) and local effects (skin, eye and respiratory irritation). The chemical may also cause harmful effects following repeated exposure through oral and dermal routes.
Key Study/Critical Effect for Screening Criteria	The lowest observed adverse effect levels (LOAEL) of 320 and 160 ppm (equivalent to 25 and 14 mg/kg bw/day, respectively) were reported in male and female rats, respectively, based on kidney and liver weights in the drinking water study (US NTP, 1992). In mice, the LOAEL was 630 ppm (104 mg/kg bw/day for males and 142 mg/kg bw/day for females) based on liver weight changes. It is reported that the fatal oral dose of the chemical is 20g in humans (HSDB).
Ecological Toxicity [3,4]	
Aquatic Toxicity	The lowest reliable acute toxicity values for aquatic species were as follows: Pimephales promelas (fish) 96-h LC50 = 1370 mg/l (nominal) Daphnia magna (invertebrates) 48-h EC50 = 55 mg/l (nominal) Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l (nominal) Pseudomonas sp. (microorganisms) 16-h TTC = 16 mg/l (nominal) In a chronic toxicity test on reproduction of the water flea Daphnia magna, the NOEC (21 days) was 0.78 mg/l (nominal, based on analytical verification).
Determination of PNEC aquatic	Using an uncertainty factor of 50 on the lowest NOEC to Daphnia a PNEC (Predicted No Effect Concentration) of 0.02 mg/L is calculated, for aquatic organisms.
Current Regulatory Controls [1]	
Australian Hazard Classification	The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xn; R22 (Acute toxicity) Xi; R38/41 (Irritation) Xn; R48/22 (Repeated dose toxicity)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 13 mg/m³ (3 ppm) time weighted average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 2 - 15 mg/m³ (0.46 – 3 ppm) in different countries such as USA (Alaska, Hawaii), Canada (Yukon), Norway and Switzerland.
Australian Food Standards	No data available.

Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [4]	
P/vP Criteria fulfilled?	No. DEA is readily biodegradable according to OECD criteria.
B/vB criteria fulfilled?	No. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16, this chemical does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The chronic aquatic toxicity of the chemical is > 0.01 mg/L. Hence the substance does not fulfil the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Human Health Tier II Assessment for Ethanol, 2,2'-iminobis-, Retrieved 2019: https://www.nicnas.gov.au
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Human Health Tier III Assessment for Ethanol, 2,2'-iminobis-, Retrieved 2019: https://www.nicnas.gov.au
3. ECHA REACH, 2,2'-iminodiethanol, Retrieved 2019: https://echa.europa.eu/
4. OECD (2002) SIDS Initial Assessment Profile for 2,2'-iminodiethanol (diethanolamine, DEA)

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Toxicity Summary - Distillates, Hydrotreated Light

Chemical and Physical Properties [1,2,3,4]	
CAS number	[redacted]
Molecular formula	C48H94
Molecular weight	Not applicable - unknown or variable composition, complex reaction products or biological materials (UVCB)
Solubility in water	0.009 to 6.45 mg/L (at 25°C)
Melting point	-49 °C
Boiling point	146 to 299 °C
Vapour pressure	1 to 3.7 kPa at 37.8 °C
Henrys law constant	No data found.
Explosive potential	Above 66°C explosive vapour/air mixtures may be formed
Flammability potential	Combustible
Colour/Form	Liquid at room temperature
Overview	Distillates, hydrotreated light (also called deodorised kerosene) is a petroleum substance. The C_9-C_{14} Aliphatic [< 2% Aromatic] Hydrocarbon Solvents Category is comprised of complex aliphatic hydrocarbon solvents that contain >98% aliphatic constituents with carbon numbers in the range of C9-C14 and less than 2% aromatic constituents. The chemical is used as a component of a drilling fluid formulation for coal seam gas extraction.
Environmental Fate[1]	
Soil/Water/Air	Members of the C_9-C_{14} Aliphatic [≤2% aromatics] Hydrocarbon Solvents Category have the potential to volatilize from surface waters, based on Henry's Law constants (HLC) representing volatility for category members that range from 4.76×10^4 to 1.67×10^6 Pa-m^3/mole (at 25°C). In the air, category members have the potential to rapidly degrade through indirect photolytic processes mediated primarily by hydroxyl radicals (•OH) with calculated degradation half-lives ranging from 0.42 to 1.10 days or 10.8 to 26.4 hours based on a 12-hr day and an •OH concentration of 1.5×10^6 •OH/cm^3. These chemicals are unlikely to degrade by hydrolysis as they lack a functional group that is hydrolytically reactive.

Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	In a 90-day study conducted in accordance with OECD TG 408, Sprague-Dawley rats were administered deodorized kerosene by gavage at doses of 0, 100, 500 or 1000 mg/kg bw/day (REACH 2013). Microscopic changes, such as incidence of a2µ-globulin, were seen in male kidneys. These effects are not considered relevant to humans. No other treatment-related effects were observed. No Lowest Observed Adverse Effect Level (LOAEL) or No Observed Adverse Effect Level (NOAEL) could be established in this study. Repeated dermal exposures to members of the kerosene/jet fuel category showed minimal systemic effects (API 2010). Animal data on repeat dermal toxicity of kerosene (petroleum) are summarised from REACH (2013) and presented in Table A29.2. The LOAELs and NOAELs are indicated for each study. Prolonged skin exposure to kerosene (petroleum) in rats and rabbits were consistently associated with local irritation. In rabbits only, systemic effects included changes in bodyweight and organ weights. It is expected that deodorized kerosene would have similar effects in the animals. In a 13-week study, rats (strain not specified) were exposed to deodorized kerosene vapour at concentrations of 0, 0.02, 0.048 or 0.10 mg/L for six hours/day, five days/week. No treatment-related effects were reported (REACH 2013).
Carcinogenicity	A study for deodorized kerosene is available in the REACH Dossier (REACH 2013) but was not reported in enough detail to be able to determine the carcinogenicity of the substance. In a study conducted similarly to OECD TG 451, B6C3F1 mice were applied 0, 250 or 500 mg/kg bw/day kerosene (petroleum) in the interscapular region (type of wrapping not specified) for 103 weeks (REACH 2013). At the end of the study, less than 10% decrease in bodyweight gain was observed at the top dose in both sexes. Mortality in females was significantly higher at the two doses compared to controls. Increased incidence and severity of chronic dermatitis was seen in all treatment groups. At the top dose, increased incidence of the following non-neoplastic lesions was reported: amyloid in the liver, kidney, adrenal cortex (males only), spleen; granulocytic hyperplasia in the bone marrow; and hyperplasia of the axillary lymph nodes (females only). The only indication of neoplastic lesions was an increased incidence of malignant lymphomas observed in treated female animals but the values were within the range of historical controls. Under the conditions of the test, kerosene (petroleum) was not carcinogenic. The LOAEL for systemic effects is 250 mg/kg bw/day. The International Agency for Research on Cancer (IARC) concluded that there is inadequate evidence for the carcinogenicity of kerosene (petroleum) in experimental animals and humans, placing the chemical in Group 3 (Not classifiable as to its carcinogenicity to humans) (IARC 1989). Deodorized kerosene is not carcinogenic, based on reading across the information available for kerosene (petroleum).
Mutagenicity/ Genotoxicity	In vitro tests reported deodorized kerosene as negative both with and without metabolic activation in Ames tests conducted in accordance with OECD TG 471 (REACH 2013; OECD 2011) and in chromosomal aberration tests conducted in accordance with OECD TG 473 (OECD 2011, 2012). In an in vivo study, deodorized kerosene was negative in a dominant lethal assay, conducted in accordance with OECD TG 478, in male Swiss mice and Long Evans rats administered 10% deodorized kerosene intraperitoneally (REACH 2013). These studies demonstrate that deodorized kerosene is not genotoxic.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	C9-C14 aliphatic (≤2% aromatic) hydrocarbon solvents and C14-C20 aliphatic (≤2% aromatic) hydrocarbon solvents are not toxic to fertility (OECD 2011, 2012). Members of the kerosene/jet fuel category are not toxic to fertility (API 2010). Sprague-Dawley rats were administered undiluted kerosene (petroleum) by gavage at doses of 0, 750, 1500 or 3000 mg/kg bw/day in males treated for 70-90 days and 0, 325, 750 or 1500 mg/kg bw/day in females treated for 21 weeks. At 750 and 1500 mg/kg bw/day, increased absolute liver weight was observed in females but with no corresponding changes in clinical chemistry or histopathology. In females only, other effects included perianal dermatitis at 1500 mg/kg bw/day and stomach hyperplasia at 750 and 1500 mg/kg bw/day. These parameters were not measured in males. In males, the study indicated dose dependent decrease in male bodyweight that was linked to nephropathy specific to male rats. Data for this effect were not provided in the study description. There were no treatment related effects on fertility in both sexes (REACH 2013). The NOAEL for systemic effects in females only was 325 mg/kg bw/day. No NOAEL can be established for fertility effects. C9-C14 aliphatic (≤2% aromatic) hydrocarbon solvents and C14-C20 aliphatic (≤2% aromatic) hydrocarbon solvents are not developmental toxicants (OECD 2011, 2012). Members of the kerosene/jet fuel category are not developmental toxicants (API 2010). In a study conducted in accordance with OECD TG 414, Sprague-Dawley rats were administered kerosene (petroleum) by gavage on gestation days (GD) 6 to 15 at doses of 0, 500, 1000, 1500 or 2000 mg/kg bw/day (REACH 2013). Bodyweight gain was decreased at 1500 and 2000 mg/kg bw/day. Foetal weight was decreased at 1500 and 2000 mg/kg bw/day which may be attributed to decreased maternal bodyweight gain. No malformations were reported. The maternal NOAEL is 1000 mg/kg bw/day. In another study, Sprague-Dawley rats were exposed (whole body) to kerosene (petroleum) in air at concentrations of 0, 106 or 364 ppm on GD 6-15. There were no treatment-related effects observed in the dams and offspring (REACH 2013). Deodorized kerosene is not considered a developmental toxicant, based on reading across data available for kerosene (petroleum).
Acute Toxicity	The chemicals have low acute toxicity based on results from animal tests following oral exposure. The median lethal dose (LD50) in rats is >2000 mg/kg bw (OECD, 2011; US EPA, 2011; OECD, 2012a; OECD, 2012b; OECD, 2012c). The chemicals have low acute toxicity based on results from animal tests following dermal exposure. The LD50 in rats and rabbits is >2000 mg/kg bw (OECD, 2011; US EPA, 2011; OECD, 2012a; OECD, 2012b; OECD, 2012c). The chemicals have low acute toxicity based on results from animal tests following inhalation exposure.
Irritation	Semi-occlusive applications of commercial grade deodorized kerosene produced slight irritation in New Zealand White and SPF rabbits in dermal irritation studies conducted in accordance with OECD TG 404. The studies reported the range of erythema and oedema scores to be 0.3-0.9 and 0.2-1.0, respectively, based on Draize scoring at 24, 48 and 72 hours. Deodorized kerosene is slightly irritating to rabbit skin. Several studies conducted similarly to OECD TG 405 showed minimal effects to the eye with the reported range of conjunctival redness score to be 0-0.2 from instillation of undiluted deodorized kerosene in the eyes of New Zealand White and SPF rabbits (OECD 2011). Deodorized kerosene is slightly irritating to rabbit eye.
Sensitisation	The C9-C14 aliphatic (≤2% aromatics) Category members do not cause skin sensitization.

Health Effects Summary	Deodorised kerosene is an aspiration hazard since it has low viscosity and is composed of aliphatic and aromatic hydrocarbons up to 10%. Deodorised kerosene has low acute oral, dermal and inhalation toxicity, and is slightly irritating to the skin and eyes. The substance is not a skin sensitiser, based on reading across data available for kerosene (petroleum). No treatment-related effects were reported in repeated oral and inhalation exposures to deodorised kerosene. Prolonged dermal exposure to kerosene (petroleum) reported local irritation in rats and rabbits, and changes in bodyweight and organ weights in rabbits. It is expected that these effects would be similar for deodorised kerosene. Based on the absence of adverse effects observed in repeat dose toxicity studies, for the purposes of quantifying the health risk to the general worker and public, the highest dose tested in the study conducted in rats (1 000 mg/kg bw/day) is used in this risk assessment. The substance is not genotoxic. It is neither a carcinogen nor a reproductive toxicant, based on reading across data available for kerosene (petroleum).
Key Study/Critical Effect for Screening Criteria	The most appropriate No-Observed-Adverse-Effect Level (NOAEL) for risk assessment is 1 000 mg/kg bw/day based on maternal toxicity (decreased bodyweight gain) at the Lowest- Observed-Adverse-Effect Level (LOAEL) of 1 500 mg/kg bw/day from a developmental toxicity study on kerosene (petroleum).
Ecological Toxicity [2]	
Aquatic Toxicity	Lowest acute endpoint for Daphnia = 0.018 mg/L (modelled)
Determination of PNEC aquatic	Based on the lowest acute endpoint for Daphnia (0.018 mg/L), an assessment factor of 100 has been applied, resulting in a PNECaquatic of 1.80E-04 mg/L.
Current Regulatory Controls [2]	
Australian Hazard Classification	All of the chemicals are classified as hazardous, with the following risk phrase for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): Xn; R65 (acute toxicity) Mixtures containing the substance are classified as hazardous with the following risk phrase based on the concentration (Conc) of the substance in the mixtures: Conc ≥10%: Xn; R65 (May cause lung damage if swallowed)
Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	No specific exposure standards are available for this chemical.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	Oils and greases (including petrochemicals) for freshwater production: <300[6] µg/L (ANZECC 2000)
PBT Assessment	
P/vP Criteria fulfilled?	No. This chemical is expected to be biodegradable. The ready biodegradability of SHELLSOL NF a solvent naphtha (petroleum), heavy aromatics (consists predominantly of C9 aromatics 25%m/m; C10 aromatics 65%, and indanes 10%) was studied in mineral nutrient medium inoculated with activated sludge (mixed liquor suspended solids 100-101 mg/L, pH 6.9) and incubated for 28 days at 20°C. SHELLSOL NF is readily biodegrade after 28 days but not within the 10 day window.
B/vB criteria fulfilled?	Category members have a potential to bioaccumulate, based on calculated log BCF values for constituents that range from 2.78 to 4.06, and calculated BCF values of 598 to 11,430 L/kg wet-weight, based on the Arnot and Gobas model, that take into account biotransformation of the chemicals in fish tissue. This chemical also has a log Kow of 6.025.

T criteria fulfilled?	Yes. The lowest acute endpoint is <1 mg/L.
Overall conclusion	Not PBT
Revised	January 2019

Human Health Risk Assessment

Occupational Exposure

Table 2 presents the calculated internal doses for adult workers associated with drilling chemical exposure/hydraulic fracturing chemical exposure.

Table 2 Calculated Internal Doses for Adult Workers

Occupational Activity	E_{derm} (mg/kg bw/day)	E_{inh} (mg/kg bw/day)	E_{total} (mg/kg bw/day)
Transport and storage	Negligible*	Negligible*	Negligible*
Mixing/blending drilling of hydraulic fracturing chemicals	0.06	0.750	**0.810**
Injection of drilling chemicals	Negligible*	Negligible*	Negligible*
Cleaning and maintenance (hydraulic fracturing)	0.012	0.150	**0.162**
Combined exposure Mixing/blending and cleaning and maintenance			**0.972**
Transport and storage of drilling muds	Negligible*	Negligible*	Negligible*

Ederm - Internal dose from dermal exposure; Einh – Internal dose from inhalation exposure; Etotal – Total internal dose from all routes.

* In the absence of accidents/incidents, repeated occupational exposures during transport and storage, or during injection of mixed/blended chemicals, are negligible. Similarly, repeated occupational exposures to the chemical via the transport and storage of drilling muds are negligible (NICNAS 2017).

Human Health Risk Characterisation

Uncertainty Factors

Using the Margin of Exposure (MOE) approach, conservative default uncertainty factors for intra- and inter-species variability are assumed to be 10 each. A MOE of less than 100 is considered a concern (NICNAS 2017).

Acute Health Risks

Acute exposure to the chemical is unlikely to result in adverse health effects. In addition, given the low concentration in the drilling fluids, exposure to the chemical via these fluids is of low concern for workers.

Chronic long-term health risks

The critical (most sensitive) adverse health effect is maternal toxicity (decreased bodyweight gain). The NOAEL established for this effect is 1000 mg/kg bw/day from a reproductive toxicity study. There are no adverse effects observed from repeated exposures to the chemical at any dose tested, up to 1000 mg/kg bw/day. This highest no-effect dose is applicable for a general worker. Margins of Exposure (MOE) for adverse health effects from repeated occupational exposures are calculated by comparing the NOAEL with exposures estimated for different occupational activities and combined activities. **Table 3** presents Margin of Exposure calculated for Adult Workers associated with drilling

chemical exposure/hydraulic fracturing chemical exposure. Risk characterisation calculations are presented in **Attachment A**.

Table3 Margins of exposure calculated for adult workers

Adult worker exposure scenario	E_{total} (mg/kg bw/day)	NOAEL (mg/kg bw/day)	Critical effect	MOE (NOAEL / E_{total})	Chemical is of concern? (MOE < 100)
Occupational Activity					
Mixing/blending drilling of hydraulic fracturing chemicals	0.810	1000	Maternal toxicity in rats	1235	No
Cleaning and maintenance (hydraulic fracturing)	0.162			6173	
Combined exposure Mixing/blending and cleaning and maintenance	0.972			1029	

Based on uncertainty factors derived for this risk characterisation, the MOEs indicate that the chemical is of low concern for workers from repeated exposures during certain operations.

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Toxicity Summary - Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues

Chemical and Physical Properties[1]	
CAS number	[redacted]
Molecular formula	C36H78N6O14
Molecular weight	UVCB
Solubility in water	100 g/L at 20 °C
Melting point	-20 °C at 101.3 kPa
Boiling point	223 °C at 101.3 kPa
Vapour pressure	0.55 - 20 Pa at 20 - 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive (100%)
Flammability potential	Not classified (50%), Non-flammable (50%)
Colour/Form	Liquid
Overview	The residuum from the reaction of diethylene glycol and ammonia. It consists predominantly of morpholine-based derivatives such as [(aminoethoxy)ethyl]morpholine, [(hydroxyethoxy)ethyl]morpholine, 3-morpholinone, and 4,4'-(oxydi-2,1-ethanediyl)bis[morpholine].
Environmental Fate[1]	
Soil/Water/Air	The substance is hydrolytically stable at pH 4, 7 and 9 at 25°C. Adsorption to solid soil phase is not to be expected. Based on the assessment of the components, it can be concluded that the mixture will not evaporate into the atmosphere. The substance is not readily biodegradable. Based on the low log Kow, the substance will have a low potential for bioaccumulation. Over time, the mixture will preferentially distribute into the compartment water.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	No adverse effects were observed in male and female rats in a 28 days and a 90 days repeated dose toxicity test conducted according to OECD 407 and OECD 408 respectively (Calvert Laboratories, Inc., 2011 and Envigo Research Limited, 2018) in which animals were exposed orally (gavage) to 0, 100, 500 or 1000 mg/kg bw/d (28 days study) and to 0, 10, 100 or 1000 mg/kg bw/d (90 days study). In both studies, an NOAEL of 1000 mg/kg bw was determined.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	In an in vivo micronucleus test on mouse bone marrow erythrocytes (BioReliance, 2010), performed according to OECD guideline 474, the animals were exposed orally (via gavage) with 500, 1000, 2000 mg/kg. This did not induce a statistically positive increase in micronuclei in the hemopoietic cells of the mouse bone marrow at the time intervals evaluated under the experimental condition of this assay. No toxicity was observed. Vehicle and positive controls were valid.

Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A Reproductive / Development Toxicity Screening Testing in Rats was performed according to OECD guideline 421 (Calvert Laboratories, Inc., 2011, Klimisch 1). In this GLP-compliant study, male and female Sprague-Dawley rats (10 animals/sex/dose) were exposed to 1000 mg/kg bw/day. Control animals received concurrent vehicle (water). The rats were exposed on a daily basis, starting two weeks prior to cohabitation until the day before the scheduled euthanasia (minimum of 4 weeks) for males and starting for a minimum of 15 days prior to cohabitation, during cohabitation and from presumed gestation days 0 through day 19 of gestation for females. One female animal was found dead on lactation day 2. All other females survived until scheduled sacrifice. No treatment-related effects were observed in clinical signs, mortality, body weight (gain), food consumption, gross pathology, organ weights or histopathology in the parental animals. There was no treatment-related effect on reproductive performance or in reproductive parameters like for instance number of gravid animals, corpora lutea per dam, total implantations, litter viability or foetal sex ratios. The incidence of neonates born alive/found dead, stillborn or missing between lactation days 0 -4 was comparable among study groups. No treatment-related malformations were observed for neonates. The body weight of neonates was statistically significantly increased with an unknown biological significance for this finding. A NOAEL of 1000 mg/kg bw/day was established.
Acute Toxicity	The oral LD50 in male and female Sprague-Dawley rats was determined to be 5000 mg/kg bw in a reliable, key study conducted similarly to OECD guideline 420 (Calvert Laboratories, Inc., 2010). Calvert Laboratories Inc (2010) determined acute dermal toxicity in 10 male / female rats following a GLP-compliant study performed equivalent to OECD guideline 402 (key study, Klimisch 1). Only one dose was tested (2000 mg/kg bw). No mortality was observed. Shortly after exposure, local erythema and oedema effects were observed in both males and females. The effects seemed to be reversible in males and 1 female. In the 4 other females, necrosis and slouching appeared.
Irritation	The skin irritation potential of the test substance is investigated in a key, reliable study performed according to OECD guideline 404 (Allen, 1994; Klimisch 2) in 3 rabbits. Semi-occlusive patches were removed from shaved test sites after exposure periods of 3 min, 1h, and 4h to 0.5mL of the test substance. The Draize scoring system was used to evaluate the results. No erythema/eschar formation and no oedema formation is observed after 3 min and 1 hour exposure. After 4 hours of exposure, very slight erythema in all 3 animals and very slight oedema in 2 animals was observed, but this was fully reversible within 24 - 48 hrs. Calvert Laboratories, Inc. (2010) investigated the eye irritation potential of the test substance in a key, reliable study performed according to EU method B.5 (Klimisch 1) in 3 rabbits. The treated eyes (with 0.1mL test substance) will remain unrinsed for at least 24 hours after instillation. The 24-, 48- and 72-hours scores will be added separately for each animal and each total divided by 3 to yield the individual mean scores for each animal. Based on the data and according to the criterial of the CLP regulation, the test substance is classified as irritant to the eyes (category 2).
Sensitisation	Based on a guinea pig maximization study, performed according to the OECD guideline 406 (Allen, 1996; Klimisch 2), the test substance is considered not sensitising to the skin.
Health Effects Summary	This chemical may cause skin and eye irritation.
Key Study/Critical Effect for Screening Criteria	The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 1000 mg/kg bw/day from the 90 day repeated oral toxicity study.
Ecological Toxicity [1]	

Aquatic Toxicity	In a static test following the procedures of the German national standard DIN 38412 using Leuciscus idus as test species a LC50 (96 h) of 681.2 mg/L (nominal) was determined [BASF AG, 1988; Study No. 10F0118/885140]. In conclusion, the substance is with high probability not acutely harmful to fish. The EC50 of the test item on daphnids was found to be greater than 122 mg/L (measured value) in a GLP guideline study according to OECD 202 [BASF SE, 2010; Study No. 50E0396/09E012]. Therefore, the test substance is with high probability acutely not harmful to aquatic invertebrates. A study was performed to assess the effect of the test item on the growth of the green alga Pseudokirchneriella subcapitata. The method followed that described in the OECD Guidelines for Testing of Chemicals (2006) No 201, "Freshwater Alga and Cyanobacteria, Growth Inhibition Test" referenced as Method C.3 of Commission Regulation (EC) No 440/2008. The effect of the test item on the growth of Pseudokirchneriella subcapitata has been investigated over a 72-Hour period. the ErC50(72h) of the test item is 45 mg/L for Pseudokirchneriella subcapitata. The toxicity to microorganisms was determined in a GLP short-term respiration test according to OECD guideline 209 using activated sludge from a municipal sewage treatment plant. After 180 minutes no inhibition effect on the respiration rate at the highest test concentration (1000 mg/L) was observed [BASF 2010; Study No. 08G0396/09G004]. Therefore, it can be concluded that inhibition of the degradation activity of activated sludge is not anticipated when introduced in appropriately low concentrations.
Determination of PNEC aquatic	The available short-term aquatic tests covering the three trophic levels (fish, daphnids, algae) showed the lowest L(E)C50 to be 45 mg/L in algae. An assessment factor of 1000 was used for a resulting PNEC for of 0.045 mg/L.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not readily biodegradable. Thus, it is expected to meet the screening criteria for persistence.
B/vB criteria fulfilled?	As the Log Pow is 0.565 at 20 °C (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.1 mg/L. Thus, it is not expected to meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	March 2019

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Toxicity Summary - Glutaraldehyde

Chemical and Physical Properties [1,2,3]	
CAS number	[redacted]
Molecular formula	C5H8O2
Molecular weight	100.11
Solubility in water	Soluble in all proportions in water and ethanol; soluble in benzene and ether.
Melting point	-14°C
Boiling point	188°C
Vapour pressure	2.03 x 10^{-3} kPa at 25 °C (50% solution)
Henrys law constant	0.011 Pa m³/mol @ 25 °C
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Colourless oily liquid. In the vapour state, glutaraldehyde has a pungent odour, with an odour threshold of 0.04 ppm.
Overview	Glutaraldehyde is manufactured in Germany by BASF and in the USA by Union Carbide Corporation. It is usually sold commercially as a 45% or 50% aqueous solution. Glutaraldehyde has a wide variety of uses throughout the world with its use spread over a number of different industries. It is used primarily as a biocide but it also has wide use as a fixative, and some use as a therapeutic agent. The principal health effects of glutaraldehyde are irritation of the skin, eye and respiratory tract, skin sensitisation and occupational asthma. Exposure data indicated that, in some situations, particularly the health care industry (disinfection), x-ray film processing and the animal health industry (spray use), health concerns may arise where available control measures such as ventilation have not been implemented to minimise exposure. Due to low and intermittent exposure, the public health risk from the industrial use of glutaraldehyde is minimal. For the use of glutaraldehyde in cosmetics, a safety margin of >400 for extensive use indicated low concern.
Environmental Fate[1]	
Soil/Water/Air	Glutaraldehyde is a hydrophilic substance that will be mainly associated with the aquatic compartment, with minor amounts partitioning to the atmosphere, following release to the environment. Hydrolysis is slow, but glutaraldehyde, like other aldehydes, undergoes aerial oxidation in solution. It biodegrades rapidly in aerobic and anaerobic aquatic environments at subcidal concentrations (below 10 mg/L) and will not bioaccumulate. Tropospheric degradation is also rapid.
Human Health Toxicity Summary [1,2,3]	

Chronic Repeated Dose Toxicity	A two-year chronic study was conducted in male and female Fischer 344 rats (NICNAS 1994). Groups of 100 male and 100 female rats were administered 0, 50, 250, or 1000 ppm w/v glutaraldehyde in drinking water (4, 17 and 64 mg/kg bw/day for the males and 6, 25 and 86 mg/kg/day for the females). The mortality rate over the treatment period was 25 to 30% for males and 19 to 23% for females with no dose-related increase. The major cause of death in all rats (control and dose groups) was large granular cell lymphatic leukaemia (LGLL). Small dose-related decreases in absolute body weight and body weight gain occurred at 250 and 1000 ppm in males and at 1000 ppm in females. Dose-related decrease in urine volumes and associated increase in osmolality were observed in higher dose animals. At necropsy at 52, 78 and 104 weeks, the only statistically significant changes in organ weights were for the kidney. Relative kidney weights were increased for males and females at 52 and 78 weeks. A significant dose-related increase in kidney weight relative to final body weight occurred for males and females in the 250 and 1000 ppm groups, including an increase in absolute kidney weight for the female rats. Changes in final body weights and the weights of other organs were minor and / or sporadic and were unlikely to be related to glutaraldehyde exposure. The total leucocyte count was significantly increased at week 104 in males at 250 and 1000 ppm, and in females at 250 ppm only. The variation in counts was large, possibly due to the large monocyte count at 250 and 1000 ppm. Changes in clinical chemistry parameters included decreases in the activities of some enzymes at 250 and 1000 ppm and occasional decreases in total protein, globulin and phosphorous; these were probably due to reduced food consumption and body weight. Gross pathology showed evidence of gastric inflammation, particularly in rats sacrificed at the end of the study, with irritation observed as ulceration, a multifocal colour change and thickening of the mucosa (dose groups not specified). Histologic examination of the tissues revealed squamous epithelial hyperplasia and keratinised cysts and oedema. Based on the observations, a NOAEL of 4 mg/kg bw/day for males and 6 mg/kg bw/day for females was established in this study. For the purpose of human health risk assessment, the lowest NOAEL (4 mg/kg bw/day) established in the two-year chronic study in rats will be used.
Carcinogenicity	In a two-year chronic/carcinogenicity study by Van Miller et al. (2002), groups of 100 male and 100 female Fischer 344 rats were treated with 0, 50, 250, or 1000 ppm w/v glutaraldehyde in drinking water. The mean glutaraldehyde consumption for each of the three groups was 4, 17 and 64 mg/kg bw/day for the males and 6, 25 and 86 mg/kg bw/day for the females. The mortality rate during the study period was 25 to 30% for males and 19 to 23% for females and was not dose-related. Gross pathology showed evidence of gastric inflammation. The main finding of the study was an increased incidence of large granular lymphocytic leukaemia (LGLL) in the spleen and liver of male and female rats in all groups, including the control group. Treated females showed a significantly increased incidence of LGLL and analysis for dose-response trend for the severity of LLGL revealed an increased severity in females at the higher dosages (53% in spleen and 54% in liver versus respectively 20% and 23% in untreated females) while no such observation were made for the males. No other significant oncogenic effects were observed during the study. Occurrence of LGLL was seen in all groups including controls; the incidence of LGLL in the 1000 ppm group was high compared to controls but no clear dose-response relationship was evident, and LGLL mainly affected treated females whereas the incidence in treated males was within the control range (REACH 2013). Historical control data for untreated Fischer 344 rats in NTP studies also indicates that the ranges for this tumour are 10 to 72% in males and 6 to 31% in females (REACH 2013). The control data in the Van Miller et al. study fitted in with the historical control data reported from NTP studies. The variability in control data for LGLL and the wide variation reported in the literature makes a definitive conclusion difficult. Base on this study, glutaraldehyde was considered not to be carcinogenic.
Mutagenicity/ Genotoxicity	Glutaraldehyde has been extensively tested for genetic activity in vitro and in vivo, however there is disagreement in the literature regarding glutaraldehyde's genetic activity (Zeiger et al. 2005). While all in vivo genotoxicity tests with glutaraldehyde

	gave negative results, mixed results were reported for in vitro mutagenicity tests. Early in vitro tests were negative (Watts 1984), but some recent bacterial assays and tests in mammalian cells indicated that glutaraldehyde could be mutagenic in vitro. A series of reverse mutation assays was carried out with various Salmonella typhimurium strains, with and without metabolic activation (REACH 2013). All assays with TA 100, 1535, 1537 and 98 were negative. Some assays with TA 102 and 104 gave positive results. Tests with Escherichia coli also yielded both positive as well as negative results. Glutaraldehyde induced sister chromatid exchanges in CHO cells with and without S9 metabolic activation in one laboratory, but was negative without S9 and only weakly positive with S9 in the second laboratory (NICNAS 1994). The difference in the results was attributed to slight differences between the data evaluation systems used in the two laboratories. Glutaraldehyde was not mutagenic in any of the in vivo assays such as peripheral blood micronucleus test, rat bone marrow chromosomal aberration assay and the Drosophila melanogaster sex-linked recessive lethal test (NICNAS 1994; REACH 2013). Chromosome aberrations in bone marrow cells were reported in only one out of eight studies using rats and mice, micronuclei were not induced in bone marrow cells of mice, and dominant lethal mutations were not induced in mice. Glutaraldehyde did not induce cell transformation in Syrian hamster embryo cells in vitro (Zeiger et al. 2005). In vivo, inhalation of glutaraldehyde induced cell proliferation in nasal tissue in rats and mice, but did not induce DNA damage at these sites. Based on these observations, it is concluded that glutaraldehyde is not a genotoxin.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Studies on the incidence of miscarriage in pregnant women have shown no difference between those exposed to glutaraldehyde and those not exposed to the chemical. Studies in female rats and mice have resulted in embryotoxicity/foetotoxicity for glutaraldehyde, but only at doses which are maternally toxic. A number of studies have found no evidence of teratogenicity.
Acute Toxicity	Several acute oral toxicity studies with glutaraldehyde have been reported in rats and other species. In one reliable study, administration of 0.2, 0.3, 0.5, 1.0, 1.7 mL/kg bw glutaraldehyde (corresponding to 226, 339, 565, 1130 and 1921 mg/kg bw, respectively) to male/female Wistar rats by gavage gave a median lethal dose (LD50) of 226 mg/kg bw (REACH 2013). Necropsy of animals that died during the observation period revealed congestion of the lungs and the abdominal viscera. In another study in Sprague-Dawley rats, the oral LD50 was 316 mg/kg bw for males and 285 mg/kg bw for females, when 10 mL of 2.15, 3.16, 4.64, 14.7% glutaraldehyde (corresponding to 215, 316, 464 and 1470 mg/kg bw) was administered by oral gavage (REACH 2013). In a separate study using different strengths of glutaraldehyde, Ballantyne (1986) showed that the oral LD50 for glutaraldehyde in rats varied with the concentration of the glutaraldehyde used. By using different concentrations of glutaraldehyde solutions (1% to 50%) and varying the administration volume to maintain a constant dose, oral LD50 in the range 66 to 733 mg/kg bw were obtained. These studies indicate that glutaraldehyde has high acute oral toxicity. Of the 18 acute dermal toxicity studies reported in REACH (2013) dossiers, results from 14 studies indicated LD50 higher than 2000 mg/kg bw. In four other studies, LD50 ranged between 250 and 1432 mg/kg bw. These studies however did not follow international guidelines and have low reliability. Based on these studies, glutaraldehyde is considered to have low acute dermal toxicity. In a well-defined study, 10 male and 10 female Sprague-Dawley rats per dose group were exposed to glutaraldehyde as liquid aerosol at 0.22, 0.31 and 0.63 mg/L for 4 hours (REACH 2013). Exposure was followed by an observation period of 14 days. During the exposure period slight nasal discharge, snout wiping, flank respiration and irregular to intermittent respiration were reported in rats. During the post-exposure period, bloody nasal discharge, red crusts surrounding the nose, whooping or gasping respiration with rasping sounds and a tremulous gait were observed. These symptoms disappeared in the surviving animals within 5 to 9 days post-exposure. Mortalities were noted in all treated groups. The determination of the LC50 values was based on the Probit Analysis. An LC50 of 0.48 mg/L was calculated for both male and female rats. In another acute inhalation study conducted in a similar manner to the above study, Sprague-Dawley rats, 10 rats per sex per dose group, were exposed to 0.1,

	0.18, 0.28, 0.39 and 0.44 mg/L glutaraldehyde as liquid aerosol for 4 hours (REACH 2013). During and after exposure, mortality and clinical signs of toxicity were recorded at regular time intervals. The LC50 in this study was established as 0.28 mg/L for females and 0.39 mg/L for males. Based on the above studies, glutaraldehyde is considered to have high acute inhalation toxicity.
Irritation	Glutaraldehyde is corrosive to the skin and eyes of rabbits at high concentrations, with signs of skin irritation evident at 2%, and eye irritation at 0.2%. Exposure to glutaraldehyde vapours in acute inhalational studies resulted in nasal irritation and respiratory difficulties. Joint irritation was seen in rabbits after intra-articular administration.
Sensitisation	The skin sensitisation effect of glutaraldehyde was demonstrated in tests with guinea pigs.
Health Effects Summary	Glutaraldehyde has high acute oral and inhalation toxicity and low to moderate acute dermal toxicity. Based on human and animal data, it is corrosive, the vapours are irritating to the respiratory tract, and it has skin and respiratory sensitisation potential. Glutaraldehyde has high repeat dose oral and inhalation toxicity, with an oral No-Observed-Adverse-Effect Level (NOAEL) of 4 mg/kg bw/day based on changes in liver and kidney weights and clinical chemistry parameters. Glutaraldehyde is not genotoxic or carcinogenic. It did not have any adverse effects on the reproductive system of adult rats or on the development of foetuses. The critical adverse health effects of glutaraldehyde are corrosivity, skin and respiratory tract sensitisation and acute and repeat dose oral and inhalation toxicity.
Key Study/Critical Effect for Screening Criteria	From the hazard characterisation, the critical (most sensitive) adverse health effects for repeated exposures to the chemical are changes in clinical chemistry parameters and relative organ (liver and kidney) weights. Glutaraldehyde has high repeat dose oral toxicity with an oral NOAEL of 4 mg/kg bw/day. This NOAEL is used in this human health risk assessment.
Ecological Toxicity [1,2,3,4]	
Aquatic Toxicity	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduction Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L In summary, the test results indicate that glutaraldehyde is slightly to moderately toxic to aquatic fauna and moderately to highly toxic to algae. In some instances, glutaraldehyde appeared to be rapidly lost from test waters in the laboratory. Such behaviour in aquatic toxicity tests generally means that their results will underestimate the inherent toxicity of a substance. However, the toxicity that will prevail under environmental conditions is likely to be lower than that recorded in the laboratory in view of the rapid degradation that would be expected to occur in natural surface waters.
Determination of PNEC aquatic	As a wide selection of species is available, applying a safety factor of 10 to the NOEC (2.1 mg/L) derived from Daphnia seems most appropriate, giving a PNEC of 2100/10 = 0.21 mg/L.
Current Regulatory Controls [1,2,4]	
Australian Hazard Classification	Glutaraldehyde is classified as hazardous in the Hazardous Substances Information System (HSIS) with the following risk phrase (Safe Work Australia 2013):

	· T (Toxic); R23/25 (Toxic by inhalation and if swallowed) · C (Corrosive ; R34 (causes burns) · R42/43 (May cause sensitisation by inhalation and skin contact). Mixtures containing the chemical are classified as hazardous with the following risk phrases based on the concentration (Conc) of the chemical in the mixtures. The risk phrases for this chemical are: · Conc ≥50%: T; R23/25; R34; R42/43 (Toxic; toxic by inhalation and if swallowed; causes burns; may cause sensitisation by inhalation and skin contact) · ≥25% Conc <50%: T; R23; R22; R34; R42/43 (Toxic; toxic by inhalation, harmful if swallowed, causes burns; may cause sensitisation by inhalation and skin contact) · ≥10% Conc <25%: C; R20/22; R34; 42/43 (Corrosive; harmful by inhalation and if swallowed; causes burns; may cause sensitisation by inhalation and skin contact) · ≥2% Conc <10%: Xn; R20/22; R37/38; R41; R42/43 (Harmful; harmful by inhalation and if swallowed; irritating to respiratory system and skin; risk of serious eye damage; may cause sensitisation by inhalation and skin contact) · ≥1% Conc <2%: Xn; R36/37/38 R42/43 (Harmful; Irritating to eyes, respiratory system and skin; may cause sensitisation by inhalation and skin contact) · ≥0.5% Conc <1%: Xi; R36/37/38; R43 (Irritating; irritating to eyes, respiratory system and skin; may cause sensitisation by skin contact)
Australian Occupational Exposure Standards	The chemical has an exposure standard of 0.41 mg/m³, 0.1 ppm; Time Weighted Average (TWA).
International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013): · Occupational Exposure limit (TWA) of 0.2 mg/m3 [Canada, China, Denmark, Japan, Korea, UK] · 0.4 mg/m3 TWA [Sweden] · 0.8 mg/m3 TWA [US (NIOSH), Greece]
Australian Food Standards	No Australian food standards relating to the chemical have been identified (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for this chemical in the Australian Drinking Water Guidelines. (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	No. As the Log Pow is -0.01 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. Chronic toxicity data >1 mg/L in invertebrates, thus glutaraldehyde does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

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6. National Occupational Health and Safety Commission, Approved Criteria for Classifying Hazardous Substances [NOHSC:0006(1993)], AGPS, Canberra, 1993.

Toxicity Summary - Methanol

Chemical and Physical Properties[1,3,4]	
CAS number	[redacted]
Molecular formula	CH4O
Molecular weight	32.04
Solubility in water	1,000 g/L at 20 °C
Melting point	-98 °C
Boiling point	65 °C
Vapour pressure	16.927 kPa at 25 °C
Henrys law constant	0.461 Pa m³/mol
Explosive potential	Vapour/air mixtures are explosive
Flammability potential	Highly flammable
Colour/Form	Clear colourless liquid
Overview	Methanol occurs naturally in humans, animals and plants. The general population is exposed to methanol mainly through consumption of food and beverages and through use of consumer products such as paints, sealers and adhesives that contain methanol as a solvent.
Environmental Fate [1,3]	
Soil/Water/Air	Air is the main target compartment, based on a fugacity model calculation (Mackay Level III) with about 73 % of environmental methanol distributing to air and 16 % to water. Methanol is degraded in the atmosphere by photochemical, hydroxyl-radical dependent reactions. The estimated elimination half-life is calculated to be about 17-18 days with a rate constant of 0.93 x 10-2 cm3/molecule-sec. Methanol is completely miscible in water and has a low octanol/water partition coefficient. These properties are indicative of high mobility in soil.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Considering the no observed adverse effect level (NOAEL) available from a 90-day rat study (500 mg/kg bw/day), the chemical is not considered to cause serious damage to health by repeated oral exposure. In a 20-day inhalation study in monkeys, 3.9 mg/L (3000 mL/m3) was identified as the LOAEL (continuous exposure) where neurotoxic lesions appeared to progress in monkeys (according to NEDO 1987). This exposure concentration correlated with methanol blood levels 80 mg/L and formate levels 30 mg/L. There was no evidence of adverse effects in rats exposed to methanol up to 6.6 mg/L, six hours/day for 28 days, except local nasal irritation and increased relative spleen weights, which were observed only at the middle dose and not considered treatment-related (Andrews et al. 1987). A NOAEL could not be established in this study. In the chronic exposure studies in rats and mice, slight treatment-related decreases in body and organ weights were reported at the highest dose. These are however not considered as 'adverse' effects. In monkeys, slight degeneration of the inside nucleus of the thalamus was observed at 0.13 and 1.3 mg/L after seven months or more (NEDO 1987). One monkey at 0.13 mg/L and two at 1.3 mg/L showed slight but clear changes in peroneal nerves indicating damage to peripheral nerves. Some signs of fibrosis at 1.3 mg/L, which were considered borderline. There were mild but significant effects on heart and kidney at 0.13 and 1.3 mg/L. Histologically, a significant increase of Sudan positive granules was noted in the 1.3 mg group without pathological manifestations (e.g. fibrosis). Although the authors considered the lowest dose (0.013 mg/L) as the LOAEL, it was observed that effects at this dose were very mild and reversible and therefore not

	considered to be adverse effects. Based on these observations, a NOAEL of 0.013 mg/L was established in this study.
Carcinogenicity	The chemical is not likely to be a carcinogen. In a chronic inhalation study, Fisher rats and B6C3F1 mice were exposed to 0.013, 0.13, and 1.3 mg/L methanol for 24 and 18 months, respectively (NEDO 1987). No differences in survival were noted in the treatment groups compared with the control group. There was no evidence of an increase in liver tumours in rats or in the spontaneous liver tumour rate in mice. In the rats, some tumours such as papillary lung adenomas (males only), adrenal phaeochromocytomas (females only) and metastatic (transition) tumours appeared at a somewhat higher incidence in high-dose group rats after week 79 and 104 without clear dose-response relationship. However these tumour incidences were not statistically significantly different from those in the control group. In the mice, there were no appreciable differences from the control in either numbers of animals with tumours or in degree of malignancy observed. Proliferative effects on the astroglia cells were observed in monkeys continuously exposed to 0.013, 0.13 and 1.3 mg/L methanol by the inhalation route (NEDO 1987). These effects however were of a transient nature and disappeared after a six-month recovery period. There were no signs of histological degeneration.
Mutagenicity/ Genotoxicity	Methanol has been examined in numerous in vitro and in vivo test systems, including bacterial, mammalian and fungal test systems. Most in vitro studies did not demonstrate mutagenic activity. A small number of studies gave ambiguous results. All other studies produced negative results consistently. The majority of in vivo assays were negative for mutagenicity and clastogenicity (OECD 2004). Methanol was therefore concluded to be not mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No impairment of fertility or reproductive performance was reported in male and female rats exposed to the chemical, except at very high doses. Male mice had morphological anomalies in spermatozoa after repeated oral dosing at 1000 mg/kg bw/day (blood level > 500 to 1000 mg/L in mice) (OECD 2004). Rodent studies indicate that methanol has developmental toxicity effects. The rodent data on developmental toxicity are relevant for humans despite the known differences in methanol metabolism between the two species. However, rodents are considered adequate models for humans only at levels where formate does not accumulate (NTP 2003). Blood methanol levels associated with serious developmental effects in rodents were in the range associated with formate accumulation (1000 to 2000 mg methanol per litre of blood), which is likely to result in metabolic acidosis, and visual and clinical effects in humans (NTP 2003; OECD 2004). The limited data available in humans do not show an association between reproductive and developmental toxicity and methanol (NTP 2003). Following a review of the developmental toxicity studies, the NTP concluded that there is evidence to suggest that females with low folate levels may be more susceptible to the adverse developmental effects of methanol, but more information was necessary to clarify this issue (NTP 2003). Based on the data available, the chemical is not considered to have reproductive or developmental toxicity in humans.
Acute Toxicity	In rats, mice, rabbits and dogs, the LD50 values after single oral administration range from about 5600 to 14 400 mg/kg bw (EHC 1997). Adverse effects noted in these animals were ataxia, narcosis and coma after high methanol doses. The animals did not exhibit acidosis and ophthalmologic changes typically seen in humans at high lethal and sub-lethal doses In rhesus monkeys, no deaths were reported at doses of 1000 to 2000 mg/kg bw, while animals receiving 3000 to 8000 mg/kg bw died within two days (OECD 2004). Treated animals showed acidosis, and some exhibited semi-coma and ophthalmologic changes. Human data, however, indicate acute oral toxicity at comparatively lower doses of 300 to 1000 mg/kg bw (EHC 1997). The reported median lethal doses (LD50) for experimental animals are 7300 mg/kg bw (mouse), 5628 mg/kg bw (rat), 14 200 mg/kg bw (rabbit) and 7000 mg/kg bw (monkey). The lowest lethal dose (LDLo) for humans ranges from 143 to 428 mg/kg bw (ChemIDplus 2012). There are limited available dermal toxicity studies in animals. In one dermal exposure study all the rats survived after application of 35 000 mg/kg bw methanol to the skin under occlusive conditions, while deaths were reported at 45 000 mg/kg bw (Eulner and Gedicke 1955). In rabbits, a dermal LD50 of 17 000 mg/kg bw was reported although no details of the study were provided (Carnegie-

	Mellon 1981). Limited data in monkeys indicate that the chemical is toxic via the dermal route (McCord 1931). Humans have been found to be more susceptible to methanol as compared to monkeys. Therefore, acute dermal toxicity with methanol is expected in humans (OECD 2004). The lowest reported dermal LD50 is 17 000 mg/kg bw, which was recorded in rabbits. Median lethal concentrations (LC50) of 87.5 and 128.2 mg/L were reported in rats following six and four hour inhalation exposures to methanol, respectively (BASF 1980a, 1980b). Clinical signs of toxicity were secretions from eyes and nose, laboured breathing, staggering, apathy and narcosis. A similar LC50 value (79 mg/L) was reported for mice following 2.25 hours exposure (Von Burg 1994). In cats, LC50 values after six-hour exposures ranged from 26 to 48 mg/L. A shorter duration of 4.5 hours led to an LC50 of 85.4 mg/L (Von Burg 1994). Studies in Rhesus monkeys indicated lethal concentrations (percent mortality not reported) at 13 mg/L after 18 hour exposure and 52 mg/L after one to four hour exposure (OECD 2004).
Irritation	The chemical is not a skin irritant. The chemical is a slight eye irritant in rabbits. High concentration of methanol vapours may cause irritation of the respiratory tract. In a short-term exposure study (details not available), exposure of rats to an atmosphere saturated with methanol vapours produced severe irritation of mucous membranes and milky corneal opacity (BASF 1975). All animals died after eight hours (BASF 1975).
Sensitisation	The chemical is not a skin sensitiser.
Health Effects Summary	Methanol has low acute oral, dermal and inhalation toxicity in experimental animals but moderate to high acute oral and dermal toxicity in humans. A Lowest Lethal Dose (LDLo) of 143 - 428 mg/kg bw (humans) has been reported. It is not a skin or eye irritant but is expected to be a moderate respiratory irritant, based on its effect on the mucous membrane in rats exposed to methanol vapours and on the effects observed in repeat dose inhalation studies. Tests with guinea pigs indicated that methanol is not a skin sensitiser. The critical effects to human health are acute toxicity from inhalation, skin contact and swallowing, and possible irreversible effects from acute oral exposure. No deaths were reported in Rhesus monkeys dosed at 2 000 mg/kg bw, but treated animals showed acidosis, and some exhibited semi-coma and ophthalmic changes. Human data, however, indicate acute oral toxicity and ophthalmic changes at comparatively lower doses of 300 - 1 000 mg/kg bw. Information on repeated dose toxicity by the dermal route is not available. Methanol was not genotoxic or carcinogenic. Reproductive and developmental toxicity studies did not show any significant effects of relevance to humans.
Key Study/Critical Effect for Screening Criteria	A No-Observed-Adverse-Effect-Concentration (NOAEC) of 0.013 mg/L (13 mg/m3) is used for this risk assessment. This NOAEC is derived from a chronic inhalation study in monkeys, in which degenerative effects in the brain and slight damage to the optic and peripheral nerves were noted at 0.13 mg/L and above. Changes in peroneal nerves were also noted in higher dosed animals, indicating damage to peripheral nerves. An oral No Observed Adverse Effect Level (NOAEL) of 500 mg/kg bw/day was also established in rats in a 90-day oral study based on increased liver enzymes (enzymes not specified) and decreased absolute brain weights at the highest dose. This value is not used in this risk assessment because acute oral data indicate that humans are more sensitive to methanol toxicity than rodents.
Ecological Toxicity [2,3]	
Aquatic Toxicity	In several 96-hour studies in fish in which methanol concentrations were measured during the tests, LC50s ranged from 15,400 to 29,400 mg/L. In the chronic toxicity study to invertebrates, the NOEC was 32,000 mg/L.
Determination of PNEC aquatic	A PNECaqua = 3.20E+03 mg/L can be calculated based on the lowest chronic toxicity value for aquatic invertebrates (Daphnia) with the assessment factor of 10.
Current Regulatory Controls[4]	
Australian Hazard Classification	The chemical is classified as hazardous with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

	T; R23/24/25 (acute toxicity) T; R39/23/24/25 (irreversible effects from acute exposure) Mixtures containing the chemical are classified as hazardous based on the concentration (Conc) of the chemical in the mixtures. The risk phrases for this chemical are: Conc ≥20%: T; R23/24/25; (Toxic: Toxic by inhalation, in contact with skin and if swallowed); R39/23/24/25; (Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed) 10% ≤Conc <20%: T; R20/21/22; (Toxic: Harmful by inhalation, in contact with skin and if swallowed); R39/23/24/25; (Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed) 3% ≤Conc <10%: Xn; R20/21/22; (Harmful: Harmful by inhalation, in contact with skin and if swallowed); R68/20/21/22; (Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed).
Australian Occupational Exposure Standards	The chemical has an exposure standard of 262 mg/m³ (200 ppm) Time Weighted Average (TWA) and 328 mg/m³ (250 ppm) Short-Term Exposure Limits (STEL) (Safe Work Australia).
International Occupational Exposure Standards	The following were identified (Galleria Chemica): 250-270 mg/m³ (200 ppm) TWA in USA, Canada, Denmark, United Kingdom, Germany, France, Estonia, Greece, Hungary, South Africa, Spain, Singapore, Taiwan, Sweden, Malta, Malaysia, Latvia, Japan, Indonesia, India, Iceland, Egypt, Ireland, Mexico, Philippines and Switzerland; 250-350 mg/m³ (250-328 ppm) STEL in USA, Canada, United Kingdom, Greece, South Africa, Singapore, Sweden, India, Egypt and Mexico; 50 mg/m³ TWA in Bulgaria; 100 mg/m³ TWA and 300 mg/m³ STEL in Poland; 133 mg/m³ TWA in Netherlands; 25 mg/m³ TWA and 50 mg/m³ STEL in China; 1300 mg/m³ (1000 ppm) STEL in France; and 1040 mg/m³ STEL in Hungary and Switzerland.
Australian Food Standards	No Australian food standards were identified (FSANZ 2013)
Australian Drinking Water Guidelines	No aesthetic or health-related guidance values were identified for methanol in the Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC) 2011).
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. Methanol is expected to be readily biodegradable.
B/vB criteria fulfilled?	No. The Log Kow for methanol is -0.82 to -0.64. Thus, methanol does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. The EC50s from the acute aquatic toxicity data on methanol are >1 mg/L, hence does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

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2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS, 2017). National assessment of chemicals associated with coal seam gas extraction in Australia. Human health hazards of chemicals associated with coal seam gas extraction in Australia.
3. OECD (2008) SIDS Initial Assessment Profile on Methanol
4. ECHA REACH, Methanol, Retrieved 2017: https://echa.europa.eu/information-on-chemicals/registered-substances
5. IPCS Acetic Acid, Retrieved 2015: http://www.inchem.org

Toxicity Summary - Polyethylene glycol

Chemical and Physical Properties	
CAS number	[redacted]
Molecular formula	(C2H4O)nH2O
Molecular weight	UVCB
Solubility in water	40 g/L @ 30 °C
Melting point	-10 °C at 101.3 kPa
Boiling point	870 °C at 101.3 kPa
Vapour pressure	0 Pa @ 25 °C
Henrys law constant	No data available
Explosive potential	Non explosive
Flammability potential	Non flammable
Colour/Form	Odourless, viscous transparent organic liquid
Overview	Polyethylene glycols, also known as PEGs, are clear, colourless, thick liquids to waxy solids, depending on the molecular weight. The molecular weight of PEGs ranges from 200 to over 6000. Some may have a faint odour and bitter taste. PEGs mix easily with water. PEGs are important commercial chemicals. They are used to make other chemicals, paper coatings, solvents, plasticizers and used in many household products, cosmetics and pharmaceuticals. One formulation, PEG 3500, is used as a laxative. PEGs are also used as food and animal feed additives.
Environmental Fate[1]	
Soil/Water/Air	Koc value of PEG was estimated as 10 L/kg by means of MCI method. This indicates that PEG will have a negligible tendency of sorption to soil and sediment and therefore have rapid migration potential to groundwater. The estimated half-life of the substance indicates that the substance is rapidly hydrolysable.
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	The substance PEG exhibits repeated dose toxicity by oral, dermal and inhalation route. A study was designed to investigate the subacute repeated dose toxicity effects of Polyethylene Glycols (PEG 400) in Wistar rats (male/female) by oral route, in an overall study period of 90 days. Dose group (5 animals per group) was fed a solution ofPEG400 equivalent to 0, 2000, 4000, 8000, 16000 or 24000 mg/kg/day in the diet. The control group received no polyethylene glycol. During the study period, body weight as a ratio to the amount of nutrient consumed, body weight, liver weight, kidney weight, micro pathology of liver and kidneys were examined. No effects upon male and female rats were observed when PEG 400 was present in the diet at a level up to 8000 mg/kg/day (8%concentration) for 90 days study period. But at 16000 mg/kg/day it showed effects on organ weight (liver and kidney heavier than that of control rats); and a decrease in weight gain was observed. Thus, from overall conclusion of the study the NOAEL (no observed adverse effect level) for repeated dose oral toxicity was considered to be 8000 mg/kg/day. And the LOAEL (low observed adverse effect level) for subacute repeated dose toxicity was considered to be 16000 mg/kg/day. Rats were exposed to airborne concentrations of 100 mg/m^3 and 1000 mg/m^3 of PEG-200 for periods up to 13 weeks. Toxicological, physiological, hematological, blood chemical, and pathological effects were evaluated during the course of the exposures. No significant lesions observed in this study occurred exclusively in exposed animals and the severity of lesions which were found was not dose-related. It is our impression that there were no PEG 200 induced lesions in rat tissue at the dosage level and exposure/post exposure periods evaluated in this study. Organ:body weight ratios in rats at all concentrations and for the 6- and 13-week exposure periods and the 30-day post exposure period showed no pattern

	of significance that could be related to PEG 200. The mice organ:body weights for the 6-week·exposure period are unavailable. No pattern of significance could be related to PEG 200 exposure for the 13-week or the 30-day post exposure periods. There were no consistently significant changes in rat blood chemistry at the end of the 6- or 13-week exposures or the 30-day post exposure period. It appears that PEG-200 produced no positive effects in the rodents at the Inn and 1000 mg/m3 PEG 200 concentrations over the 13 weeks of exposure used in this study. Thus it is concluded that the NOAEC value of PEG-200 in rats was observed at dose level of 1000 mg/m^3. The NOAEL value of PEG in rabbit was observed at dose level of 760 mg/kg bw/day. The supporting study indicates the TDLo (TDLo - Lowest published toxic dose) of PEG was observed at a dose concentration of 30 mL/kg (30000 mg/kg) in a 30 days study period where the dosage of PEG was intermittently given to rodent-rabbit by the dermal route(full study is not available). Considering the above results it is concluded that PEG is non-toxic by dermal route.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	PEG was found to be non-genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	The one generation reproductive toxicity NOAEL (no observed adverse effect level) of PEG in rat was observed at a dose concentration of 1698.09 mg/kg bw/day. On the basis of this NOAEL value it indicates that PEG does not exhibit toxic effects to rat below the above mention dose.
Acute Toxicity	Acute toxicity of PEG to mouse by the oral route indicates that the substance does not exhibits acute toxicity by the oral route. Similarly the acute values of inhalation also indicate that the substance does not exhibits acute toxicity by the inhalative route. Thus, it can be inferred that the target substance is non-toxic to any of the oral, dermal and inhalation route of exposure.
Irritation	The available studies indicate that the substance PEG is not classified as a skin and eye irritant according to CLP regulation within the dose levels mentioned in the study.
Sensitisation	In the human repeat insult patch test 216 subjects were enrolled and 200 subsequently completed the study. PEG 200 caused some degree of sensitization response in 1 of the 200 subjects. This subject was a 61 year old white woman.
Health Effects Summary	PEG is non acute toxic to oral, dermal and inhalation route, shows no irritation effect to skin and eye, is not genotoxic and is not developmental and reproductive toxic.
Key Study/Critical Effect for Screening Criteria	Oral: In chronic repeated dose toxicity study by polyethylene glycols (PEG) 400 showed no effect upon male and female dogs when present in the diet at a level of 500 mg/kg/day (2% concentration) for one year. Thus NOAELs (no observed adverse effect level) for repeated dose oral toxicity was considered to be 500 mg/kg/day. Inhalation: The NOAEC value of PEG-200 in rats was observed at dose level of 1000 mg/m^3. Dermal: The NOAEL value of PEG in rabbit was observed at dose level of 760 mg/kg bw/day.
Ecological Toxicity [1]	
Aquatic Toxicity	The toxicity values of fish, invertebrates and algae are LC50 = 100 mg/L, LC50 = 1000 mg/L and EC 50 = 15.91 mg/L, respectively.
Determination of PNEC aquatic	Acute LC50 values are reported for fish, aquatic invertebrates, and freshwater algae. Since there is valid acute toxicity data for three trophic levels, an assessment factor of 1000 is used (in accordance with EU guidance). Based on the EC50 for freshwater algae (the most sensitive species in short term tests), the aquatic PNEC is 15.91 µg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.

Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. PEG is non persistent in nature and so is considered to have rapid biodegradation in the environment.
B/vB criteria fulfilled?	No. The calculated BCF of PEG is 3.2 dimensionless and below the threshold of 2000.
T criteria fulfilled?	No. Acute toxicity data >1 mg/L in fish, invertebrates and algae, thus PEG does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	January 2019

References

1. ECHA REACH European Chemicals Agency Database: http://apps.echa.europa.eu

Toxicity Summary - Sodium carbonate

Chemical and Physical Properties[1,2,3,4,6]	
CAS number	[redacted]
Molecular formula	Na_2CO_3
Molecular weight	105.99 g/mol
Solubility in water	215 g/l at 20 °C
Melting point	851 °C
Boiling point	Decomposition
Vapour pressure	No data found
Henrys law constant	No data found
Explosive potential	It reacts violently with acids and reacts with magnesium, phosphorous pentoxide causing explosion hazard
Flammability potential	Reacts with fluorine causing fire hazard
Colour/Form	White powder
Overview	Sodium carbonate has been reviewed in the OECD-SIDS program (OECD, 2002a,b).Sodium carbonate is a strong alkaline compound with a pH of 11.6 for a 0.1M aqueous solution. The pKa of carbonate (CO3 2-) is 10.33, which means that at a pH of 10.33 both carbonate and bicarbonate are present in equal amounts. In water, sodium carbonate dissociates into sodium ion (Na+) and carbonate (CO3 2-). The carbonate ions will react with water, resulting in the formation of bicarbonate and hydroxide, until equilibrium is established. Sodium carbonate is used in many countries (e.g. U.S. and EU) as a food additive. It is regarded as a 'Generally Recognised as Safe' (GRAS) substance in food with no limitation other than current good manufacturing practice. Sodium carbon is extensively used across a range of industries and processes such as in the manufacturing of sodium salts, glass, soap/detergents and aluminium. Inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded.
Environmental Fate[1,2,3,4]	
Soil/Water/Air	The high water solubility and low vapor pressure indicate that sodium carbonate will be found predominantly in the aquatic environment. In water, sodium carbonate dissociates into sodium (Na+) and carbonate (CO3 2-) and both ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	No chronic oral and dermal data are available. Due to the biological importance of the products formed by the stomach acid (biocarbonate and carbon dioxide), systemic toxicity is not expected. In rats, histopathological changes of the respiratory tract and the lungs were seen following repeated inhalation exposure to sodium carbonate (70 mg/m^3 aqueous sodium cabonate at pH 11.6 for 3.5 months) and potassium carbonate (0.4 mg/L potassium carbonate at pH 9.9 for 21days). These effects were considered local responses to the high alkalinity of this group of chemicals (OECD, 2002; REACHa; REACHb).
Carcinogenicity	No data are available. Based on the available data from carcinogenicity studies with related substances (sodium bicarbonate and potassium bicarbonate), the chemicals in this group are not considered carcinogenic (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.

Mutagenicity/ Genotoxicity	Based on the available data, this chemical is not considered to be genotoxic (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the limited information available, this chemical does not show specific reproductive or developmental toxicity (OECD, 2002; REACHa; REACHb). Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.
Acute Toxicity	In animal tests, this chemical was of low acute toxicity following oral exposure. The median lethal dose (LD50) was >2000 mg/kg bw in rats (OECD, 2002; REACHa; REACHb).The majority of the animals that died following acute oral exposure to sodium carbonate at concentrations up to 2600 mg/kg/bw showed oral or nasal discharge, lesions in the liver, mottled lungs, mottled or pale kidneys and a red or partly gas-filled gastro-intestinal tract. In animal tests, this chemical was of low acute toxicity following dermal exposure. The median lethal dose (LD50) was >2000 mg/kg bw in rats (OECD, 2002; REACHa; REACHb). No systemic effects were observed following dermal exposure to sodium carbonate. Local severe skin irritation (severe erythema and oedema) was seen at the application site (OECD, 2002; REACHa; REACHb). In animal tests, this chemical was of low acute toxicity following inhalation exposure. The median lethal dose (LC50) was >2000 mg/m^3 in rats (OECD, 2002; REACH, a & b). Signs of respiratory impairment including dyspnoea, wheezing, excessive salivation and a distended abdomen were observed immediately after inhalation exposure to sodium carbonate of up to 2300 mg/m^3. Excessive salivation, repeated swallowing and a lack of appetite were observed 2–5 hours after exposure. Animals that died had lesions in the anterior trachea, posterior pharynx and larynx, along with an accumulation of mucus, vesiculation and mucosal oedema (REACHa).
Irritation	Sodium carbonate is classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in HSIS (Safe Work Australia). However, in several eye irritation studies in rabbits, sodium carbonate was found to be severely irritating to the eyes, with effects including conjunctivitis, marked corneal opacity and iritis, which persisted for seven days (REACHa; REACHb). The available data support an amendment to the current HSIS eye irritation classification for sodium carbonate.
Sensitisation	Based on the limited data available, sodium carbonate is not considered to be skin sensitisers (OECD, 2002; REACHa; REACHb). No structural flags for sensitisation are present.
Health Effects Summary	The critical health effects for risk characterisation include serious eye damage and respiratory irritation because of the high basicity of the chemicals in this group. Skin irritation and corrosion of eyes and mucous membranes are also of concern where long-term exposure to the solid or concentrated solutions may occur. These effects are particularly relevant to domestic use of the chemicals.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water screening value for sodium (180 ppm, aesthetic) and pH may apply to sodium carbonate.
Ecological Toxicity [1,2,3,4]	
Aquatic Toxicity	The acute 96-hour LC50 to three sizes of Bluegill sunfish (*Lepomis macrochirus*) exposed to sodium carbonate is 300 mg/L for all sizes. The acute 96-hour LC50 to mosquitofish (*Gambusia affinis*) is 740 mg/L. The acute 48-hour EC50 value to the invertebrate *Ceriodaphnia* cf. *dubia* is from 200 to 227 mg/L.
Determination of PNEC aquatic	PNECaquatic: Experimental results are available for two trophic levels. Acute E(L)C50 values are available for fish (300 mg/L) and *Ceriodaphnia* (200 mg/L). On the basis that the data consists of short-term results from two trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 200 mg/L for Daphnia. The PNECaquatic is 0.2 mg/L.

Current Regulatory Controls[1]	
Australian Hazard Classification	Sodium carbonate is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia): 'Xi; R36 (Irritating to eyes)'.
Australian Occupational Exposure Standards	Sodium carbonate has an exposure standard of 7.5 mg/m^3 (5 ppm) time weighted average (TWA) and 15 mg/m^3 (10 ppm) short-term exposure limit (STEL) (Safework Australia).
International Occupational Exposure Standards	Occupational exposure standard limits for sodium and potassium carbonate recommended by other countries are provided below (Galleria Chemica, 2013): US Dept of Energy (DOE) Temporary Emergency Exposure Limits (TEELs): Sodium carbonate: TEEL-0 = 10 mg/m^3 , TEEL-1 = 30 mg/m^3 , TEEL-2 = 50 mg/m^3, TEEL-3 = 500 mg/m^3 No other country has an occupational exposure limit specifically for sodium and potassium carbonate, although many countries have assigned a generic TWA exposure limits of 10 mg/m^3 (inhalable dust), and 3 mg/m^3 (respirable dust) for particles not otherwise classified (PNOC).
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[4,6]	
P/vP Criteria fulfilled?	Not applicable, inorganic substance, ubiquitous in environment.
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	No chronic toxicity data exist; however, the acute EC(L)50s are >0.1 mg/L. Thus, does not meet the screening criteria for toxicity
Overall conclusion	Not PBT
Revised	March 2019

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Toxicity Summary - Sodium Erythorbate

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	C6H7NaO6
Molecular weight	199.13
Solubility in water	Soluble; 146 g/L at 20 °C and pH 6
Melting point	160 °C at 101.3 kPa
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	Non-flammable (100%)
Colour/Form	White, free-flowing crystals
Overview	Sodium erythorbate is a synthetic antioxidant used in food and cosmetic formulations. Foliar application of sodium erythorbate sprays and dusts are used to control young tree decline in citrus trees and to reduce ozone damage to Thompson seedless grapes. It is also used in hydraulic fracturing mixtures to prevent precipitation of metal oxides (iron control). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1]	
Soil/Water/Air	The chemical is not expected to be readily biodegradable. The chemical achieved 56% degradation in 28 days according to test guidelines OECD 301E. However, the degradation after 28 d was not yet finished as a plateau is not yet visible in the degradation curve; thus, a further degradation of the product seems to be possible.
Human Health Toxicity Summary[1]	
Chronic Repeated Dose Toxicity	Male 6-week-old F344 rats were given doses of 5% Sodium Erythorbate in feed for 168 days. Parameters of urinary excretion were investigated and the urinary bladder epithelium was examined using light and scanning electron microscopy at weeks 8, 16, and 24. The urine of rats fed Sodium Erythorbate had increased pH, elevated content of crystals and sodium, and decreased osmolality; however, no morphological alterations such as hyperplasia were detected in the mucosa. The urine values and urinary bladder mucosa were similar to controls at doses below 5 g/kg/day.

Carcinogenicity	F344/DuCrj rats of both sexes (6-week-old) were given 1.25% or 2.5% Sodium Erythorbate in drinking water for 104 weeks and untreated water for 8 additional weeks. Rats of the control group were given untreated water only. Each group consisted of 52 male and 50 female rats. Cumulative consumption of Sodium Erythorbate by male rats was 217 g/rat (1.25%) and 430 g/rat (2.5%). Consumption by females was 206 g/rat (1.25%) and 583 g/rat (2.5%). Body weight of rats given 2.5% Sodium Erythorbate was reduced by 8.5% for males and 15.5% for females at weeks 88 and 85, respectively, compared to controls. Body weight gain was normal in rats of the low dose group. All male treated and control rats (except two of the high-dose group) had testicular interstitial cell tumours. Various tumours occurred in 80% of control males, 69% of males given the low dose, and 78% of males given the high dose. A 6-18% incidence of leukaemia, pheochromocytoma, mammary fibroadenoma, and mesothelioma was observed. Of the females of the control, 1.25%, and 2.5% dose groups, 94%, 88%, and 78% had tumours, respectively. Twenty to 43% of females (all groups) had leukaemia, mammary fibroadenoma, endometrial stromal polyp and/or pituitary adenoma. Females given 2.5% Sodium Erythorbate had significantly fewer tumours than control females. The pattern of occurrence of the various types of tumours was similar among the groups. Sodium Erythorbate did not enhance the development of rare spontaneous tumours or transform benign tumours (e.g., solid adenoma of the thyroid) to carcinomas. The investigators concluded that Sodium Erythorbate was not carcinogenic in F344 rats.
Mutagenicity/ Genotoxicity	Sodium Erythorbate (99.8% pure; 5.0 mg/plate) was non-mutagenic in S. typhimurium strains TA92, TA94, TA98, TA100, TA1535, and TA1537 with and without S9 activation. Sodium Erythorbate (0.25 mg/mL plate) was also negative in the chromosomal aberration assay using Chinese hamster fibroblasts; Sodium Erythorbate did not induce the formation of polyploid cells after 48 hours, and caused 1 % chromosomal breaks after 24 hours.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Sodium erythorbate did not cause maternal or fetal toxicity when administered to female rats and mice during gestation by oral intubation at dosages up to 1,030 mg/kg/day. Developmental toxicity did not occur after pregnant rats were given up to 5% sodium erythorbate in feed during a 13-week teratogenesis study. It produced negative results in the Ames test, the host-mediated assay using S. typhimurium, chromosomal aberration tests using Chinese hamster ovary fibroblasts, the dominant lethal test using rats, and the B. subtilis rec assay.
Acute Toxicity	Sodium erythorbate powder was applied to the intact and abraded skin of six rabbits as a single 2 g/kg dose. A substantial amount of residual compound was observed 24 hours after dosing. No erythema, edema, or other signs of dermal irritation were observed at five of six test sites. One rabbit (abraded skin) had slight (1+) erythema at 24 hours that cleared by 48 hours.
Irritation	Sodium erythorbate powder did not cause signs of dermal irritation when applied to the intact and abraded skin of rabbits. Instillation of sodium erythorbate powder to the conjunctival sac of rabbits caused slight and transient reddening of the conjunctiva that cleared within 24 hours.
Sensitisation	In a dermal sensitization study (according to OECD 429) with Sodium erythorbate (5, 10, 25% w/w in propylene glycol), young adult female CBA/Ca (CBA/CaOlaHsd) mice (4/group) were tested using the local lymph node assay (LLNA). In this study, Sodium erythorbate was not considered a potential skin sensitizer.
Health Effects Summary	Sodium erythorbate did not show signs of toxicity, carcinogenicity, mutagenicity, irritation and sensitisation in the studies reported. This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The Australian drinking water guideline value for sodium may apply.

Ecological Toxicity [1,2]	
Aquatic Toxicity	The acute toxicity of the sodium erythorbate to the freshwater fish rainbow trout (Oncorhynchus myldss) has been investigated and gave a 96-Hour LC50 of greater than 100 mg/L (semi-static). The acute toxicity of sodium erythorbate to Daphnia magna gave an EC50 (48 h) of 84 - 100 mg/L. The effect of the test item on the growth of Pseudokirchneriella subcapitata has been investigated over a 72-Hour period. The EC50 (72 h) was 160 mg/L while the NOEC (72 h) was 20 mg/L.
Determination of PNEC aquatic	A PNECaquatic of 84 µg/L was calculated using the lowest endpoint of EC50 of 84 mg/L for Daphnia magna. An assessment factor of 1000 was used.
Current Regulatory Controls[4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Could potentially be persistent as it is not readily biodegradable.
B/vB criteria fulfilled?	No. The Log Pow is -3.29 (Log Pow < 4.5) which does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. Based on measured acute toxicity endpoints of greater than 1 mg/L Sodium erythorbate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	April 2019

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Toxicity Summary - Starch

Chemical and Physical Properties[1,2,4,6]	
CAS number	[redacted]
Molecular formula	(C6H10O5)n
Molecular weight	UVCB
Solubility in water	In cold water, starch absorbs water reversibly and swells slightly. In hot water, irreversible swelling occurs, producing gelatisation.
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	Combustible
Flammability potential	No data available.
Colour/Form	White powder, tasteless and has no smell
Overview	Starch is a high –polymeric carbohydrate material primarily composed of amylopectin and amylose. It is usually derived from cereal grains such as corn, wheat and sorghum and from roots and tubers such as potatoes and tapioca. It includes starch which has been pregelatinized by heating in the presence of water. This chemical has been identified by NICNAS to be of low concern to human health and thus required no further assessment.
Environmental Fate[7]	
Soil/Water/Air	Based on information from NICNAS (2006): In a ready biodegradation test, the notified polymer (Potato Starch Modified) showed an 86.87% degradation during a Modified Sturm Test (OECD Test Guideline 301B) indicating that it was readily biodegradable. The test was verified using a sodium benzoate standard which showed 93.77% degradation at the end of the study. In addition a toxicity control consisting of a mixture of the test substance and sodium benzoate showed 83.49% degradation at the end of the study period, indicating that the test material did not inhibit the microbial activity. The notified polymer does potentially contain cationic and anionic functional groups, however based on the typical dissociation constants for the functionalities and their ratio within the polymer it is expected to have a net anionic charge throughout most of the environmental pH range, becoming slightly cationic only at the low end of the range. In landfill and the sewer, the notified chemical is expected to be relatively readily degraded by biotic and abiotic pathways to ultimately yield water and oxides of carbon and nitrogen and salts of chlorine and sodium. Any incineration of the notified polymer would result in its destruction and the formation of carbon dioxide and water and ash containing salts of chlorine and sodium. The notified polymer has a high molecular weight not expected to bioaccumulate.

Human Health Toxicity Summary[2,3]	
Chronic Repeated Dose Toxicity	A long-term study was carried out on the effects of inoculating 1.5 g of starch powder into the peritoneal cavity of rats. After an initial considerable inflammatory reaction, the intense vascular reaction subsided, leaving firm adhesions that were still present in animals sacrificed at 18 months (Ell90). Feeding of unmodified cornstarch and potato starch to groups of rats at dietary levels up to 30% (equivalent to 27.4-33.6 g/kg bw/d) in a 2-year test and 10% (food intake not indicated) in a 3-generation test did not result in distinct toxicologically significant effects (Gro74). Rats fed a cooked diet containing 62% unmodified maize starch (equivalent to 51.1 g/kg bw/d*) for 2 years also did not show significant toxicological effects, including reproductive effects over 3 generations (Tru79). Slight growth retardation was seen in rats exposed for 4 weeks to raw potato starch at a dietary level of 40% (equivalent to 46.0-52.8 g/kg bw/d) (Fer73).
Carcinogenicity	Not classifiable as a human carcinogen (A4)
Mutagenicity/ Genotoxicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	There were no indications for significant toxicity, carcinogenicity or reproduction toxicity of starch in rats fed 27.4-52.8 g/kg bw/day.
Acute Toxicity	Toxicity of starch given orally to albino rats were studied. Experiments were performed upon CBL albino rats weighing 140 ± 15 (mean ± S.D.). Starch was given daily for 14 consecutive days in total daily oral doses of 36, 72, 120 and 168 g/kg and in animals which did not succumb to gastric rupture in doses gradually increasing to 204, 240 and 288 g/kg. Gastric rupture appeared in 50 – 75% of rats given starch in amounts of 168 g/kg and over. Of the survivors of gastric rupture, 5% died of pneumonia and 20% from bowel obstruction during the 14 days of starch administration. Doses of one tenth body weight and above produced some inhibition of growth, doses of one fifth body weight and above increased the susceptibility to pneumonia and bowel obstruction owing to the inability of the animal to evacuate the starch calculi. It was noted that doses of this order could not readily be taken by humans and smaller doses had insignificant toxicity. Acute respiratory effects after exposure to dust from the refining process of potato starch have been described (personal sampling: 3.9-56.0 mg/m^3, total dust). The responsible agent could not be identified although the authors suspected endotoxin to be the causative agent (Hol94). Millers and bakers occupationally exposed to grain and flour dusts (personal sampling: 1.1-14.3 mg/m^3, total dust) showed significantly higher incidences of coughing and chronic bronchitis compared to a non-exposed reference group (Mas95, Mas96). A dose-response relationship was observed between dust exposure levels and chronic respiratory symptoms (Mas95). Although flour is a complex product that is mainly made up of starch (70%) and gluten (12%), it may also contain mite dust and endotoxins. The causative role of starch in the observed respiratory symptoms is therefore not clear. The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).
Irritation	Skin contact with a total dose of 300 µg of starch, intermittently applied over a 3-day period, resulted in a mild erythema and slight oedema of the skin in humans (ACG99).
Sensitisation	No data available.
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	The intraperitoneal LD50 of starch in mice is 6600 mg/kg (ACG99).

Ecological Toxicity[7]	
Aquatic Toxicity	Based on QSAR modelling: Crassostrea virginica 96 h = 1000 mg/L Orthopristis chrysoptera 96 h = 5000 mg/L Bairdiella chrysoura 96 h = 5000 mg/L
Determination of PNEC aquatic	Based on the lack of ecotoxicity data, PNECaquatic was not determined.
Current Regulatory Controls[2,4]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	TWA = 10 mg/m^3
International Occupational Exposure Standards	TLV: 10 mg/m^3, as TWA The current administrative occupational exposure limit (MAC) for starch in the Netherlands is 10 mg/m^3, 8-hour TWA, equal to the occupational exposure limit for nuisance dust.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No. This substance is expected to be readily biodegradable.
B/vB criteria fulfilled?	No. This substance is not expected to be bioaccumulative.
T criteria fulfilled?	Based on QSAR modelling, this substance is not expected to meet the toxicity criteria.
Overall conclusion	Not PBT
Revised	April 2019

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Toxicity Summary - Xanthan Gum

Chemical and Physical Properties[1,3]	
CAS number	[redacted]
Molecular formula	Unspecified
Molecular weight	high-molecular weight (of the order of 1000 kDa)
Solubility in water	Water-soluble
Melting point	No data available.
Boiling point	No data available.
Vapour pressure	No data available.
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	No data available.
Overview	Xanthan gum is a high molecular weight anionic polysaccharide secreted by the bacteria *Xanthomonas compestris*. It is used as a stabilizer and thickener for foods, pharmaceuticals, and cosmetics, for rheology control in water-based systems, and in oil and gas drilling. Xanthan gum is used for controlling the viscosity of drilling muds (DoE 2014). This chemical has been identified by NICNAS to be of low concern to human health based on an initial screening approach and thus required no further assessment.
Environmental Fate[1]	
Soil/Water/Air	Xanthan gum is expected to exhibit similar behaviour to that of guar gum because the two compounds are chemically similar. Thus, it is expected to adsorb strongly to soil and sediment and there is limited potential for it to reach surface waters via dissolved runoff and / or to leach into ground water. Volatilisation from soils and water is not considered to be a likely transport process in the environment (US EPA 2005). Xanthan gum is expected to readily undergo microbial biodegradation in the environment (on the bases that it is polysaccharide and expected to be readily biodegradable), and the potential to bioaccumulate in organisms is considered to be low.
Human Health Toxicity Summary[2]	
Chronic Repeated Dose Toxicity	Groups of 30 male and 30 female Charles River CD strain rats were fed diets for 104 weeks supplying O, 0.25, 0.5, or 1.0 g/kg b.w./day xanthan gum. No abnormalities which could be attributed to ingestion of these experimental diets were found with regard to survival, body-weight gain, food consumption, behaviour, or appearance. Ophthalmic and haematologic examination yielded normal results. Analysis of blood for glucose, SGOT, and prothrombin time showed no abnormalities in test groups. Organ weights were within normal limits and no lesions attributable to xanthan gum were found on gross and histopathological examination (Woodard et al., 1973). Xanthan gum was administered in the diet at levels supplying 0, 0.25, 0.37, or 1.0 g/kg b.w./day to groups of 4 male and 4 female beagle dogs for 107 weeks. No effects attributable to administration of the gum were seen in the treated animals with regard to survival, food intake, body-weight gain, electrocardiograms, blood pressure, heart rate, body temperature, or ophthalmic and neurological examinations. Haemoglobin, total and differential white cell counts, coagulation and prothrombin times, thrombocyte counts, serum alkaline phosphatase, blood urea nitrogen, blood glucose, SGOT, and SPGT were the same in control and treated animals. Urine pH, glucose concentrations, and sediment contents were comparable between test and control groups, but there was a dose-related

	increase in urine SG and a more frequent appearance of urinary albumin in dogs consuming 1.0 g/kg b.w./day of gum than in the other groups. Stool consistency was normal at the 0.37 g/kg level, but stools were loose at the top-dose level. The weight of the faeces showed a dose-related increase, as would be expected from feeding a non-absorbed hydrophilic gum at high-dose levels. The increased urinary SG is consistent with physiological adjustment for the extra water excreted in the faeces. Examination of the appearance and weights of organs and histopathological examinations failed to detect any adverse effects of treatment with xanthan gum at any dose level (Woodward et al.,1973).
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	A three-generation reproduction study was carried out using groups of 10 male and 20 female rats in the first generation and 20 male and 20 female rats in subsequent generations. Dosage levels of 0, 0.25, and 0.5 g/kg/day were administered in the diet. Criteria evaluated were survival, body weight, general appearance, behaviour, the number of litters produced, number of live births and still births, physical condition of the young, weight at birth and weaning, and survival of the young. Females that had fewer than two litters were examined to determine whether there was foetal resorption. Malformations in offspring were recorded and gross and micropathological examinations were made on the offspring of the second and third generations. No adverse effects attributable to xanthan gum were found in this study (Woodard et al., 1973).
Acute Toxicity	A study was carried out on an unspecified number of rats fed diets containing 7.5 or 10% xanthan gum for 99-110 days. No adverse effects were observed in extensive investigatins on these animals (Booth et al., 1963). In a 91-day feeding study, a reduced rate of weight gain was found in groups of rats receiving 7.5 or 15% xanthan gum in the diet. Diets containing 3 or 6% gum did not reduce weight gain. No significant alterations in haemoglobin, red or white cell counts, or organ weights were observed in these rats. Histological examination of tissues from rats at the 15% level showed no pathological effects. At the highest-dose level the animals produced abnormally large faecal pellets, but diarrhoea did not occur. A paired-feeding test was used to compare the growth of rats ingesting a diet containing 7.5% xanthan gum and comparable rats restricted to the same intake of control diet. No differences in weight gain were found at the end of 18 days, indicating the absence of a growth-inhibiting factor (Booth et al.,1963). Groups of 3 male and 3 female beagle dogs were fed diets supplying 0, 0.25, or 0.5 g/kg b.w./day xanthan gum for 12 weeks. Animals in the high-dose group had softer stools than normal, but no diarrhoea. Growth was slightly retarded in the males and the serum cholesterol level was lowered in both sexes of the high-dose group. No other adverse effects were seen. The no-adverse-effect-level in this test was considered to be 0.25 g/kg b.w./day (USDA, 1964).
Irritation	Daily application of a 1% solution for 15 days to rat skin produced no signs of irritation. Daily application of a 1% solution for five days to rabbit conjunctiva produced no signs of irritation.
Sensitisation	Intradermal challenge tests in guinea-pigs did not produce evidence of sensitization (Hendrickson & Booth, sine data).
Health Effects Summary	A mild skin and eye irritant
Key Study/Critical Effect for Screening Criteria	The Joint FAO/WHO Expert Committee on Food Additives allocated an Acceptable Daily Intake (ADI) of “not specified”.
Ecological Toxicity [1,2,3]	
Aquatic Toxicity	Acute Fish (measured) = 420 mg/L
Determination of PNEC aquatic	Based on acute fish toxicity of 420 mg/L, an assessment factor of 1000 was used for a resulting PNEC of 0.42 mg/L.
Current Regulatory Controls	

Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	No biodegradation information was found on xanthan gum. However, xantham gum is a naturally occurring polysaccharide which would be expected to readily biodegrade. Thus, it is not expected to meet the screening criteria for persistence
B/vB criteria fulfilled?	Xantham gum is not expected to meet the criteria for bioaccumulation.
T criteria fulfilled?	Not applicable. Acute toxicity data >1 mg/L in fish, thus xanthan gum does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	March 2019

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Toxicity Summary - Sodium Glycolate

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	C2H3NaO3
Molecular weight	98.033 g/mol
Solubility in water	1.00E+06 g/mL at 25 C
Melting point	210-218 °C
Boiling point	265.6 °C at 760 mmHg
Vapour pressure	4.58E-10 at 25 deg C
Henrys law constant	No data available
Explosive potential	No data found
Flammability potential	Non flammable
Colour/Form	White powder
Overview	Sodium Glycolate is the salt of glycolic acid and is used in cosmetics and personal care products primarily as an exfoliant or buffering agent Limited information is available for sodium glycolate, as such, this toxicity profile includes data on Glycolic Acid. Glycolic acid is widely used in cosmetic products. Glycolic acid belongs to a group of chemicals commonly known as fruit acids or AHAs (alpha hydroxy acids). The National Industrial Chemical Notification and Assessments Scheme (NICNAS) conducted a preliminary assessment of the use of glycolic acid in cosmetics in April 2000. The assessment concluded there was no significant risk. Glycolic acid is absorbed by ingestion, inhalation and through the skin. In humans, it is mainly excreted unchanged in the urine while smaller amounts are metabolised to glyoxylic and oxalic acids, which are also excreted in the urine. The kinetics and metabolism are qualitatively similar in rats and humans; however, rats metabolise a greater proportion to carbon dioxide and eliminate the chemical faster than humans. In laboratory animals, glycolic acid is harmful by single-dose ingestion or inhalation of high doses. Depending on concentration and pH, it may be corrosive or irritating to the skin, eyes and respiratory system. It is toxic to the kidneys by repeated oral administration. When glycolic acid is given to pregnant rats by mouth on a daily basis, it induces malformations at high, maternally toxic doses. In two studies, there was an 8-9% reduction in foetal body weight and a substantial increase in minor skeletal abnormalities at dose levels associated with mild maternal toxicity. In another study, a marginal increase in foetal abnormalities was seen at a dose associated with marginal maternal toxicity, with no effects on foetal development seen at lower doses. Glycolic acid is not mutagenic. It does not impair fertility or neonatal growth during lactation. There are no animal studies of systemic or developmental toxicity from dermal exposure and no carcinogenicity studies. Glycolic acid is a metabolite of ethylene glycol and is the immediate cause of the metabolic acidosis and kidney failure associated with ethylene glycol poisoning in humans.

Environmental Fate[1]	
Soil/Water/Air	If released to soil, sodium glycolate is expected to have very high mobility based upon an estimated Koc of 0.14. The pKa of sodium glycolate is 3.6, indicating that this compound will exist almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization of sodium glycolate from moist soil surfaces is not expected to be an important fate process because the compound exists as an anion and ions do not volatilize. Sodium glycolate is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Utilizing the Japanese MITI test, 86% of the Theoretical BOD was reached in 2 weeks indicating that biodegradation is an important environmental fate process in soil and water. If released into water, sodium glycolate is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. A pKa of 3.6 indicates hydroxycaetic acid will exist almost entirely in the anion form at pH values of 5 to 9 and, therefore, volatilization from water surfaces is not expected to be an important fate process. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions
Human Health Toxicity Summary [1]	
Chronic Repeated Dose Toxicity	A 3-month oral gavage study was conducted in Sprague-Dawley rats given solutions containing technical grade glycolic acid at doses of 0, 150, 300 or 600 mg/kg/day of glycolic acid (DuPont, 1999a*). The study determined an overall NOAEL equal to 150 mg/kg/day, based on body weight, body weight gain, food consumption and food efficiency in both sexes and on kidney lesions in males.
Carcinogenicity	No carcinogenicity studies were available for assessment and it is not possible to classify glycolic acid for carcinogenic effects. Ethylene glycol did not induce tumours in carcinogenicity studies in rats and mice and is not suspected of having carcinogenic effects in humans (Cavender & Sowinski, 1994).
Mutagenicity/ Genotoxicity	Glycolic acid has been tested in a number of assays for genetic toxicity in accordance with OECD's Test Guidelines and to GLP standards. The tests available for assessment included *in vitro* assays for reverse mutation in bacteria, forward mutation in mouse lymphoma cells and chromosomal aberration in Chinese hamster ovary cells. An *in vivo* somatic cell mutagenicity test (mouse bone marrow micronucleus test) was also available. All tests were negative, except the *in vitro* assay for gene mutation in mouse lymphoma cells which was positive at high concentrations of glycolic acid (2500-5000 mg/L) in the presence of metabolic activation.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Statistically significant developmental toxicity occurred at doses of 332 mg/kg/day glycolic acid by mouth and 833 mg/kg/day sodium glycolate by subcutaneous injection. These doses are assessed to be high as they correspond to an internal dose that is estimated to be unattainable in humans exposed to glycolic acid by skin contact and/or inhalation in the occupational environment. No impairment of fertility was observed in a well-conducted study involving the oral administration of up to 600 mg/kg/day of glycolic acid to male and female rats for 18-22 weeks.
Acute Toxicity	In animal studies, glycolic acid was found to cause lethality by ingestion, inhalation or injection in all species tested. Deaths occurred up to 12 days following exposure, with kidney lesions being the most common finding at necropsy. In GLP studies in the rat conducted according to OECD's Test Guidelines or similar protocols, the oral LD_{50} was 1357 mg/kg and the

	LC_{50} from nasal inhalation of aerosolised glycolic acid was 2520 mg/m^3 (2.5 mg/L) in male and >3640 mg/m^3 (>3.6 mg/L) in female rats. No dermal toxicity studies were available. In mice and rats, lethal dose levels were consistently lower in males than in females, apparently because the metabolite oxalic acid, which is prone to precipitate as calcium oxalate in the kidney and urinary tract of rodents, is formed at a faster rate in male as compared to female animals. Cases of human intoxication have not been reported. However, there is a considerable body of data on the effects of acute poisoning from ingestion of ethylene glycol, which is of low toxicity in itself, but is slowly metabolised to glycolic acid. The estimated lethal dose of ethylene glycol in humans is approximately 1600 mg/kg, with death occurring from metabolic acidosis, cardiopulmonary collapse and/or renal failure within one to several days of exposure (Cavender & Sowinski, 1994). There is no evidence of non-lethal irreversible effects from single exposures to glycolic acid in animals, or in humans from ethylene glycol poisoning.
Irritation	Glycolic acid irritates the skin and eyes.
Sensitisation	One skin sensitisation study in guinea pigs conducted according to OECD Guideline No. 406 and to GLP standards was negative, as were repeat insult patch tests of numerous cosmetic products covering a wide range of concentrations and pH values in groups comprising 25-198 healthy human subjects per product. When a small number of commercial cosmetic products containing 0.5-6% glycolic at pH 3.6-4.2 were tested by repeat insult patching followed by UV irradiation, no evidence of photosensitising potential was observed. A maximization study using guinea pigs (number of animals not stated) was performed in which induction consisted of intradermal injection of 10% and topical application of 25% Sodium Glycolate; the challenge application was 25% (ESLUR, 1994b). Sodium Glycolate was not a sensitiser. There were no findings indicating that glycolic acid may be a respiratory sensitiser.
Health Effects Summary	The available animal studies indicate that glycolic acid is harmful by single-dose ingestion or inhalation. Depending on concentration and pH, it may be either corrosive or irritating to the skin, eyes and respiratory system.
Key Study/Critical Effect for Screening Criteria	The NOAEL based on a 3-month oral rat toxicity test and on maternal and developmental toxicity in pregnant rats given oral doses of glycolic acid is 150 mg/kg/day.
Ecological Toxicity [4]	
Aquatic Toxicity	Green algae (Pseudokirchnerie lla subcapitata) 72-hr EC50 (growth) = 44.0 mg/L; 72-hr EC50 (biomass) = 21.6 mg/L Fathead minnows (Pimephales promelas) . 96-hr LC50 = 164 mg/L. Water fleas (Daphnia magna) 48-hr EC50 = 141 mg/L
Determination of PNEC aquatic	On the basis that the data consists of short-term results from three trophic levels, an assessment factor of 1,000 has been applied to the lowest reported effect concentration of 21.6 mg/L for green algae. The $PNEC_{aquatic}$ was calculated to be 0.0216 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.

Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Glycolic acid is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on the measured log Kow of -1.11 and an estimated BCF of 3, Glycolic acid is not bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of Glycolic acid is > 0.01 mg/L. Hence the substance does not fulfill the screening criteria for toxic (T)
Overall conclusion	Not a PBT substance (based on screening data).
Revised	September 2020

References

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2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 2000. Glycolic Acid, Priority Existing Chemical Assessment Report No. 12
3. OECD Categorisation Results from the Canadian Domestic Substance List, Acetic acid, hydroxyl-, monosodium salt, CAS # [redacted]
4. USEPA; Hazard Characterization Document, Screening level Hazard Characterization for Glycolic Acid (79-14-1). P. 14. Available from as of May 7, 2014: http://www.epa.gov/chemrtk/hpvis/hazchar/79141_Glycolic%20Acid_June%202010.pdf)

Toxicity Summary - Barium Sulphate

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	Ba(SO4)
Molecular weight	233.39
Solubility in water	3.1 mg/L at 20°C
Melting point	1580°C
Boiling point	1600°C at 760 mm Hg (Decomposes)
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	Odourless white powder
Overview	Barium sulphate is an inorganic compound. It is partially soluble in water, dissociating into barium and sulphate ions; both are ubiquitous in the environment. The ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health.
Environmental Fate[1]	
Soil/Water/Air	The dissolution of barium substances in the environment and corresponding dissolved Ba levels are controlled by the solubility of barite (BaSO4) and witherite (BaCO3), two naturally occurring barium minerals and the concentration of dissolved Ba cations in freshwater is rather low. However, in the dissolved state, the divalent barium cation, is the predominant form in soil, sediments and water. The solubility of barium compounds increases as solution pH decreases. Barium in soils is not expected to be very mobile because of the formation of water-insoluble salts (sulphate and carbonate) and its inability to form soluble complexes with humic and fulvic materials. Transport, fate, and toxicity of barium in the environment are largely controlled by the solubility of barium minerals. The barium cation is the moiety of toxicological concern, and thus the hazard assessment is based on Ba2+.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level of 4000 pm. Individual effects observed at 2000 ppm barium chloride in drinking water (corresponding to the final barium dose of 61.1 and 80.9 mg Ba/kg bw/day to male and female rats respectively) were regarded as not treatment-related, and this dose level therefore represents the NOAEL. No systemic toxicity was shown to result from long term inhalation exposure in humans to high concentrations of barium sulphate. Particle overload is observed for insoluble particles such as barium sulphate, whereby the rat is the most sensitive species studied, and species-specific differences are demonstrated in various mechanistic animal studies. It has been demonstrated with reasonable certainty that lung overload conditions are not relevant for human health.
Carcinogenicity	There was no evidence of carcinogenic activity (showing no chemical related increase of malignant or benign neoplasms) of barium chloride in both sexes of rats and mice that received 500, 1250, and 2500 ppm. Thus, the concentration of 2500 ppm represents a NOAEL (corresponding to barium doses of 60 and 75 mg/kg bw/d to male and female rats, respectively, and 160 and 200 mg/kg bw/d to male and female mice, respectively).

Mutagenicity/ Genotoxicity	Not likely to be mutagenic or genotoxic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Only a screening test is available. However, based on this study there are no indications of a substantial impairment of fertility in rats up to the highest dose tested. Thus, the NOAEL was 4000 ppm (to average doses of 201.5 and 179.5 mg Ba/kg bw/d to male and and female rats, respectively). NOAELs on developmental toxicity for rats of 4000 ppm were derived. However, this NOAEL is of limited value to evaluate the potential for barium to induce developmental effects because there was no exposure of the females during gestation.
Acute Toxicity	The toxicity of barium sulphate and barium chloride is based on the Ba2+cation and therefore on the solubility of the test substance. Barium chloride is well water soluble (ca. 375 g/L) at pH ca. 6.5 (pH of artificial sweat solution), whereas barium sulphate is low soluble (3.1 mg/L at pH 9). Due to the fact that Barium chloride seems to be no toxic via the dermal route it can be concluded that barium sulphate will result in a dermal LD50 of >>2000 mg/kg bw and should therefore not classified as acute toxic to the dermal route.
Irritation	Not irritating to skin or eyes.
Sensitisation	Barium sulphate is expected to be not sensitizing to skin.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	The repeated dose toxicity via oral application was considered the key study. Rats were dosed at 61.1 and 80.9 mg Ba2+ /kg bw/day to male and female rats via feed for 90 days. The values refer to 104 and 138 mg/kg bw/day. The NOAEL for barium toxicity in this study is based on depressed body weight gains, elevated phosphorus levels, neurobehavioral effects and chemically related lesions in the kidney and lymphoid tissue at the highest dose level. Individual effects observed were regarded as non-treatment related.
Ecological Toxicity[1]	
Aquatic Toxicity	Short-term toxicity EC/LC50 values of barium sulphate available for 3 trophic levels: 96 hrs LC50: >3.5 mg/L (Fish) 48 hrs LC50: 14.5 mg/L (Invertebrates) 72 hrs EC50: 1.15 mg/L (Algae) Long-term toxicity data are available for three trophic levels: 33 days NOEC: 1.26 mg/L (Fish) 21 days NOEC: 2.9 mg/L (Invertebrates) 72 hrs NOEC: 1.15 mg/L (Algae)
Determination of PNEC aquatic	Data from short and long-term tests with three trophic levels are available. An assessment factor of 10 is applied to the lowest EC50 of 1.15 mg/L (algae). A PNECaqua of 115 µg/L was derived.
Current Regulatory Controls[5,6,7,8]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.

PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; barium and sulphate ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	Not applicable. Chronic toxicity data >1 mg/L, thus barium sulphate does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	December 2021

References

1. ECHA REACH, Barite sulfate, Retrieved 2021: https://echa.europa.eu/
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.industrialchemicals.gov.au/.
3. NCBI, 2021. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved December 2021.
4. EHS Support, Barium Sulfate. Available at: https://www.santos.com/wp-content/uploads/2021/04/Barium-sulfate-March-2021.pdf. Retrieved December 2021.
5. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.
7. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved December 2021: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
8. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - Calcium oxide

Chemical and Physical Properties[1,2,3,4]	
CAS number	[redacted]
Molecular formula	CaO
Molecular weight	56.08
Solubility in water	1.19 g/L at 20 °C
Melting point	2572°C
Boiling point	2850°C
Vapour pressure	Negligible at 25 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Greyish yellow, odourless, hygroscopic solid
Overview	Calcium oxide (CaO), is an inorganic compound commonly known as quicklime or burnt lime, is a widely used chemical compound. The chemical is used as a component of a hydraulic fracturing fluid formulation for coal seam gas extraction. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment.
Environmental Fate[5]	
Soil/Water/Air	Calcium oxide reacts immediately upon exposure to water, forming calcium hydroxide, which itself reacts with carbon dioxide to form calcium carbonate. The final reaction products of both limestone and calcium oxide in the environment are therefore essentially the same, although calcium oxide typically has lower concentrations of magnesium and other inorganic chemicals than limestone and produces a higher initial concentration of hydroxide ions. Calcium and carbonate ions occur naturally in all environmental compartments and are important nutrients for various organisms. Calcium is mobile in soil and, if released to the environment, should be expected to experience significant partitioning to the water compartment. However, calcium ions may also form insoluble precipitates with anions present in the environment, such as carbonate ions, and settle out of the aqueous phase.
Human Health Toxicity Summary[2]	
Chronic Repeated Dose Toxicity	Several repeat dose studies using analogues of calcium oxide (calcium hydroxide, calcium carbonate, calcium gluconate) investigating the effect of calcium ions on various metabolic functions in experimental animals are available in the literature. However, all these studies were considered inappropriate for derivation of a No Observed Adverse Effect Level (NOAEL) by the study authors, as they did not follow any international guidelines (ECHA REACH).
Carcinogenicity	No data available. Using a read across study, calcium oxide is considered not likely to be carcinogenic.
Mutagenicity/ Genotoxicity	Calcium oxide is not mutagenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In two developmental toxicity studies conducted according to methods equivalent or similar to the OECD TG 414 (Prenatal Developmental Toxicity Study), calcium oxide was administered by gavage to pregnant female Wistar rats up to 680 mg/kg bw/day and CD-1 mice up to 440 mg/kg bw/day during gestation days 6 to 15 (10 consecutive doses). There were no clear discernible effects on implantation, maternal survival or foetal survival in any species at any of the doses. The number of abnormalities seen in either soft or skeletal tissues of the test groups did not

	differ significantly from those occurring spontaneously in the controls. No NOAEL could be established for maternal toxicity or foetal developmental effects. Based on the available data, calcium oxide is not considered to be a developmental toxicant.
Acute Toxicity	A study on acute oral toxicity of calcium oxide in female rats was conducted by a scientifically accepted method. Different doses of calcium oxide suspended in polyethylene glycol (0.2 g/mL) were administered to rats by gavage. No deaths were observed at 2000 mg/kg bw, indicating that the oral median lethal dose (LD50) for rats is >2000 mg/kg bw. No adverse effects were observed following treatment. No macroscopic findings were observed at necropsy. Calcium oxide has low oral acute toxicity with an oral LD50 of >2000 mg/kg bw. Acute dermal toxicity studies with calcium oxide are not available. An acute dermal toxicity study was conducted in rabbits using moistened calcium hydroxide (Ca(OH)2). As calcium oxide (CaO) is converted to Ca(OH)2 in the presence of moisture, the test results for Ca(OH)2 are also applicable for CaO. No animal deaths were observed at 2500 mg/kg bw Ca(OH)2, indicating that the dermal LD50 for male/female rabbits is >2500 mg/kg bw. No adverse effects were observed following the treatment. Based on the results with Ca(OH)2, calcium oxide is considered to have low acute dermal toxicity.
Irritation	Results from two skin irritation studies with calcium hydroxide (hydrated calcium oxide) indicated that calcium hydroxide causes skin irritation. The US Occupational Health Guideline for calcium oxide states 'calcium oxide causes irritation of the eyes, nose, throat and skin. Severe burns may result from contact with this chemical'. Calcium oxide is also considered to be a severe eye irritant.
Sensitisation	No data available.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	Calcium oxide has low acute oral and dermal toxicity, is a skin and respiratory irritant and a severe eye irritant. Calcium oxide is not genotoxic or carcinogenic and does not have any developmental effects in animals. Given the constituent ions of calcium oxide which are subject to tight homeostatic control in the body, repeated exposure to calcium oxide is regarded to have no significant systemic effects. In an epidemiological study, no significant adverse effects were observed in lime-kiln workers exposed to 1.2 mg/m^3 lime dust. This atmospheric concentration was taken as an overall NOAEC for calcium oxide. This NOAEC will be carried forward for human health risk assessment. The critical health effects of calcium oxide are skin and respiratory irritation and severe eye irritation.
Ecological Toxicity [2,5]	
Aquatic Toxicity	Oncorhynchus mykiss 96-hour LC50: 50.6 mg/L Daphnia magna 48-hour EC50: 49.1 mg/L Pseudokirchneriella subcapitata 72 hour EC10: 79.22 mg/L A 42-day Oncorhynchus mykiss test showed that enhanced Ca2+ diets (60 mg Ca2+) had no effects on survival. Mean fish weights remained constant across all treatments. A 14-day Crangon septemspinosa test showed an EC10 of 32 mg/L.
Determination of PNEC aquatic	A Tier 1 assessment of the environmental risks from the use of substances in the Limestone and its derivatives group is not required.
Current Regulatory Controls[2]	
Australian Hazard Classification	Calcium oxide is listed as hazardous in the Hazardous Substances Information System (HSIS). No risk phrases have been assigned to this chemical.
Australian Occupational Exposure Standards	The chemical has an exposure standard of 2 mg/m^3, Time Weighted Average (TWA)

International Occupational Exposure Standards	The following exposure standards are identified in Galleria Chemica (2013): Occupational Exposure limit (TWA) of 2 mg/m^3 [Canada, Denmark, Korea, UK, US (NIOSH)] Permissible Exposure Limits (PEL) of 5 mg/m^3 [US (OSHA 1978)].
Australian Food Standards	Calcium oxide is allotted the following International Numbering System of food additives number: INS 529 (Food Standards Australia New Zealand 2013).
Australian Drinking Water Guidelines	Calcium oxide is used in water treatment to correct pH and adjust alkalinity, for coagulation optimisation, corrosion control and water softening. Typical calcium oxide concentrations used in drinking water treatment depend on the quality of the water to be treated and the purpose of treatment (e.g. water softening, pH adjustment or alkalinity increase) and can vary from 5 to 500 mg/L.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	Not applicable (inorganic salt, ionic species ubiquitous in environment).
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions; sodium and hydroxide ions are ubiquitous and are present in most water, soil and sediment.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, calcium oxide does not meet the screening criteria for toxicity.
Overall conclusion	It is not currently possible to categorise the environmental hazards of metals and other inorganic chemicals according to standard persistence, bioaccumulation and toxicity (PBT) hazard criteria. These criteria were developed for organic chemicals and do not take into account the unique properties of inorganic substances and their behaviour in the environment.
Revised	December 2021

References

1. ECHA REACH, Calcium oxide, Retrieved 2021: https://echa.europa.eu/
2. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
3. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2021: https://www.industrialchemicals.gov.au/.
4. NCBI, 2021. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved December 2021.
5. EHS Support, Calcium oxide, calcium hydroxide. Available at: https://www.santos.com/wp-content/uploads/2021/05/Calcium-oxide-and-calcium-hydroxide-March-2021.pdf. Retrieved December 2021.
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7. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved December 2021: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.

Toxicity Summary - 1,2,3-Propanetriol, homopolymer, (Z)-9-octadecenoate

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	(C3H8O3)x
Molecular weight	UVCB
Solubility in water	550 g/L at 20 °C and pH 6.5
Melting point	-90 °C at 101.3 kP
Boiling point	274 °C at 100.8 kPa
Vapour pressure	0.047 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Colourless to slightly yellow liquid with characteristic odour
Overview	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [1]	
Soil/Water/Air	Based on the available data for the substance itself and for read-across substances and main components of the target UVCB substance, 1,2,3-Propanetriol, homopolymer (CAS [redacted]) is readily biodegradable according to OECD criteria. The half-life time of the major constituents in Polyglycerol-3 (diglycerol and triglycerol) at pH values normally found in the environment (pH 4-9) were determined to be > 1 year. Thus, the substance will slowly hydrolyse under environmental conditions. However, due to their ready biodegradability, hydrolysis is not expected to be a relevant degradation pathway for this substance. 1,2,3 -Propanetriol, homopolymer is water soluble (> 550 g/L) and has a low log Kow value (log Kow = -2) assuming a low adsorption potential. Bioaccumulation in aquatic organisms is unlikely since the substance has a low log Kow of -2, which assumes that the substance will not cross biological membranes.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Repeated dose toxicity studies with Polyglycerin are not available. The results of experimental studies with the read across substance glycerol are presented below. Repeated oral exposure to glycerol does not induce adverse effects other than local irritation of the gastro-intestinal tract. In a 2 year study, groups of 22 rats (Long-Evans) received 5, 10 and 20% glycerol (natural or synthetic) in their diet (males 2000, 4000 and 8000 mg/kg bw; females 2500, 5000 and 10000 mg/kg bw). No systemic or local effects were observed (NOEL 10,000 mg/kg bw/day).
Carcinogenicity	Based on the read-across substance (Polyglycerol Polyricinoleate PGPR) and supporting information (glycerol), Polyglycerol-3 does not possess any carcinogenic properties.
Mutagenicity/ Genotoxicity	Based on available data with polyglycerin (not containing glycerin), the test substance is not mutagenic or clastogenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the read-across substance (glycerol): No effects on fertility and reproductive performance were observed in a two-generation study with glycerol administered by gavage (NOAEL 2000 mg/kg bw/day). No maternal toxicity or teratogenic effects were seen in the rat, mouse or rabbit at the highest dose levels tested in a guideline comparable teratogenicity study (NOEL 1180 mg/kg bw/day).

Acute Toxicity	The acute oral toxicity of the test item was investigated in 5 female and 5 male rats using purified water as vehicle. The study was performed according to OECD test guideline 401 and followed the principles of GLP. All animals were administered the test compound by single-dose gavage at a dose-level of 2000 mg/kg body weight. The observation period was 14 days. No deaths occurred during the study. Clinical signs of intoxication were also not observed during the course of the study. Body weight development was normal and within the range commonly recorded for this strain and age. At necropsy no macroscopic findings were recorded. Based on the findings of this limit-test the median lethal dosage (LD50) of the test item in male/female rats is greater than 2000 mg/kg body weight. The acute dermal toxicity of glycerin was tested in a method equivalent to the OECD 402 guideline. No adverse effects were observed. The same can be expected for polyglycerin.
Irritation	Not irritating to rabbit eyes or skin.
Sensitisation	Not a skin sensitiser
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	A 2 year oral toxicity study conducted was conducted in rats with glycerin. No systemic or local effects were observed. The NOAEL for this study is 10,000 mg/kg/day. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability). Derived drinking water guideline = 39 ppm
Ecological Toxicity [1]	
Aquatic Toxicity	LC50 (96 hrs) for fish: 500 mg/L EC50 (48 h) for invertebrates: 1 g/L EC50/NOEC (72 h) for algae: 1 g/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 72h-NOErC of 500 mg/L (algae). A PNECaqua of 5 mg/L was derived.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. The substance has been found to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is -2 at 25 °C and pH 6.2 - 6.3 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 for this substance is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. ECHA REACH, 1,2,3-Propanetriol, homopolymer, Retrieved 2022: https://echa.europa.eu/
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
3. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.
4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - 1,2,3-Propanetriol, homopolymer

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	(C3H8O3)x
Molecular weight	UVCB
Solubility in water	550 g/L at 20 °C and pH 6.5
Melting point	-90 °C at 101.3 kP
Boiling point	274 °C at 100.8 kPa
Vapour pressure	0.047 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	Non-explosive
Flammability potential	Non-flammable
Colour/Form	Colourless to slightly yellow liquid with characteristic odour
Overview	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [1]	
Soil/Water/Air	Based on the available data for the substance itself and for read-across substances and main components of the target UVCB substance, 1,2,3-Propanetriol, homopolymer (CAS [redacted] is readily biodegradable according to OECD criteria. The half-life time of the major constituents in Polyglycerol-3 (diglycerol and triglycerol) at pH values normally found in the environment (pH 4-9) were determined to be > 1 year. Thus, the substance will slowly hydrolyse under environmental conditions. However, due to their ready biodegradability, hydrolysis is not expected to be a relevant degradation pathway for this substance. 1,2,3 -Propanetriol, homopolymer is water soluble (> 550 g/L) and has a low log Kow value (log Kow = -2) assuming a low adsorption potential. Bioaccumulation in aquatic organisms is unlikely since the substance has a low log Kow of -2, which assumes that the substance will not cross biological membranes.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	Repeated dose toxicity studies with Polyglycerin are not available. The results of experimental studies with the read across substance glycerol are presented below. Repeated oral exposure to glycerol does not induce adverse effects other than local irritation of the gastro-intestinal tract. In a 2 year study, groups of 22 rats (Long-Evans) received 5, 10 and 20% glycerol (natural or synthetic) in their diet (males 2000, 4000 and 8000 mg/kg bw; females 2500, 5000 and 10000 mg/kg bw). No systemic or local effects were observed (NOEL 10,000 mg/kg bw/day).
Carcinogenicity	Based on the read-across substance (Polyglycerol Polyricinoleate PGPR) and supporting information (glycerol), Polyglycerol-3 does not possess any carcinogenic properties.
Mutagenicity/ Genotoxicity	Based on available data with polyglycerin (not containing glycerin), the test substance is not mutagenic or clastogenic.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Based on the read-across substance (glycerol): No effects on fertility and reproductive performance were observed in a two-generation study with glycerol administered by gavage (NOAEL 2000 mg/kg bw/day). No maternal toxicity or teratogenic effects were seen in the rat, mouse or rabbit at the highest dose levels tested in a guideline comparable teratogenicity study (NOEL 1180 mg/kg bw/day).

Acute Toxicity	The acute oral toxicity of the test item was investigated in 5 female and 5 male rats using purified water as vehicle. The study was performed according to OECD test guideline 401 and followed the principles of GLP. All animals were administered the test compound by single-dose gavage at a dose-level of 2000 mg/kg body weight. The observation period was 14 days. No deaths occurred during the study. Clinical signs of intoxication were also not observed during the course of the study. Body weight development was normal and within the range commonly recorded for this strain and age. At necropsy no macroscopic findings were recorded. Based on the findings of this limit-test the median lethal dosage (LD50) of the test item in male/female rats is greater than 2000 mg/kg body weight. The acute dermal toxicity of glycerin was tested in a method equivalent to the OECD 402 guideline. No adverse effects were observed. The same can be expected for polyglycerin.
Irritation	Not irritating to rabbit eyes or skin.
Sensitisation	Not a skin sensitiser
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	A 2 year oral toxicity study conducted was conducted in rats with glycerin. No systemic or local effects were observed. The NOAEL for this study is 10,000 mg/kg/day. Uncertainty factors: 10 (interspecies variability); 10 (intraspecies variability). Derived drinking water guideline = 39 ppm
Ecological Toxicity [1]	
Aquatic Toxicity	LC50 (96 hrs) for fish: 500 mg/L EC50 (48 h) for invertebrates: 1 g/L EC50/NOEC (72 h) for algae: 1 g/L
Determination of PNEC aquatic	Data from short-term tests with three trophic levels are available. An assessment factor of 100 is applied to the lowest 72h-NOErC of 500 mg/L (algae). A PNECaqua of 5 mg/L was derived.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. The substance has been found to be readily biodegradable.
B/vB criteria fulfilled?	No. As the Log Pow is -2 at 25 °C and pH 6.2 - 6.3 (Log Pow < 4.5), it is not expected to be bioaccumulative.
T criteria fulfilled?	No. The acute EC50 for this substance is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. ECHA REACH, 1,2,3-Propanetriol, homopolymer, Retrieved 2022: https://echa.europa.eu/
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
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4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Acetic acid, ethenyl ester, polymer with ethenol

Chemical and Physical Properties[1,2,3]	
CAS number	[redacted]
Molecular formula	(C4H6O2.C2H4O)x (This substance is a polymer)
Molecular weight	130.14 g/mol (monomer); polymer variable (UVCB)
Solubility in water	Water solubility expected to be low
Melting point	No data available
Boiling point	No data available
Vapour pressure	Expected to be negligible
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	No data available
Overview	A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate [3]	
Soil/Water/Air	Polymers with a molecular weight greater than 1,000 g/mol generally have a negligible vapor pressure, which indicates that the chemical is likely to exist solely as particulate matter in the atmosphere. As particulate matter, atmospheric oxidation is not expected to be a significant route of environmental removal. Likewise, volatilization from water or moist soil is not expected to occur at an appreciable rate. Non-ionic polymers such as poly(vinyl acetate)-poly(vinyl alcohol) polymer are not expected to be highly soluble in water based on its predominantly hydrophobic structure. If discharged to the aquatic environment, this polymer is expected to partition to soil or sediment. It is not expected to be highly mobile if released to the soil compartment. Vinyl polymers not expected to undergo rapid degradation. In an OECD 302B (Zahn Wellens) test carried out using poly(vinyl acetate)-poly(vinyl alcohol) polymer, the test substance was found to be less than 10 % degraded after 28 days, indicating essentially no degradation. However, some bacterial species like Pseudomonads and Sphingomonads are known to efficiently degrade the substance. Additionally, some fungal species like Penicillium sp. And Geotrichum fermentans WF9101 have also been reported to degrade the substance efficiently. Microbial enzymes like oxidase, hydrolase, and dihydrogenase play an important role in the degradation of poly(vinyl acetate)-poly(vinyl alcohol) polymer. The high molecular weight of the polymer is expected to preclude or minimize bioaccumulation. Polymers with a number average molecular weight (NAMW) greater than 1,000 g/mol cannot cross biological membranes.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity /	No data available.

Developmental Toxicity/Teratogenicity	
Acute Toxicity	No data available.
Irritation	No data available.
Sensitisation	No data available.
Health Effects Summary	Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework.
Key Study/Critical Effect for Screening Criteria	No data available.
Ecological Toxicity [3]	
Aquatic Toxicity	No ecotoxicity data was identified. Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.
Determination of PNEC aquatic	Not determined.
Current Regulatory Controls [4,5,6,7]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [3]	
P/vP Criteria fulfilled?	Yes. Poly(vinyl acetate)-poly(vinyl alcohol) polymer is not expected to be biodegradable. Thus, it meets the criteria for persistence.
B/vB criteria fulfilled?	No. Poly(vinyl acetate)-poly(vinyl alcohol) polymer is not expected to bioaccumulate. Polymers with a NAMW greater than 1,000 g/mol cannot cross biological membranes. Thus, it does not meet the screening criteria for bioaccumulation.
T criteria fulfilled?	No. There are no acute or chronic toxicity studies on poly(vinyl acetate)-poly(vinyl alcohol) polymer. However, the high molecular weight of the substance is expected to negate or limit the bioavailability of the substance thus minimizing toxic effects on environmental receptors.Thus, poly(vinyl acetate)-poly(vinyl alcohol) polymer does not meet the criteria for toxicity.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.

2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.
3. EHS Support, Poly(vinyl acetate) – Poly(vinyl alcohol) polymer. Available at: https://www.santos.com/wp-content/uploads/2021/08/Polyvinyl-acetate-polyvinyl-alcohol-polymer-June-2021.pdf. Retrieved June 2022.
4. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
5. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
6. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
7. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Calcium Carbonate

Chemical and Physical Properties[1,2,4]	
CAS number	[redacted]
Molecular formula	CH2O3.Ca -
Molecular weight	100.09 g/mol
Solubility in water	0.0166 g/L at 20oC (slightly soluble)
Melting point	825°C (decomposes) at 101.3 kPa
Boiling point	No data available
Vapour pressure	No data available
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	No data available
Colour/Form	White powder
Overview	Calcium carbonate is an inorganic compound, the most natural forms being chalk, limestone and marble. It is partially soluble in water, dissociating into calcium (Ca^{2+}) and carbonate (CO_3^{2-}) ions; both are ubiquitous in the environment. The ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues. Calcium carbonate is of low toxicity concern to aquatic and terrestrial organisms. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate[2]	
Soil/Water/Air	Calcium carbonate, or $CaCO_3$, comprises more than 4% of the earth's crust and is found throughout the world. Its most natural forms are chalk, limestone, and marble, produced by the sedimentation of the shells of small fossilised snails, shellfish, and coral over millions of years. Calcium carbonate is partially soluble in water, dissociating into calcium (Ca^{2+}) and carbonate (CO_3^{2-}) ions. Both ions are ubiquitous in the environment. The addition of calcium carbonate to an aquatic ecosystem could result in a shift towards alkalinity and a tendency to increase the pH. The carbonate ions will react with water, forming bicarbonate (HCO_3^-) and hydroxide (OH^-) ions, until an equilibrium is reached. Ca^{2+} and CO_3^{2-} ions are not expected to adsorb on particulate matter or surfaces and will not accumulate in living tissues.
Human Health Toxicity Summary[3]	
Chronic Repeated Dose Toxicity	No systemic toxicological findings could be detected in rats after repeated administration of uncoated nano calcium carbonate by the oral route for a period of 90 days. The results of this study are read across to bulk calcium carbonate. Several potential adverse effects have been reported following calcium supplementation e.g. effects on kidney function, milk-alkali syndrome, kidney stones and interactions with minerals. However, these effects are more prevalent in those people suffering from renal insufficiency and following the ingestion of high doses of calcium. No systemic toxicity was observed in a 90-day inhalation study where rats were exposed to uncoated calcium carbonate at a maximum concentration of 0.399 mg/L, stated as the NOEC. The local effects observed at this level were limited to increased lung weights accompanied by increases in BAL-derived inflammation and cytotoxicity biomarkers, which were reversible in males but were not fully reversible in females within a 4-week recovery period. Hence the NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L. The results of this study are read across to bulk calcium carbonate.

Carcinogenicity	Uncoated nano calcium carbonate is not expected to pose a risk of carcinogenicity.
Mutagenicity/ Genotoxicity	Uncoated nano calcium carbonate was negative in the following assays: In vitro gene mutation study in bacteria (OECD TG 471) using Salmonella typhimurium strains TA 98, TA 100, TA 1535 and TA 1537 and Escherichia coli WP2 uvrA with and without metabolic activation (S9). In vitro chromosome aberration study in mammalian cells (OECD TG 473) using human lymphocytes in the presence and absence of metabolic activation. In vitro gene mutation study in mammalian cells (OECD TG 476) using mouse lymphoma L5178Y cells in the presence and absence of metabolic activation. The results of these studies are read across to bulk calcium carbonate.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	Under the conditions of the OECD TG 422 study, uncoated nano calcium carbonate administered to male and female rats up to a dose level of 1000 mg/kg bw/day for a period of up to 48 days is not toxic to reproduction and has no effect on fertility or development. No treatment-related effects were observed for reproduction; hence, a NOEL for reproductive toxicity was considered to be 1000 mg/kg bw/day. The results of this study are read across to bulk calcium carbonate. The prenatal developmental toxicity study also demonstrated that calcium carbonate was neither foetotoxic nor teratogenic at the concentrations used. Since no adverse effects were noted at the highest dose level tested (1.25% Ca in diet), the NOAEL for teratogenic and maternal toxic effects in rats is in excess of 1.25% Ca, equivalent to approximately 1963 - 2188 mg/kg bw/day of calcium carbonate.
Acute Toxicity	Bulk calcium carbonate is not considered to be acutely harmful by the oral, dermal or inhalation routes.
Irritation	Bulk calcium carbonate is not considered to be irritating to the skin or eyes.
Sensitisation	Based on the results of an OECD TG 429 study performed using nano calcium carbonate and read across to bulk calcium carbonate, where the Stimulation Index was < 3, bulk calcium carbonate is considered to be a non-sensitiser
Health Effects Summary	This chemical has been identified by NICNAS to be of low concern to human health.
Key Study/Critical Effect for Screening Criteria	In the repeated dose toxicity study, NOAEC for local effects was established as 0.212 mg/L and the LOAEC at 0.399 mg/L.
Ecological Toxicity[4]	
Aquatic Toxicity	96 h EC50 for fish >100mg/L 48 h EC50 for Daphnia >100 mg/L 72 h ERC50 for algae >14 mg/L
Determination of PNEC aquatic	Experimental results are available for three trophic levels. Acute LC50 values are available for fish, invertebrates, and algae. On the basis that the data consists of short term results from three trophic levels, an assessment factor of 1000 has been applied to the lowest reported effect concentration of 14 mg/L for algae. The PNEC aquatic is 0.014 mg/L.
Current Regulatory Controls	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	No data available.
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.

Aquatic Toxicity Guidelines	No data available.
PBT Assessment[1]	
P/vP Criteria fulfilled?	Not applicable (inorganic chemical, ionic species ubiquitous in environment)
B/vB criteria fulfilled?	Not applicable. Bioaccumulation is not applicable to these inorganic ions.
T criteria fulfilled?	Not applicable. Expected to have low toxicity to aquatic organisms.
Overall conclusion	Not PBT
Revised	July 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2019: https://www.nicnas.gov.au
2. Department of the Environment and Energy 2017, National assessment of chemicals associated with coal seam gas extraction in Australia, prepared by the National Industrial Chemicals Notification and Assessment Scheme
3. ECHA REACH, Calcium carbonate, Retrieved 2022: https://echa.europa.eu/
4. EHS Support, Magnesium Oxide. Available at: https://www.santos.com/wp-content/uploads/2021/04/Calcium-Carbonate-March-2021.pdf. Retrieved June 2022.

Toxicity Summary - Cellulose (Organic Fibres)

Chemical and Physical Properties[1,2]	
CAS number	[redacted]
Molecular formula	$C_{12}H_{22}O_{11}$
Molecular weight	342.30
Solubility in water	Insoluble
Melting point	500 to 518 °F (Decomposes)
Boiling point	Decomposes
Vapour pressure	0 mm Hg (approx)
Henrys law constant	No data available.
Explosive potential	No data available.
Flammability potential	No data available.
Colour/Form	Odourless, white powdery fibres
Overview	The biopolymer composing the cell wall of vegetable tissues. Prepared by treating cotton with an organic solvent to de-wax it and removing pectic acids by extraction with a solution of sodium hydroxide. The principal fibre composing the cell wall of vegetable tissues (wood, cotton, flax, grass, etc.). Technical uses depend on the strength and flexibility of its fibres. Insoluble in water. Soluble with chemical degradation in sulfuric acid, and in concentrated solutions of zinc chloride. Soluble in aqueous solutions of cupric ammonium hydroxide. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to human health and the environment and thus required no further assessment.
Environmental Fate	
Soil/Water/Air	No data available.
Human Health Toxicity Summary [1,2,3]	
Chronic Repeated Dose Toxicity	No data available.
Carcinogenicity	No data available.
Mutagenicity/ Genotoxicity	No data available.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	No data available.
Acute Toxicity	Inhalation LC50 (rat) > 5,800 mg/m^3/4h Oral LD50 (rat) >5 gm/kg Dermal LD50 (rat) >2 gm/kg
Irritation	Irritation to eyes, skin, mucous membrane
Sensitisation	No data available.
Health Effects Summary	Causes irritation to eyes, skin, mucous membrane.
Key Study/Critical Effect for Screening Criteria	The dermal rat acute toxicity LD50 >2 gm/kg was considered the most sensitive endpoint.
Ecological Toxicity	
Aquatic Toxicity	No data available.

	Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.
Determination of PNEC aquatic	No data available.
Current Regulatory Controls [3,4,5,6]	
Australian Hazard Classification	No data available.
Australian Occupational Exposure Standards	TWA = 10 mg/m^3
International Occupational Exposure Standards	No data available.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment [1]	
P/vP Criteria fulfilled?	No. Expected to be biodegradable.
B/vB criteria fulfilled?	No. Not expected to bioaccumulate.
T criteria fulfilled?	No data available.
Overall conclusion	Not PBT
Revised	June 2022

References

1. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Human Health Tier 1 Assessment. Retrieved 2022: https://www.industrialchemicals.gov.au/.
2. NCBI, 2022. National Center for Biotechnology Information. Available at: https://pubchem.ncbi.nlm.nih.gov/. Retrieved February 2022.
3. HCIS, Hazardous Chemical Information System, Safe Work Australia, Retrieved February 2022: http://hcis.safeworkaustralia.gov.au/HazardousChemical.
4. ILO, International Labour Organisation, International Chemical Safety Cards (ICSCs), Retrieved February 2022: http://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en.
5. ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.
6. NHMRC, 2018. Australian Drinking Water Guidelines 6, 2011, Version 3.5 Updated August 2018. National Water Quality Management.

Toxicity Summary - Sodium Bromide

Chemical and Physical Properties[1,2]	
CAS number	7647-15-6
Molecular formula	NaBr
Molecular weight	102.89 g/mol
Solubility in water	946000 mg/L at 25C
Melting point	755 °C
Boiling point	1390 °C
Vapour pressure	0.000000018 hPa at 25 °C
Henrys law constant	No data available
Explosive potential	No data available
Flammability potential	Not flammable
Colour/Form	White crystals, granules, or powder
Overview	Sodium bromide is an inorganic sodium salt having bromide as the counterion. It is a bromide salt and an inorganic sodium salt. A Tier 1 Human Health and Environmental Assessment for this chemical has been conducted by NICNAS which concluded that it was low concern to the human health and the environment.
Environmental Fate [1]	
Soil/Water/Air	The chemical nature of the bromide ion is such that it cannot biodegrade. The bromide ion is also stable to photolysis and abiotic degradation. This is demonstrated by the presence of significant quantities in certain environmental systems, e.g. sea water and some soils. The high water solubility and negative charge of the ion suggest that this species will partition predominantly to the aqueous phase. The very low vapour pressure measured for sodium bromide indicates that the volatilisation of the ion into the atmosphere in quantities of concern will not occur. The very high water solubility of sodium bromide suggests that the log Pow is very low. This, together with the measured low BCF of 0.23 indicates that it is unlikely that sodium bromide will accumulate in biological membranes
Human Health Toxicity Summary [1,2]	
Chronic Repeated Dose Toxicity	Sodium bromide is an inorganic salt that dissociates to its composite ions in aqueous solutions at environmental pH and temperature. Comparison of the available data on the various bromide salts have shown that the bromide ion is the relevant ion for determination of the toxicological profile with simple cations such as potassium, sodium or ammonium, that are ubiquitous in nature, having little or no influence on the bromide ion properties. It is therefore justified to read-across data from other inorganic bromide salts to sodium bromide. Observations in a 4-week oral study in female rats (Van Logten M.J.et al., 1973) and a 90-day oral study in male and female rats (Van Logten M.J.et al., 1974) demonstrated that sodium bromide caused behavioural changes, growth reduction, increased thyroid and adrenals weights, and a dose-related disturbance of the endocrine system. The NO(A)EL for rats was 15 mg (Br-)/kg bw/day from the 90-day oral study. The results of an additional 90-day repeat dose study with sodium bromide (Van Logten M.J.et al., 1976) and a 90-day study with a similar salt, ammonium bromide (Barton S.J.et al., Inveresk Research, Report No. 18612) did not show any evidence of cellular change, even in potential target tissues such as the endocrine (thyroid) or neural systems, that could be considered preneoplastic change. Repeat dose studies in dogs were performed according to non-standard tests in which animals received 78 rising to 312 mg (Br-)/kg bw/day for 400 days (Rosenblum I., 1958). Signs of toxicity noted were stated as being comparable with signs noted in human after suffering bromide intoxication. Although no NO(A)EL

	was determined, the study author states that dogs receiving 78 mg (Br-)/kg/day showed no mortalities and only minimal signs of toxicity. The ion of concern for systemic toxicity is bromide. The study by Barton et al on ammonium bromide gives the lowest reliable NOAEL for bromide salts = 100 mg/kg bw/day. The NOAEL has been extrapolated to NaBr giving a final NOAEL for inorganic bromide salts of 95 mg/kg bw/day.
Carcinogenicity	Sodium bromide is not listed by the International Agency for Research on Cancer (IARC) as a carcinogen. Rats received KBr in food for 104 weeks in a testing regime approximating OECD guideline 453. No detrimental changes were seen in the clinical signs, mortality, food and water consumption, ophthalmoscopic examination, haematology, clinical chemistry, urinalysis or organ weights of the treated animals. There is no evidence for potential carcinogenicity.
Mutagenicity/ Genotoxicity	Sodium bromide is not considered to be genotoxic based on the available data.
Reproductive Toxicity / Developmental Toxicity/Teratogenicity	In a two-generation reproductive toxicity study in rats according to guideline OECD Guideline 416 (Two-Generation Reproduction Toxicity Study) There were no indicators of toxicity or adverse effects on reproductive parameters in either generation evaluated at 50mg/kg/day of sodium bromide. The NOAEL for parental toxicity, reproductive performance and pre-and postnatal development was therefore established as 50mg/kg/day
Acute Toxicity	Sodium bromide is not acutely toxic by the oral or dermal routes (Oral LD50 = 4200 mg/kg, dermal LD50 >2000 mg/kg). The inhalation study of sodium bromide is scientifically unjustified, since the bromide ion has a very low volatility based on the vapour pressure of 1.8 x 10-6Pa (Cowlyn T.C., 1991) and has a particle size which excludes inhalation (> 100 µm). Therefore exposure to significant quantities of bromide ions by direct inhalation is not likely to occur. Based on the experimental results, sodium bromide is not classified for acute toxicity by the oral or dermal routes.
Irritation	Sodium bromide is not classified as an irritant to skin or eyes.
Sensitisation	Sodium bromide is not classified as a skin sensitiser.
Health Effects Summary **Key Study/Critical Effect for Screening Criteria**	A Tier 1 Human Health Assessment for this chemical has been conducted by NICNAS which concluded that it Poses no unreasonable risk to human health based on Tier I assessment under the NICNAS IMAP assessment framework
Ecological Toxicity [1,2]	
Aquatic Toxicity	The effect of acute and chronic exposure to sodium bromide on aquatic organisms was observed in the studies reported here. Sodium bromide was found to be non-toxic to the aquatic environment. The short term toxicity to fish studies showed that the LD50 to the most sensitive species, Juvenile turbot, is >440 mg/L, according to OECD guideline 203. A number of chronic studies were performed with Poecilia reticulata and Oryzias latipes. The NOEC ranged from 10 to 3219 mg/L and 32 to 320 mg/L respectively. None of the validity criteria of the tests with the two species can be considered as fulfilled, as individual mortality and effect data were not given. The studies were not performed according to GLP. A considered number of studies with Daphnia magna are available. The toxicity data show that the sensitivity of Daphnia magna to the test substance is variable, with NOECs ranging from 2.8 to >117 mg/L sodium bromide.

	NOEC values were derived from acute and (semi) chronic toxicity tests with freshwater green algae, (cyano)bacteria and duckweed (Lemna minor). The test results show that the organisms have a similar toxicity to sodium bromide as the NOEC values ranged from 3200 mg/L to 4200 mg/L.
Determination of PNEC aquatic	A Tier 1 Environmental Risk Assessment for this chemical has been conducted by NICNAS which concluded that it is an inorganic substance comprising ions of low ecotoxicological concern. This chemical is not expected to pose an unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded. Sodium bromide poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework.
Current Regulatory Controls	
Australian Hazard Classification	The chemical is not listed in the Hazardous Substances Information System (HSIS) (Safe Work Australia 2013).
Australian Occupational Exposure Standards	No specific exposure standards were available.
International Occupational Exposure Standards	No information available.
Australian Food Standards	No information available.
Australian Drinking Water Guidelines	No guidance values available.
Aquatic Toxicity Guidelines	No guidance values available.
PBT Assessment [1,2]	
P/vP Criteria fulfilled?	No. The substance is an inorganic compound and is not subject to biodegradation.
B/vB criteria fulfilled?	No. As the BCF is 0.23, it is not expected to be bioaccumulative.
T criteria fulfilled?	No. Chronic and acute toxicity data >1 mg/L, sodium bromide does not meet the screening criteria for toxicity.
Overall conclusion	Not PBT

References

1. ECHA REACH, Sodium bromide, Retrieved: https://echa.europa.eu/
2. National Industrial Chemicals Notification and Assessment Scheme (NICNAS). IMAP, Sodium Bromide. Retrieved: https://services.industrialchemicals.gov.au/search-assessments/?assessmentcasnumber=7647-15-6

Appendix J

SDS for Drilling and Packer Fluids

SAFETY DATA SHEET

NewPerm™ NF

Issue Date 29-Jul-2016 **Revision Date** 07-Jul-2021 **Version** 1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

0

Product identifier

Product Name NewPerm™ NF

Product Code NDF00503

Other means of identification

Pure substance/mixture Mixture

Recommended use of the chemical and restrictions on use

Recommended Use shale inhibitor

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

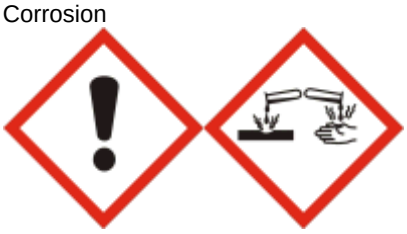
Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Acute toxicity - Oral	Category 4 - (H302)
Acute toxicity - Dermal	Category 4 - (H312)
Skin corrosion/irritation	Category 1 - (H314)
Serious eye damage/eye irritation	Category 1 - (H318)
Skin sensitization	Category 1B - (H317)
Specific target organ toxicity (single exposure)	Category 3 - (H335)

Label elements

Exclamation mark
Corrosion



Signal word
Danger

Hazard statements
H302 - Harmful if swallowed
H312 - Harmful in contact with skin
H314 - Causes severe skin burns and eye damage
H317 - May cause an allergic skin reaction
H335 - May cause respiratory irritation

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing/eye protection/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Use only outdoors or in a well-ventilated area
Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
Call a POISON CENTER or doctor/physician if you feel unwell
Wash contaminated clothing before reuse
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation or rash occurs: Get medical advice/attention
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Call a POISON CENTER or doctor/physician if you feel unwell
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Do NOT induce vomiting
Precautionary Statements - Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other hazards
Harmful to aquatic life
General Hazards
This substance does not meet the PBT/vPvB criteria of REACH, annex XIII

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Chemical name	CAS No.	Weight-%	REACH Registration Number
Hexanedinitrile, hydrogenated, high-boiling fraction	[redacted]	30-40	No data available

Additional information
The pH of the mixture is adjusted to pH 9-10 with Hydrochloric Acid (CAS 7647-01-0)

Section 4: FIRST AID MEASURES

Description of first aid measures

General advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur. Get immediate medical advice/attention.

Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention. May cause an allergic skin reaction.

Ingestion Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.

Self-protection of the first aider Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Wear personal protective clothing (see section 8). Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation.

Most important symptoms and effects, both acute and delayed

Symptoms Burning sensation. Itching. Rashes. Hives.

Indication of any immediate medical attention and special treatment needed

Note to physicians Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. May cause sensitization in susceptible persons. Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Dry chemical, CO2, water spray or alcohol-resistant foam.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. In the event of fire and/or explosion do not breathe fumes.

Hazardous combustion products Carbon oxides. Nitrogen oxides (NOx).

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Attention! Corrosive material. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

Other Information Refer to protective measures listed in Sections 7 and 8.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Keep out of the reach of children. Store locked up. Protect from moisture. Store away from other materials.

Incompatible materials Strong oxidizing agents Aldehydes Halogens Acids Ketone Nitrates Halogenated compounds Phenols Isocyanates

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Face protection shield.

Skin and body protection Wear suitable protective clothing. Long sleeved clothing. Chemical resistant apron.

Hand protection Wear suitable gloves. Impervious gloves.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	liquid	**Odor**	Pungent.
Color	brown	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	9.0 - 10.0	
Melting point / freezing point		No information available
Boiling point / boiling range	100 °C	
Flash point	> 100 °C	
Evaporation rate		No information available
Flammability (solid, gas)		Not applicable
Flammability Limit in Air		Not applicable
Upper flammability limit:		Not applicable
Lower flammability limit:		Not applicable
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.00-1.10	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		
Dynamic viscosity		

Other Information

Softening point No information available
Molecular weight No information available

VOC Content (%)	14
Liquid Density	1.00-1.10 g/cm3
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid Exposure to air or moisture over prolonged periods.

Incompatible materials

Incompatible materials Strong oxidizing agents. Aldehydes. Halogens. Acids. Ketone. Nitrates. Halogenated compounds. Phenols. Isocyanates.

Hazardous Decomposition Products

Hazardous Decomposition Products None known.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available. Corrosive by inhalation. (based on components). Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Inhaled corrosive substances can lead to a toxic edema of the lungs. Pulmonary edema can be fatal. May cause irritation of respiratory tract.

Eye contact Specific test data for the substance or mixture is not available. Causes burns. (based on components). Corrosive to the eyes and may cause severe damage including blindness. Causes serious eye damage. May cause irreversible damage to eyes.

Skin contact Specific test data for the substance or mixture is not available. May cause irritation. May cause sensitization by skin contact. Repeated or prolonged skin contact may cause allergic reactions with susceptible persons. (based on components). May be absorbed through the skin in harmful amounts. Harmful in contact with skin.

Ingestion Specific test data for the substance or mixture is not available Causes burns (based on components) Ingestion causes burns of the upper digestive and respiratory tracts May cause severe burning pain in the mouth and stomach with vomiting and diarrhea of dark blood. Blood pressure may decrease. Brownish or yellowish stains may be seen around the mouth. Swelling of the throat may cause shortness of breath and choking May cause lung damage if swallowed May be fatal if swallowed and enters airways

Symptoms Redness. Burning. May cause blindness. Coughing and/ or wheezing. Itching. Rashes. Hives.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral) 1,922.60 mg/kg
ATEmix (dermal) 1,754.80 mg/kg ppm mg/l

Unknown acute toxicity 18 % of the mixture consists of ingredient(s) of unknown toxicity
18 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
18 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
18 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
18 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
18 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Hexanedinitrile, hydrogenated, high-boiling fraction	= 1500 mg/kg (Rat)	> 200 mg/kg (Rabbit)	-

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation MAY CAUSE SKIN IRRITATION.

Serious eye damage/eye irritation Classification based on data available for ingredients. Causes burns. Risk of serious damage to eyes.

Respiratory or skin sensitization May cause sensitization by skin contact.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure May cause respiratory irritation.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity

Unknown aquatic toxicity 0 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability Readily biodegradable.

Product Information			
Method	Exposure time	Value	Results
OECD Test No. 306: Biodegradability in Seawater	28 days	62.4% Biodegradation	Readily biodegradable

Bioaccumulative potential

Bioaccumulation There is no data for this product.

Component Information

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not Regulated

IATA Not Regulated

IMDG Not Regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Does not comply
PICCS	Does not comply
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Brunei Poison List Not applicable.

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 29-Jul-2016

Revision Date 07-Jul-2021

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

SAFETY DATA SHEET

NewZan™ D

A safety data sheet is not required for this product under Article 31 of REACH

Issuing Date 07-Jul-2016 **Revision Date** 11-Aug-2021 **Version** 1.9

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product Code NDF00020

Product Name NewZan™ D

EC No 234-394-2

CAS No [redacted]

Synonyms Xanthan Gum

Pure substance/mixture Substance

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Viscosifier

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids S.p.A.
Via Salaria 1313/C
00138 ROMA (Italy)
For further information, please contact

Contact Point
Telephone: + 39 06 8856111
Fax: +39 06 8889363
Website: www.newpark.com

E-mail address hse-hqit@newpark.com

1.4. Emergency telephone number

Emergency Telephone - §45 - (EC)1272/2008	
Europe	**112**
Croatia	+385 1 7776 920 ; +385 01 2348 342 (Centar za kontrolu otrovanja, 24 sata)
France	+(33)-975181407
Germany	0800-181-7059; +(49)- 69643508409
Hungary	+(36)-18088425
Italy	800-789-767; +(39)-0245557031 Milano 24/24 Ospedale Niguarda Ca'grande Piazza ospedale maggiore 3 +39 0266101029

	Roma 24/24 Policlinico Gemelli Largo Agostino Gemelli 8 +39 063054343
Netherlands	+(31)-858880596
Romania	(+40)-37-6300026
Spain	900-868538; +(34)-931768545
Switzerland	145, (+41) 435082011
United Kingdom	+(44)-870-8200418

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.2. Label elements

This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]
Hazard statements
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.3. Other hazards

May form combustible dust concentrations in air.

This substance does not meet the PBT/vPvB criteria of REACH, annex XIII.

SECTION 3: Composition/information on ingredients

3.1 Substances

Chemical name	Weight-%	REACH registration number	EC No	Classification according to Regulation (EC) No. 1272/2008 [CLP]	Specific concentration limit (SCL)	M-Factor	M-Factor (long-term)
Xanthan Gum 11138-66-2	100	No data available	234-394-2	No data available	-	-	-

Full text of H- and EUH-phrases: see section 16

Acute Toxicity Estimate
No information available

This product does not contain candidate substances of very high concern at a concentration >=0.1% (Regulation (EC) No. 1907/2006 (REACH), Article 59)

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact	Wash skin with soap and water. In the case of skin irritation or allergic reactions see a physician.
Ingestion	Rinse mouth.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms	No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media	Dry chemical, CO2, sand, earth, water spray or regular foam.
Large Fire	CAUTION: Use of water spray when fighting fire may be inefficient.
Unsuitable extinguishing media	Do not scatter spilled material with high pressure water streams.

5.2. Special hazards arising from the substance or mixture

Specific hazards arising from the chemical	Fine dust dispersed in air may ignite. Material becomes extremely slippery when wet.
Hazardous combustion products	Carbon oxides.

5.3. Advice for firefighters

Special protective equipment and precautions for fire-fighters	Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions	Ensure adequate ventilation. Avoid generation of dust.
For emergency responders	Use personal protection recommended in Section 8.

6.2. Environmental precautions

Environmental precautions	See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for containment	Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	Use personal protective equipment as required. Avoid generation of dust. Sweep up and shovel into suitable containers for disposal.
Prevention of secondary hazards	Clean contaminated objects and areas thoroughly observing environmental regulations.

6.4. Reference to other sections

Reference to other sections	See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid generation of dust. Wash thoroughly after handling.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Identified uses
Risk Management Methods (RMM) The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits
This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles). Use eye protection according to EN 166, designed to protect against spray mists.

Skin and body protection Wear suitable protective clothing. (EN 340).

Respiratory protection No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required. (EN 136, EN 140, EN 141, EN 143, EN 149, EN 405).

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls No information available.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	Solid
Appearance	Powder
Color	Off-white
Odor	Odorless.
Odor threshold	No information available

Property	**Values**	**Remarks • Method**
Melting point / freezing point		Not applicable
Boiling point / boiling range		Not applicable
Flammability (solid, gas)		No information available
Flammability Limit in Air		Not applicable
Upper flammability limit:		
Lower flammability limit:		
Flash point		Not applicable
Autoignition temperature		No information available
Decomposition temperature		No information available
pH		Not applicable
pH (as aqueous solution)		No information available
Kinematic viscosity		Not applicable
Dynamic viscosity		Not applicable
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Vapor pressure		No information available
Relative density	1.02-1.45	
Bulk density		
Liquid Density		
Vapor density		No information available
Particle characteristics		No information available
Particle Size		
Particle Size Distribution		

9.2. Other information

9.2.1. Information with regard to physical hazard classes

Explosives

Explosive properties	Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard
Oxidizing properties	Not applicable

9.2.2. Other safety characteristics

No information available Not applicable

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity Not reactive under normal conditions.

10.2. Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to mechanical impact	None.
Sensitivity to static discharge	Fine dust dispersed in air, in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

10.4. Conditions to avoid

Conditions to avoid Incompatible materials. dust formation.

10.5. Incompatible materials

Incompatible materials Strong oxidizing agents.

10.6. Hazardous decomposition products

Hazardous Decomposition Products None known based on information supplied.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Numerical measures of toxicity
No information available

Acute toxicity

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation None known.

Serious eye damage/eye irritation None known.

Respiratory or skin sensitization None known.

Germ cell mutagenicity None known.

Carcinogenicity None known.

Reproductive toxicity None known.

STOT - single exposure None known.

STOT - repeated exposure None known.

Aspiration hazard Not applicable.

11.2. Information on other hazards

11.2.1. Endocrine disrupting properties

Endocrine disrupting properties No information available.

11.2.2. Other information

Other adverse effects No information available.

SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

12.2. Persistence and degradability

Persistence and degradability No information available.

12.3. Bioaccumulative potential

Bioaccumulation No information available.

12.4. Mobility in soil

Mobility in soil No information available.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment The product does not contain any substance(s) classified as PBT or vPvB.

12.6. Endocrine disrupting properties

Endocrine disrupting properties No information available.

12.7. Other adverse effects
No information available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Waste codes / waste designations according to EWC / AVV	Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information

IATA

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	
Special Provisions	None

IMDG

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	
Special Provisions	None
14.7 Maritime transport in bulk according to IMO instruments	No information available

RID

14.1 UN/ID no	Not Regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	
Special Provisions	None

ADR

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	
Special Provisions	None

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations

Germany

Water hazard class (WGK)	slightly hazardous to water (WGK 1)

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Authorizations and/or restrictions on use:

This product does not contain substances subject to authorization (Regulation (EC) No. 1907/2006 (REACH), Annex XIV) This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

Persistent Organic Pollutants
Not applicable

Ozone-depleting substances (ODS) regulation (EC) 1005/2009
Not applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical Safety Report None

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend
SVHC: Substances of Very High Concern for Authorization:

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database

International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine's PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Issuing Date 07-Jul-2016

Revision Date 11-Aug-2021

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006
Disclaimer
According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, as amended by Regulation (EU) No. 2015/830. This document is provided as an information resource relating exclusively to the product or material described herein. The information contained herein may not be applicable to other products/ materials or processes and may not be valid when this product/material is used in combination with any other product/material or process. The information provided in this document is compiled by Newpark Drilling Fluids LLC or its representatives from various sources including manufacturers, suppliers and other third-party sources, and is based on the information available as of the indicated date of preparation. As the conditions under which this product could be used will vary and may not be within the control of Newpark Drilling Fluids LLC there is no guarantee that the precautions outlined above will be sufficient for all individuals or situations. The buyer assumes all responsibility for using and handling the product in accordance with federal, state, provincial, or local regulations. For the product/ material described in this document, NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE.

End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **OMYACARB**

Synonyms AGRICULTURAL LIME ● CALCIUM CARBONATE ● CHALK ● LIMESTONE ● OMYACARB 10 ● OMYACARB 2 ● OMYACARB 20 ● OMYACARB 40 ● OMYACARB 5

1.2 Uses and uses advised against

Uses BRIDGING AGENT ● DRILLING FLUID ADDITIVE ● WEIGHTING AGENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
LIMESTONE (CALCIUM CARBONATE)	[redacted]	215-279-6	>96%
QUARTZ (CRYSTALLINE SILICA)	[redacted]	238-878-4	<1%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities should be available.

4.2 Most important symptoms and effects, both acute and delayed
See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters
No fire or explosion hazard exists.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
If spilt, collect and reuse where possible. If reuse is not possible, contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Calcium carbonate (Limestone, Marble, Whiting)	SWA [AUS]	--	10	--	--
Quartz (respirable dust)	SWA [AUS]	--	0.05	--	--
Quartz (respirable dust) (Precautionary advice)	WorkSafe VIC	--	0.02	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	When using large quantities or where heavy contamination is likely, wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	OFF-WHITE POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	825°C
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Relative density	2.7
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity
Calcium carbonate reacts with acids and acidic salts to generate gaseous carbon dioxide with effervescence (bubbling). The reaction with concentrated solutions of acids is rapid and exothermic. The effervesence can create extensive foaming. Ignites on contact with fluorine.

10.2 Chemical stability
Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions
Polymerization will not occur.

10.4 Conditions to avoid
Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials
Incompatible with acids (e.g. nitric acid), fluorine, aluminium (hot) and ammonium salts.

10.6 Hazardous decomposition products
May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
LIMESTONE (CALCIUM CARBONATE)	> 5000 mg/kg (rat)	--	--

Skin Not classified as a skin irritant. Prolonged or repeated contact may result in mild irritation and rash.

Eye Not classified as an eye irritant. Contact may result in mild irritation, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Insufficient data available to classify as a mutagen.

Carcinogenicity Crystalline silica is classified as carcinogenic to humans (IARC Group 1). However, there is a body of evidence supporting the fact that increased cancer risk would be limited to people already suffering from silicosis.

Reproductive Insufficient data available to classify as a reproductive toxin.

STOT - single exposure Not classified as causing organ damage from single exposure.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure. Repeated exposure to crystalline silica may cause lung fibrosis (silicosis), however due to the low levels of respirable crystalline silica in this product, adverse health effects are not anticipated with normal use.

Aspiration Not relevant.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
Calcium carbonate occurs naturally in a wide variety of substances including limestone, marble and egg shells. It is not anticipated to cause adverse environmental effects.

12.2 Persistence and degradability
Dissolved calcium carbonate dissociates into calcium and carbonate ions. Calcium ions will be assimilated by living organisms in the water and the carbonate will become part of the carbon cycle.

12.3 Bioaccumulative potential
This product does not bioaccumulate.

12.4 Mobility in soil

Due to its limited solubility, calcium carbonate precipitates and deposits on the sediment.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

EXPOSURE CONTROL: If utilised in a closed system the potential for over exposure is reduced. If not used in a closed system, local exhaust ventilation is recommended to control exposure. Provide eye wash and safety shower in close proximity to points of potential exposure. Where the potential for an inhalation risk exists, an approved respirator may be required. Do not eat, store, consume food, tobacco or drink in areas where product is used.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **POTASSIUM CHLORIDE**

Synonyms KCL ● MURIATE OF POTASH ● POTASH ● SYLVITE

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE ● FERTILISER ● INHIBITOR

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
POTASSIUM CHLORIDE	[redacted]	231-211-8	>97%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities should be available.

4.2 Most important symptoms and effects, both acute and delayed

Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases (potassium oxides, chlorides) when heated to decomposition.

5.3 Advice for firefighters
Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE

Eye / Face	At high dust levels, wear dust-proof goggles.
Hands	With prolonged use, wear PVC or rubber or cotton gloves.
Body	With prolonged use, wear coveralls.
Respiratory	At high dust levels, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE SOLID
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	1413°C
Melting point	773°C
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Specific gravity	2.0
Solubility (water)	340 g/L @ 20°C
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization will not occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Potassium chloride is not in general strongly reactive. Violent reaction with BrF3 and with a mixture of sulfuric acid potassium permanganate mixture (NTP, 1992). Reacts with concentrated sulfuric acid to generate fumes of hydrogen chloride. Incompatible with oxidising agents.

10.6 Hazardous decomposition products

May evolve toxic gases (potassium oxides, chlorides) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity May be harmful if swallowed in large quantities. Additional toxicity data for potassium chloride:
LD50 (Intraperitoneal): 620 mg/kg (mouse)
LD50 (Intravenous): 117 mg/kg (mouse)
LDLo (Ingestion): 20 mg/kg (man)
LDLo (Intraperitoneal): 900 mg/kg (guinea pig)
LDLo (Intravenous): 77 mg/kg (guinea pig)

LDLo (Subcutaneous): 2120 mg/kg (frog)
TDLo (Ingestion): 60 mg/kg/days (woman)

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
POTASSIUM CHLORIDE	2600 mg/kg (rat)	--	--

Skin Not classified as a skin irritant. Contact may result in mild irritation and rash.

Eye Contact may cause discomfort, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity No evidence of mutagenic effects.

Carcinogenicity No evidence of carcinogenic effects.

Reproductive No relevant or reliable studies were identified.

STOT - single exposure Acute potassium poisoning via ingestion is rare as a large single dose usually induces vomiting, and potassium is rapidly excreted by the body, however this product does have the potential to cause cardiovascular disorders.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration Not relevant.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

In short-term acute toxicity tests with fish, daphnia and algae the following results were found (lowest test result values): Ictalurus punctulus 48h-LC50 = 720 mg/l; Daphnia magna: 48h-LC50 = 177 mg/l; Nitzschia linearis: 120 h-EC50 = 1337 mg/l. A chronic reproductive test with the invertebrate Daphnia magna gave a LOEC of 101 mg/l. All the studies compiled on the acute and chronic aquatic toxicity were > 100 mg/L. Thus it is concluded that KCl is not hazardous to freshwater organisms. Taking into considerations the background concentrations of KCl in seawater (380 mg/l K+ and 19,000 mg/l Cl-), it is concluded that there is no reason for further investigations of KCl on marine species. The low concern for the environment is supported by the absence of a bioaccumulation potential for the substance.

12.2 Persistence and degradability

Biodegradability does not pertain to inorganic substances.

12.3 Bioaccumulative potential

Does not bioaccumulate.

12.4 Mobility in soil

No impact if small amount is released to the soil.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Collect and place in sealable containers and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **SAPP**

Synonyms DISODIUM DIHYDROGEN PYROPHOSPHATE ● DISODIUM PYROPHOSPHATE

1.2 Uses and uses advised against

Uses ACIDIFIER ● BUFFERING AGENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
DISODIUM PYROPHOSPHATE	[redacted]	231-835-0	100%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once).

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases (phosphorus oxides) when heated to decomposition.

5.3 Advice for firefighters
Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Ventilate area where possible.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled and tightly closed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Nuisance dust	SWA [AUS]	--	10	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE POWDER
Odour	SLIGHT ODOUR
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	> 600°C
Evaporation rate	NOT AVAILABLE
pH	4 - 5 (10% Solution)
Vapour density	NOT AVAILABLE
Specific gravity	1.35 - 1.41
Solubility (water)	119 g/L
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve toxic gases (phosphorus oxides) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity Low toxicity. Ingestion of large quantities may result in nausea, vomiting and gastrointestinal irritation.

Ingestion of large quantities may also result in serious disturbances in calcium metabolism.

LD50 (Ingestion): 2650 mg/kg (mouse)
LD50 (Intraperitoneal): 1 g/kg (mouse)
LD50 (Intravenous): 59 mg/kg (mouse)
LD50 (Subcutaneous): 480 mg/kg (mouse)

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
DISODIUM PYROPHOSPHATE	2650 mg/kg (mouse)	> 2000 mg/kg (rat)	> 0.58 mg/L/4hrs (rat)

Additional ingredient toxicity values:

DISODIUM PYROPHOSPHATE (7758-16-9)
LD50 (intraperitoneal) 1 g/kg (mouse)
LD50 (intravenous) 59 mg/kg (mouse)
LD50 (subcutaneous) 480 mg/kg (mouse)

Skin Low to moderate irritant. Prolonged or repeated contact may result in irritation and rash.

Eye Low to moderate irritant. Contact may result in mild irritation, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Low irritant. Over exposure may result in irritation of the nose and throat, with coughing.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No information provided.

12.2 Persistence and degradability
Biodegradability does not pertain to inorganic substances.

12.3 Bioaccumulative potential
Does not bioaccumulate.

12.4 Mobility in soil
No information provided.

12.5 Other adverse effects
No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Dispose of to an approved landfill or waste processing site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

SAFETY DATA SHEET

AVAGLYCO LC

Issuing Date 16-Dec-2016 **Revision Date** 08-Nov-2021 **Version** 1.2

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product Code NDF00220

Product Name AVAGLYCO LC

Pure substance/mixture Substance

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use shale stabilizer

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids S.p.A.
Via Salaria 1313/C
00138 ROMA (Italy)
For further information, please contact

Contact Point Telephone: + 39 06 8856111
Fax: +39 06 8889363
Website: www.newpark.com

E-mail address hse-hqit@newpark.com

1.4. Emergency telephone number

Emergency Telephone - §45 - (EC)1272/2008	
Europe	**112**
Croatia	+385 1 7776 920 ; +385 01 2348 342 (Centar za kontrolu otrovanja, 24 sata)
France	+(33)-975181407
Germany	0800-181-7059; +(49)- 69643508409
Hungary	+(36)-18088425
Italy	800-789-767; +(39)-0245557031 Milano 24/24 Ospedale Niguarda Ca'grande Piazza ospedale maggiore 3 +39 0266101029 Roma 24/24 Policlinico Gemelli Largo Agostino Gemelli 8 +39 063054343
Netherlands	+(31)-858880596
Romania	(+40)-37-6300026
Spain	900-868538; +(34)-931768545

Switzerland	145, (+41) 435082011
United Kingdom	+(44)-870-8200418

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.2. Label elements

This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]
Hazard statements
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.3. Other hazards

No information available.

SECTION 3: Composition/information on ingredients

3.1 Substances

Full text of H- and EUH-phrases: see section 16

Acute Toxicity Estimate
No information available

This product does not contain candidate substances of very high concern at a concentration >=0.1% (Regulation (EC) No. 1907/2006 (REACH), Article 59)

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water. In the case of skin irritation or allergic reactions see a physician.

Ingestion Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Consult a physician if necessary.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media Water spray or fog. Carbon dioxide (CO2).

Large Fire CAUTION: Use of water spray when fighting fire may be inefficient.

Unsuitable extinguishing media Do not scatter spilled material with high pressure water streams.

5.2. Special hazards arising from the substance or mixture

Specific hazards arising from the chemical No information available.

Hazardous combustion products Carbon oxides.

5.3. Advice for firefighters

Special protective equipment and precautions for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation. Keep people away from and upwind of spill/leak.

For emergency responders Use personal protection recommended in Section 8.

6.2. Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Take up mechanically, placing in appropriate containers for disposal.

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

6.4. Reference to other sections

Reference to other sections See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Take off contaminated clothing and wash before reuse.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Identified uses
Risk Management Methods (RMM) The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits
This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Personal protective equipment

Eye/face protection No special protective equipment required.

Skin and body protection No special protective equipment required.

Respiratory protection No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	Liquid
Appearance	liquid
Color	clear
Odor	Slight.
Odor threshold	No information available

Property	**Values**	**Remarks • Method**
Melting point / freezing point		No information available
Boiling point / boiling range	> 100 °C	
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		
Lower flammability limit:		
Flash point	> 150 °C	
Autoignition temperature		No information available
Decomposition temperature		No information available
pH	5 - 7	

pH (as aqueous solution)		No information available
Kinematic viscosity		No information available
Dynamic viscosity		No information available
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Vapor pressure		No information available
Relative density	0.980-1.020	
Bulk density		
Liquid Density	0.980-1.020	
Vapor density		No information available
Particle characteristics		No information available
Particle Size		
Particle Size Distribution		

9.2. Other information

9.2.1. Information with regard to physical hazard classes
Not applicable

9.2.2. Other safety characteristics
No information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity No information available.

Remarks Not reactive under normal conditions.

10.2. Chemical stability

Stability Stable under normal conditions.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge None.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

10.4. Conditions to avoid

Conditions to avoid None known based on information supplied.

10.5. Incompatible materials

Incompatible materials None known based on information supplied.

10.6. Hazardous decomposition products

Hazardous Decomposition Products None known based on information supplied.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Information on likely routes of exposure

Product Information

Inhalation	Specific test data for the substance or mixture is not available.
Eye contact	Specific test data for the substance or mixture is not available.
Skin contact	Specific test data for the substance or mixture is not available.
Ingestion	Specific test data for the substance or mixture is not available.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Numerical measures of toxicity
No information available

Acute toxicity

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation	No information available.
Serious eye damage/eye irritation	No information available.
Respiratory or skin sensitization	No information available.
Germ cell mutagenicity	No information available.
Carcinogenicity	No information available.
Reproductive toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration hazard	No information available.

11.2. Information on other hazards

11.2.1. Endocrine disrupting properties

Endocrine disrupting properties No information available.

11.2.2. Other information

Other adverse effects No information available.

SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity Contains 100 % of components with unknown hazards to the aquatic environment.

12.2. Persistence and degradability

Persistence and degradability No information available.

12.3. Bioaccumulative potential

Bioaccumulation No information available.

12.4. Mobility in soil

Mobility in soil No information available.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment No information available.

12.6. Endocrine disrupting properties

Endocrine disrupting properties No information available.

12.7. Other adverse effects
No information available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Waste codes / waste designations according to EWC / AVV Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information

IATA

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user	
Special Provisions	None

IMDG

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable

14.6 Special precautions for user
Special Provisions None
14.7 Maritime transport in bulk according to IMO instruments No information available

RID
14.1 UN/ID no Not Regulated
14.2 Proper shipping name Not Regulated
14.3 Transport hazard class(es) Not regulated
14.4 Packing Group Not Regulated
14.5 Environmental hazard Not applicable
14.6 Special precautions for user
Special Provisions None

ADR
14.1 UN number or ID number Not regulated
14.2 Proper shipping name Not Regulated
14.3 Transport hazard class(es) Not regulated
14.4 Packing Group Not Regulated
14.5 Environmental hazard Not applicable
14.6 Special precautions for user
Special Provisions None

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Germany
Water hazard class (WGK) slightly hazardous to water (WGK 1)

Italy
-D. LGs. 81/2008 (single text on the protection of health and safety in the workplace) and subsequent amendments and Directive 2009/161/EU-assessment of chemical risk under title IX
-Legislative Decree 3 April 2006, no 152 (environmental standards)
-"Seveso III Directive" – Legislative Decree of 26 June 2015, n° 105 (Implementation of the Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances)

European Union
Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Authorizations and/or restrictions on use:
This product does not contain substances subject to authorization (Regulation (EC) No. 1907/2006 (REACH), Annex XIV) This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

Persistent Organic Pollutants
Not applicable

Ozone-depleting substances (ODS) regulation (EC) 1005/2009
Not applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical Safety Report No information available

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend
SVHC: Substances of Very High Concern for Authorization:

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine’s PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Issuing Date 16-Dec-2016

Revision Date 08-Nov-2021

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006
Disclaimer
According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, as amended by Regulation (EU) No. 2015/830. This document is provided as an information resource relating exclusively to the product or material described herein. The information contained herein may not be applicable to other products/ materials or processes and may not be valid when this product/material is used in combination with any other product/material or process. The information provided in this document is compiled by Newpark Drilling Fluids LLC or its representatives from various sources including manufacturers, suppliers and other third-party sources, and is based on the information available as of the indicated date of preparation. As the conditions under which this product could be used will vary and may not be within the control of Newpark Drilling Fluids LLC there is no guarantee that the precautions outlined above will be sufficient for all individuals or situations. The buyer assumes all responsibility for using and handling the product in accordance with federal, state, provincial, or local regulations. For the product/ material described in this document, NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE.

End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **SODA ASH**

Synonyms SODA ASH DENSE ● SODIUM CARBONATE

1.2 Uses and uses advised against

Uses DRILLING AID

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Serious Eye Damage / Eye Irritation: Category 1
Specific Target Organ Toxicity (Single Exposure): Category 3 (Respiratory Irritation)

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **DANGER**

Pictograms

Hazard statements

H318 Causes serious eye damage.
H335 May cause respiratory irritation.

Prevention statements

P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response statements

P304 + P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/physician.

Storage statements

P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Disposal statements

P501	Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SODIUM CARBONATE	[redacted]	207-838-8	>97%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities should be available.

4.2 Most important symptoms and effects, both acute and delayed

Irritating to the eyes and skin.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters

Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Ventilate area where possible.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Sodium Carbonate (total dust)	SWA [AUS]	--	10	--	--

Biological limits
No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	854°C
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE

9.1 Information on basic physical and chemical properties

Vapour density	NOT AVAILABLE
Specific gravity	2.533
Solubility (water)	170 g/L
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity May be harmful if swallowed.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
SODIUM CARBONATE	> 2000 mg/kg (rat) (NICNAS)	> 2000 mg/kg (rat) (NICNAS)	> 2000 mg/m³ (rat) (NICNAS)

Additional ingredient toxicity values:

SODIUM CARBONATE (497-19-8)

LD50 (intraperitoneal) 117 mg/kg (mouse)

LD50 (subcutaneous) 2210 mg/kg (mouse)

Skin Contact may result in irritation, redness, rash and dermatitis.

Eye Contact may result in irritation, lacrimation, pain, redness and possible permanent damage.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Over exposure may result in irritation of the nose and throat, with coughing. High level exposure may result in breathing difficulties.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure. Carbonate ions are neutralised under physiological conditions to form bicarbonate ions and/or carbon dioxide, which are major products of all human metabolic activities; therefore, systemic toxicity is not expected.

Aspiration Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Fishes, Lepomis macrochirus, LC50, 96 h, 300 mg/l. Crustaceans, Ceriodaphnia dubia, EC50, 48 h, 200 - 227 mg/l.

12.2 Persistence and degradability

Not applicable for inorganic substances. The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Not expected to bioaccumulate.

12.4 Mobility in soil

If sodium carbonate is emitted to soil it can escape to atmosphere as carbon dioxide, precipitate as a metal carbonate, form complexes or stay in solution.

12.5 Other adverse effects

WATER: If released to waterways, alkaline products may change the pH of the waterway. Fish will die if the pH reaches 10-11 (goldfish 10.9, bluegill 10.5). SOIL: May leach to groundwater with toxic effects on aquatic life as above. ATMOSPHERE: Not expected to reside in the atmosphere. Drops or particles released to atmosphere should be removed by gravity and/or be rained out.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Collect without generating dust. Place in clean, sealed containers and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **SODIUM SULPHITE**

Synonyms SODIUM SULFITE

1.2 Uses and uses advised against

Uses ANTIOXIDANT ● FOOD PRESERVATIVE ● LABORATORY REAGENT ● PAPER INDUSTRY ● PHOTOGRAPHIC DEVELOPER ● REDUCING AGENT ● WATER TREATMENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Acute Toxicity: Oral: Category 4
Serious Eye Damage / Eye Irritation: Category 1
Contact with acids liberates toxic gas.

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **DANGER**

Pictograms

Hazard statements

AUH031	Contact with acids liberates toxic gas.
H302	Harmful if swallowed.
H318	Causes serious eye damage.

Prevention statements

P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.

Response statements

P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTRE or doctor/physician.
P330	Rinse mouth.

Storage statements

None allocated.

Disposal statements

P501	Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SODIUM SULPHITE	[redacted]	231-821-4	>97%
SODIUM SULPHATE	[redacted]	231-820-9	<2.5%
SODIUM CARBONATE	[redacted]	207-838-8	<0.1%
WATER	[redacted]	231-791-2	<0.1%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). Urgent hospital treatment is likely to be needed. If swallowed, do not induce vomiting.
First aid facilities	Eye wash facilities and safety shower are recommended.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve sulphur oxides and sodium oxides when heated to decomposition.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Sodium Carbonate (total dust)	SWA [AUS]	--	10	--	--

Biological limits
No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator. At high dust levels, wear a Full-face Class P3 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE CRYSTALLINE SOLID
Odour	ODOURLESS
Flammability	NON FLAMMABLE

9.1 Information on basic physical and chemical properties

Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	9.0 to 10.5
Vapour density	NOT AVAILABLE
Relative density	2.6
Solubility (water)	SOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity
Contact with acids liberates toxic gas.

10.2 Chemical stability
Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions
Polymerization is not expected to occur.

10.4 Conditions to avoid
Avoid heat, sparks, open flames and other ignition sources. Avoid exposure to air and moisture. Sensitive to air and moisture.

10.5 Incompatible materials
Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid). Strong reducing agent.

10.6 Hazardous decomposition products
May evolve sulphur oxides and sodium oxides when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity Harmful if swallowed.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
SODIUM SULPHITE	820 mg/kg (mouse); 3560 mg/kg (rat)	> 2000 mg/kg (rat)	> 5500 mg/m3/4hrs (rat)
SODIUM SULPHATE	5989 mg/kg (mouse)	--	--
SODIUM CARBONATE	> 2000 mg/kg (rat) (AICIS)	> 2000 mg/kg (rat) (AICIS)	> 2000 mg/m³ (rat) (AICIS)

Additional ingredient toxicity values:

SODIUM SULPHITE (7757-83-7)

LD50 (intraperitoneal)	950 mg/kg (mouse)
LD50 (intravenous)	175 mg/kg (mouse)
LDLo (intravenous)	400 mg/kg (cat)
LDLo (oral)	2825 mg/kg (rabbit)
LDLo (subcutaneous)	600 mg/kg (rabbit)

SODIUM SULPHATE (7757-82-6)

LD50 (intravenous)	1220 mg/kg (rabbit)
LDLo (intravenous)	1220 mg/kg (mouse)
TDLo (oral)	14 g/kg (mouse - 8-12 days pregnant)
TDLo (subcutaneous)	806 mg/kg/26 weeks intermittently (mouse)

SODIUM CARBONATE (497-19-8)

LD50 (intraperitoneal)	117 mg/kg (mouse)
LD50 (subcutaneous)	2210 mg/kg (mouse)

Skin Contact may result in irritation, redness, rash and dermatitis.

Eye Contact may result in irritation, lacrimation, pain, redness and possible serious eye damage.

Sensitisation Some individuals are hypersensitive to sulphites and may experience adverse reactions following exposure. Individuals known to be hypersensitive or with existing respiratory problems (eg asthma) are advised to avoid exposure.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Over exposure may result in mucous membrane irritation of the respiratory tract, with coughing.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No information provided.

12.2 Persistence and degradability
Biodegradability does not pertain to inorganic substances.

12.3 Bioaccumulative potential
This product does not bioaccumulate.

12.4 Mobility in soil
No information provided.

12.5 Other adverse effects
Avoid contamination of drains and waterways.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Cover spill with soda ash or sodium bicarbonate. Mix and spray with water, may be effervescent. Wait until reaction is complete, scoop into a large beaker and cautiously add equal volume of sodium hypochlorite (reaction may be vigorous). Add more water, stir and allow to stand (~1hr). Dilute and neutralise. Absorb with sand/similar dispose of to an approved landfill site, or alternatively (for small amounts) flush to sewer with large excess of water.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

WORKPLACE CONTROLS AND PRACTICES: Unless a less toxic chemical can be substituted for a hazardous substance, ENGINEERING CONTROLS are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **TRIETHANOLAMINE**

Synonym(s) TEA

1.2 Uses and uses advised against

Use(s) CHEMICAL INTERMEDIATE ● LABORATORY REAGENT ● SOLVENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone number(s)

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

GHS classification(s)
Skin Corrosion/Irritation: Category 2
Serious Eye Damage / Eye Irritation: Category 1
Specific Target Organ Systemic Toxicity (Single Exposure): Category 3
Specific Target Organ Systemic Toxicity (Repeated Exposure): Category 2

2.2 Label elements

Signal word **DANGER**

Pictogram(s)

Hazard statement(s)

H315	Causes skin irritation.
H318	Causes serious eye damage.
H335	May cause respiratory irritation.
H373	May cause damage to organs through prolonged or repeated exposure.

Prevention statement(s)

P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P264	Wash thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

Response statement(s)

P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/physician.
P314	Get medical advice/attention if you feel unwell.
P321	Specific treatment is advised - see first aid instructions.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before re-use.

Storage statement(s)

P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Disposal statement(s)

P501	Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
TRIETHANOLAMINE	[redacted]	203-049-8	>60%
DIETHANOLAMINE	[redacted]	203-868-0	>=10 to <=30%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. To protect rescuer, use a Type A (Organic vapour) respirator or an Air-line respirator (in poorly ventilated areas). Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting. Rinse mouth out with water and give plenty of water to drink.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Over exposure may result in irritation to the eyes, nose and respiratory system. May cause allergic contact dermatitis.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains and waterways.

5.2 Special hazards arising from the substance or mixture

Combustible. May evolve toxic gases (carbon/ nitrogen oxides, amines, ammonia, hydrocarbons) when heated to decomposition.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Ventilate area where possible. Contact emergency services where appropriate.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Store as a Class C2 Combustible Liquid (AS1940).

7.3 Specific end use(s)

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Diethanolamine (h)	SWA (AUS)	3	13	--	--
Triethanolamine	SWA (AUS)	--	5	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.

PPE

Eye / Face Wear splash-proof goggles.

Hands Wear PVC or rubber gloves.

Body Wear coveralls.

Respiratory Where an inhalation risk exists, wear a Type A (Organic vapour) respirator. If spraying, wear a Type A-Class P1 (Organic gases/vapours and Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	CLEAR LIQUID
Odour	MILD AMMONIACAL ODOUR
Flammability	CLASS C2 COMBUSTIBLE
Flash point	190°C (cc)
Boiling point	335°C
Melting point	12°C
Evaporation rate	< 0.01 (n-Butyl acetate = 1)
pH	10.5 (1 % Solution)
Vapour density	4.80 (Air = 1)
Specific gravity	NOT AVAILABLE
Solubility (water)	SOLUBLE
Vapour pressure	< 1 kPa @ 20°C
Upper explosion limit	NOT AVAILABLE
Lower explosion limit	NOT AVAILABLE
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	450 mPa·s @ 25°C
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

9.2 Other information

Relative density	1.123

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Hazardous polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites), acids (e.g. nitric acid), nitrites, heat and ignition sources. Also incompatible with organic anhydrides, isocyanates, vinyl acetate, acrylates, substituted allyls, alkylene oxides, epichlorohydrin, aldehydes, copper, brass and aluminium.

10.6 Hazardous decomposition products

May evolve toxic gases (carbon/ nitrogen oxides, amines, ammonia, hydrocarbons) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity May be harmful if swallowed, in contact with skin, and/or if inhaled.

Information available for the ingredient(s):

Ingredient	Oral Toxicity (LD50)	Dermal Toxicity (LD50)	Inhalation Toxicity (LC50)
TRIETHANOLAMINE	2200 mg/kg (rabbit)	> 20 mL/kg (rabbit)	--
DIETHANOLAMINE	620 uL/kg (rat)	7640 uL/kg (rabbit)	--

Additional ingredient toxicity value(s):

TRIETHANOLAMINE (102-71-6)

LD50 (intraperitoneal)	1450 mg/kg (mouse)
TDLo (oral)	16 g/kg/64 weeks (mouse - cancer)

DIETHANOLAMINE (111-42-2)

LD50 (intramuscular)	1500 mg/kg (rat)
LD50 (intraperitoneal)	120 mg/kg (rat)
LD50 (intravenous)	778 mg/kg (rat)
LD50 (subcutaneous)	2200 mg/kg (rat)
LDLo (oral)	3 g/kg (rat)

Skin	Contact may result in irritation, redness and rash.
Eye	Contact may result in irritation, lacrimation, pain and redness.
Sensitisation	Triethanolamine has been reported to cause allergic contact dermatitis. It is not known to cause respiratory sensitisation.
Mutagenicity	Insufficient data available to classify as a mutagen.
Carcinogenicity	Triethanolamine and diethanolamine are not classifiable as to carcinogenicity to humans (IARC Group 3).
Reproductive	Insufficient data available to classify as a reproductive toxin.
STOT - single exposure	Over exposure may result in irritation of the nose and throat, with coughing. High level exposure may result in breathing difficulties.
STOT - repeated exposure	Diethanolamine may cause damage to organs (liver) through prolonged and repeated exposure.
Aspiration	Not expected to present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

In soil and water, triethanolamine will biodegrade fairly rapidly following acclamation (half-life in the order of days to weeks). In soil, residual triethanolamine may leach to groundwater. LC50 (shrimp): > 100 ppm.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal	Reduce with sodium thiosulphate/ bisulphite (not strong reducing agent), acidify with 3M sulphuric acid. Scoop into a container of water and neutralise with soda ash. Absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule Classified as a Schedule 5 (S5) Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

The classifications and phrases listed below are based on the Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008(2004)].

Hazard codes

Xi	Irritant
Xn	Harmful

Risk phrases

R37/38	Irritating to respiratory system and skin.
R41	Risk of serious damage to eyes.
R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed.

Safety phrases

S25	Avoid contact with eyes.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S39	Wear eye/face protection.

Inventory listing(s) **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **TOPSPOT**

Synonyms TOP SPOT

1.2 Uses and uses advised against

Uses SURFACTANT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SURFACTANT(S)	-	-	Not Available
NON HAZARDOUS INGREDIENTS	Not Available	Not Available	Remainder

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed
Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters
No fire or explosion hazard exists.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear splash-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls. In a laboratory situation, wear a laboratory coat.
Respiratory	Not required under normal conditions of use.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	DARK AMBER COLOURED TO BLACK LIQUID
Odour	MILD ODOUR
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Specific gravity	1.1 to 1.2
Solubility (water)	NOT AVAILABLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity	This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated.
Skin	Not classified as a skin irritant. Contact may result in mild irritation.
Eye	Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.
Sensitisation	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	No evidence of mutagenic effects.
Carcinogenicity	No evidence of carcinogenic effects.
Reproductive	No relevant or reliable studies were identified.
STOT - single exposure	Not classified as causing organ damage from single exposure.
STOT - repeated exposure	Not classified as causing organ damage from repeated exposure.
Aspiration	This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal	For small amounts, absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required). Ensure that appropriate personal protective equipment is used during disposal.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

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LD50	Lethal Dose, 50% / Median Lethal Dose
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OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
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[End of SDS]

PRODUCT BULLETIN

TopSpot™

SPOTTING ADDITIVE

NEWPARK DRILLING FLUIDS
www.newparkdf.com

PRODUCT DESCRIPTION

TopSpot™ spotting additive is an environmentally friendly blend of organic surfactants designed to free differentially stuck pipe when using water-based drilling fluids. The product works by thinning or cracking the filter cake and by adding lubricity to the borehole-pipe interface, thereby reducing the "pull-out" force. It is shipped as a concentrate and can be easily and rapidly blended with freshwater, seawater or brine.

BENEFITS

TopSpot spotting fluid is an environmentally safe solution for freeing differentially stuck pipe, reducing the time, costs and potential hazards.

APPLICATION

TopSpot spotting additive is used in water-based drilling fluids whenever stuck pipe is encountered. The spotting fluid prepared with this additive can be weighted when necessary to maintain an equivalent hydrostatic head in the borehole. The used spot may be circulated out and either diverted or allowed to mix with the existing system. If the volume of the spot is large enough to cause more than a 110% dilution of the existing system, the spot should be diverted. Incorporation of less than 10% can be easily treated with conventional products. This product is safe for offshore applications and passes ecotoxicological tests, with LC50 results of ≥1,000,000 ppm in Generic Mud #7.

TREATMENT RECOMMENDATION

TopSpot spotting fluids are prepared by mixing 20% by volume TopSpot concentrate in either freshwater, seawater or brine. The fluids can be weighted with appropriate additions of XC Polymer and barite as specified in the accompanying table.

MATERIAL NEEDED FOR 50 BBL OF WEIGHTED SPOTTING FLUID

Desired Weight (lb/gal)	10	12	15	18
Freshwater or Seawater (bbl)	38	35	30	26
TopSpot (drum)	7	7	6	5
NewZan™ D (lb)	115	105	90	75
Barite (sack)	42	97	184	267

TYPICAL PHYSICAL PROPERTIES

Appearance..... Amber to black, viscous liquid

Flash Point..... 220° F (104°C)

Specific Gravity.....1.1-1.2 at 77°F (25°C)

HANDLING AND STORAGE

Avoid contact with skin and eyes. Store in a well-ventilated area. Use appropriate hygiene, clothing and personal protective equipment suitable for work being done. Review the SDS thoroughly before using this product.

PACKAGING

TopSpot spotting additive is available in 55-gallon (208-liter) drums and bulk quantities.

SAFETY DATA SHEET

TrueScav™ HD

Issue Date 29-Aug-2018 **Revision Date** 29-Aug-2018 **Version** 1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name TrueScav™ HD

Product Code NDF00394

Other means of identification

Recommended use of the chemical and restrictions on use

Recommended Use oxygen scavenger

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Hazard statements
Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Other hazards
General Hazards
No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Non-hazardous ingredients	Proprietary	>99

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid generation of dust. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials Strong oxidizing agents

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid		
Appearance	Powder	**Odor**	No information available.
Color	White	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	5 - 8	
Melting point / freezing point	160 °C	
Boiling point / boiling range		No information available
Flash point		No information available
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.2-1.7	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		Not applicable
Dynamic viscosity		Not applicable

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity Stable under normal conditions.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials Strong oxidizing agents.

Hazardous Decomposition Products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral) 5,005.00 mg/kg

Unknown acute toxicity 100 % of the mixture consists of ingredient(s) of unknown toxicity

0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
100 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation None known.

Serious eye damage/eye irritation None known.

Respiratory or skin sensitization None known.

Germ cell mutagenicity None known.

Carcinogenicity None known.

Reproductive toxicity None known.

STOT - single exposure None known.

STOT - repeated exposure None known.

Aspiration hazard Not applicable.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity 100 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation No information available.

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not Regulated

IATA Not Regulated

IMDG Not Regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 29-Aug-2018

Revision Date 29-Aug-2018

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

SAFETY DATA SHEET

AVADEFOAM NS

Issue Date 18-Apr-2017 **Revision Date** 28-Mar-2019 **Version** 1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

1

Product identifier

Product Name AVADEFOAM NS

Product Code NDF00251

Other means of identification

Pure substance/mixture Mixture

Recommended use of the chemical and restrictions on use

Recommended Use Defoamer

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Hazard statements
Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Other hazards

General Hazards

No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Chemical name	CAS No	Weight-%
Non-hazardous ingredients	Proprietary	

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Water. Carbon dioxide (CO2).

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials None known

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Liquid		
Appearance	liquid	**Odor**	Slight.
Color	clear	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH		No data available
Melting point / freezing point		No data available
Boiling point / boiling range		No data available
Flash point	> 100 °C	
Evaporation rate		No data available
Flammability (solid, gas)		Not applicable
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	0.95-0.97	
Water solubility	Insoluble in water	
Solubility(ies)		No data available
Partition coefficient		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity		No data available

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	0.95-0.97 g/cm3
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials None known.

Hazardous Decomposition Products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document
ATEmix (oral) 10,010.00 mg/kg

Unknown acute toxicity 100 % of the mixture consists of ingredient(s) of unknown toxicity
95 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
100 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity 95 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation No information available.

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not regulated

IATA Not regulated

IMDG Not regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Complies
PICCS	Does not comply
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

Ozone-depleting substances (ODS) Not applicable

Persistent Organic Pollutants Not applicable

Export Notification requirements Not applicable

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 18-Apr-2017

Revision Date 28-Mar-2019

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

SAFETY DATA SHEET

AVAPOLYMER 5050

Issue Date 12-Apr-2017 **Revision Date** 02-Aug-2017 **Version** 1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name AVAPOLYMER 5050

Product Code NDF00252

Other means of identification

Pure substance/mixture Mixture

Recommended use of the chemical and restrictions on use

Recommended Use shale stabilizer

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number 1800 127 406 (Australia); +64 4 917 9888 (International)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Hazard statements
Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Other hazards

May be harmful in contact with skin

General Hazards

No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Additional information

The product contains no substances which at their given concentration, are considered to be hazardous to health

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number	Poisons Information Center, Australia: 13 11 26 Poisons Information Center, New Zealand: 0800 764 766
Inhalation	Remove to fresh air.
Eye contact	Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.
Skin contact	Wash skin with soap and water.
Ingestion	Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms	No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media

Water spray (fog). Carbon dioxide (CO2).

Unsuitable extinguishing media	No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products	Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters	Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid generation of dust. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials None known

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid		
Appearance	powder	**Odor**	Slight.
Color	No information available	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	8.0 - 11.0	20 g/L solution
Melting point / freezing point		No data available
Boiling point / boiling range		No data available
Flash point		Not applicable
Evaporation rate		No data available
Flammability (solid, gas)		No data available
Flammability Limit in Air		No data available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density		No data available
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		Not applicable
Dynamic viscosity		Not applicable

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity Stable.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials None known.

Hazardous Decomposition Products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral) 27,000.00 mg/kg
ATEmix (dermal) 2,002.00 mg/kg

Unknown acute toxicity 100 % of the mixture consists of ingredient(s) of unknown toxicity
40 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
40 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration hazard	No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity	The environmental impact of this product has not been fully investigated.
Unknown aquatic toxicity	100 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability	No information available.

Bioaccumulative potential

Bioaccumulation	No information available.

Mobility

Mobility in soil	No information available.
Mobility	No information available.

Other adverse effects

Other adverse effects	No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products	Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.
Contaminated packaging	Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG	Not regulated
IATA	Not regulated
IMDG	Not regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
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ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

Ozone-depleting substances (ODS) Not applicable

Persistent Organic Pollutants Not applicable

Export Notification requirements Not applicable

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 12-Apr-2017

Revision Date 02-Aug-2017

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **BARITE POWDER**

Synonyms BARITE (API 13A SECTION 7) ● NEWBAR ● RHEOBAR

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE ● WEIGHTING AGENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

This product contains a small quantity of quartz, crystalline silica. Prolonged and repeated exposure to concentrations of crystalline silica exceeding the workplace exposure limit (WEL) may lead to chronic lung disease such as silicosis. IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC Classification Group I.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
BARIUM SULPHATE	[redacted]	231-784-4	>89%
QUARTZ (CRYSTALLINE SILICA)	[redacted]	238-878-4	<3%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once).

First aid facilities Eye wash facilities should be available.

4.2 Most important symptoms and effects, both acute and delayed

Repeated exposure to crystalline silica may result in lung fibrosis (silicosis). Principal symptoms of silicosis are coughing and breathlessness. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve toxic gases (sulphur oxides) when heated to decomposition.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Barium sulphate	SWA [AUS]	--	10	--	--
Barium sulphate (inhalable)	SWA [Proposed]	--	4	--	--
Barium sulphate (respirable)	SWA [Proposed]	--	1.35	--	--
Quartz (respirable dust)	SWA [AUS]	--	0.1	--	--
Quartz (respirable dust)	SWA [Proposed]	--	0.05	--	--
Quartz (respirable dust)	WorkSafe VIC	--	0.05	--	--

Biological limits No Biological Limit Value allocated.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE

Eye / Face Wear dust-proof goggles.

Hands Wear PVC or rubber gloves.

Body When using large quantities or where heavy contamination is likely, wear coveralls.

Respiratory Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	OFF-WHITE POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT RELEVANT
Melting point	> 1300°C
Evaporation rate	NOT RELEVANT
pH	8.2 (20% Slurry)
Vapour density	NOT RELEVANT
Specific gravity	4.20
Solubility (water)	INSOLUBLE
Vapour pressure	NOT RELEVANT
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT RELEVANT
Autoignition temperature	NOT RELEVANT
Decomposition temperature	NOT RELEVANT
Viscosity	NOT RELEVANT
Explosive properties	NOT EXPLOSIVE
Oxidising properties	NON OXIDISING
Odour threshold	NOT RELEVANT

9.2 Other information

Bulk density	~1.5 kg/L

10. STABILITY AND REACTIVITY

10.1 Reactivity
Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability
Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions
Polymerization is not expected to occur.

10.4 Conditions to avoid
Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials
Incompatible with oxidising agents (e.g. hypochlorites), acids (e.g. nitric acid), alkalis (e.g. sodium hydroxide), heat and ignition sources.

10.6 Hazardous decomposition products
May evolve toxic gases (sulphur oxides) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity Based on available data, the classification criteria are not met.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
BARIUM SULPHATE	> 5000 mg/kg (rat)	> 2000 mg/kg (rat)	--

Skin Contact may result in irritation, redness, pain and rash.

Eye Contact may result in irritation, lacrimation, pain, redness and blurring or dimness of vision.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Crystalline silica is classified as carcinogenic to humans (IARC Group 1). However, there is a body of evidence supporting the fact that increased cancer risk would be limited to people already suffering from silicosis.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Over exposure may result in irritation of the nose and throat, coughing, dizziness, drowsiness and headache.

STOT - repeated exposure Repeated exposure to respirable silica may result in pulmonary fibrosis (silicosis). Silicosis is a fibronodular lung disease caused by deposition in the lungs of fine respirable particles of crystalline silica. Principal symptoms of silicosis are coughing and breathlessness.

Aspiration Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
Fish Toxicity: LC50 (Rainbow trout) > 7500 ppm/96hrs; LC50 (Fresh Water Trout) > 21,000 ppm/96hrs; LC50 (Salt Water Stickel Back) > 56,000 ppm/96hrs.

12.2 Persistence and degradability
Barium sulphate (major ingredient of barite (60-100%)) is insoluble in water and not biodegradable.

12.3 Bioaccumulative potential
Not expected to bioaccumulate.

12.4 Mobility in soil
No information provided.

12.5 Other adverse effects
This product is not anticipated to cause adverse effects to animal or plant life if released to the environment in small quantities.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Dispose of to an approved landfill or waste processing site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **CALCIUM CHLORIDE POWDER 94-97%**

Synonyms CALCIUM CHLORIDE ANHYDRATE

1.2 Uses and uses advised against

Uses CONCRETE CONDITIONER ● DESICCANT ● DUST CONTROL AGENT ● FOOD ADDITIVE ● INDUSTRIAL APPLICATIONS

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Serious Eye Damage / Eye Irritation: Category 2A

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **WARNING**

Pictograms

Hazard statements

H319 Causes serious eye irritation.

Prevention statements

P264 Wash thoroughly after handling.

P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response statements

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337 + P313 If eye irritation persists: Get medical advice/attention.

Storage statements
None allocated.

Disposal statements
None allocated.

2.3 Other hazards
No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
CALCIUM CHLORIDE ANHYDROUS	[redacted]	233-140-8	94 to 97%
SODIUM CHLORIDE	[redacted]	231-598-3	1 to 5%
WATER	[redacted]	231-791-2	1%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed
Irritating to the eyes and skin.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases (chlorides) when heated to decomposition.

5.3 Advice for firefighters
Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits No Biological Limit Value allocated.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	> 1600°C
Melting point	772°C
Evaporation rate	NOT RELEVANT
pH	7.0 to 9.0
Vapour density	NOT AVAILABLE
Specific gravity	2.15
Solubility (water)	590 kg/m³ (Approximately)
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT

9.1 Information on basic physical and chemical properties

Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid contact with incompatible substances.

10.5 Incompatible materials

Incompatible with acids (e.g. nitric acid), methyl vinyl ether, zinc/ galvanised metals, bromine trifluoride, boron oxide and calcium oxide. May react exothermically with water (i.e. releasing heat).

10.6 Hazardous decomposition products

May evolve toxic gases (chlorides) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Based on available data, the classification criteria are not met. Toxicity Data available for the ingredients:
CALCIUM CHLORIDE ANHYDROUS (10043-52-4):
LD50 (Ingestion): 1000 mg/kg (rat)
LD50 (Intraperitoneal): 210 mg/kg (mouse)
LD50 (Intravenous): 42 mg/kg (mouse)
LD50 (Subcutaneous): 823 mg/kg (mouse)
LDLo (Ingestion): 1384 mg/kg (rabbit)
LDLo (Intravenous): 150 mg/kg (guinea pig)
LDLo (Subcutaneous): 249 mg/kg (cat)
TDLo (Intravenous): 20 mg/kg/1 hour (woman)
SODIUM CHLORIDE (7647-14-5):
LC50 (Inhalation): > 42000 mg/m3/1 hour (rat)
LD50 (Ingestion): 3000 mg/kg (rat)
LD50 (Intraperitoneal): 2602 mg/kg (mouse)
LD50 (Intravenous): 645 mg/kg (mouse)
LD50 (Skin): > 10000 mg/kg (rabbit)
LD50 (Subcutaneous): 3000 mg/kg (mouse)
LDLo (Ingestion): 8000 mg/kg (rabbit)
LDLo (Intravenous): 300 mg/kg (guinea pig)
LDLo (Subcutaneous): 2160 mg/kg (guinea pig)
TDLo (Ingestion): 12357 mg/kg (human)

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
CALCIUM CHLORIDE ANHYDROUS	2301 mg/kg (rat)	> 5000 mg/kg (rabbit)	--
SODIUM CHLORIDE	3000 mg/kg (rat)	> 10000 mg/kg (rabbit)	> 42000 mg/m³/1 hour (rat)

Additional ingredient toxicity values:

SODIUM CHLORIDE (7647-14-5)

LD50 (intraperitoneal)	2602 mg/kg (mouse)
LD50 (intravenous)	645 mg/kg (mouse)
LD50 (subcutaneous)	3000 mg/kg (mouse)
LDLo (intravenous)	300 mg/kg (guinea pig)
LDLo (oral)	8000 mg/kg (rabbit)
LDLo (subcutaneous)	2160 mg/kg (guinea pig)
TDLo (oral)	12357 mg/kg (human)

Skin	Not classified as a skin irritant. Contact may result in mechanical irritation, redness and rash.
Eye	Causes serious eye irritation. Contact may result in irritation, lacrimation, pain and redness.
Sensitisation	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	Insufficient data available to classify as a mutagen.
Carcinogenicity	Insufficient data available to classify as a carcinogen.
Reproductive	Insufficient data available to classify as a reproductive toxin.
STOT - single exposure	Not classified as causing organ damage from single exposure.
STOT - repeated exposure	Not classified as causing organ damage from repeated exposure.
Aspiration	This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

Biodegradability does not pertain to inorganic substances.

12.3 Bioaccumulative potential

This product does not bioaccumulate.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal	Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
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HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **CAUSTIC SODA**

Synonyms SODIUM HYDROXIDE SOLID

1.2 Uses and uses advised against

Uses MANUFACTURE OF CHEMICALS ● REAGENT ● SCRUBBING AGENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Skin Corrosion/Irritation: Category 1A

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **DANGER**

Pictograms

Hazard statements

H314 Causes severe skin burns and eye damage.

Prevention statements

P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P264 Wash thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response statements

P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/physician.
P321	Specific treatment is advised - see first aid instructions.
P363	Wash contaminated clothing before reuse.

Storage statements

P405	Store locked up.

Disposal statements

P501	Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SODIUM HYDROXIDE	[redacted]	215-185-5	>99%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. To protect rescuer, use an Air-line respirator where an inhalation risk exists. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Causes severe skin burns and eye damage.

4.3 Immediate medical attention and special treatment needed

CORROSIVE POISONING TREATMENT: Immediate treatment preferably in a hospital is mandatory. In treating corrosive poisoning, DO NOT INDUCE VOMITING; DO NOT ATTEMPT GASTRIC LAVAGE; and DO NOT ATTEMPT TO NEUTRALISE THE CORROSIVE SUBSTANCE. Vomiting will increase the severity of damage to the oesophagus as the corrosive substance will again come in contact with it. Attempting gastric lavage may result in perforating either the oesophagus or stomach. Immediately dilute the corrosive substance by having the patient drink milk or water. If the trachea has been damaged tracheostamy may be required. For oesophageal burns begin broad-spectrum antibiotics and corticosteroid therapy. Intravenous fluids will be required if oesophageal or gastric damage prevents ingestion of liquids. Long-range therapy will be directed toward preventing or treating oesophageal scars and strictures.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire. Use carbon dioxide or suitable dry chemical extinguisher. Do NOT use water.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve flammable hydrogen gas in contact with some metals. Direct contact with water can produce a violent exothermic reaction.

5.3 Advice for firefighters

Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

2X

2 Fine Water Spray.

X Wear liquid-tight chemical protective clothing and breathing apparatus. Contain spill and run-off.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Allow only trained personnel wearing appropriate protective equipment to be involved in spill response. Avoid accidents, clean up immediately. Increase ventilation. Avoid walking through spilled product as it is slippery when spilt. Isolate the danger area. Use clean, non-sparking tools and equipment. Shut off all possible sources of ignition.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Mechanically collect as much of the spill as possible. Absorb with sand, earth or clay. Transfer to suitable, labelled, corrosion-resistant containers and dispose of promptly as hazardous waste. Spill on areas other than pavement, dirt or sand may be handled by removing the affected soils and placing into approved containers.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Ensure an eye bath and safety shower are available and ready for use. Observe good personal hygiene practices and recommended procedures. Wash thoroughly after handling. Take precautionary measures against static discharges by bonding and grounding equipment. Avoid contact with eyes, skin and clothing. Do not inhale product vapours. Avoid prolonged or repeated exposure. Do not smoke, eat or drink when handling product. Product can react violently with water and acids. Caustic solution generates heat when further diluted with water. Concentrations greater than 40%, the heat generated can raise temperatures above the boiling point resulting in sporadic, violent eruptions or spattering. Emergency showers and eye-washes must be available. When used in its various applications, the product must be prevented from coming into uncontrolled direct contact with other products such as acids and metals. Never neutralise the solid product.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well-ventilated area. Keep containers tightly closed when not in use. Inspect regularly for deficiencies such as damage or leaks. Protect against physical damage. Store away from incompatible materials as listed in section 10. Store away from aluminium, tin, zinc and alloys (bronzes), chrome and lead. Protect from damp and kept apart from acids, halogenated hydrocarbons, nitroparaffins, etc. The floor must be waterproof and anti-slip. A water supply or source must be provided in the place of storage. Emergency showers and eye-washes must be available. Special conditions: Prevent the product from becoming damp or erated. Hygroscopic product. Becomes carbonated in contact with the air or moisture.

7.3 Specific end uses

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Sodium hydroxide (peak limitation)	SWA [AUS]	--	2 (Peak)	--	--

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear a faceshield and dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Wear coveralls and rubber boots and a PVC apron.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator. At high dust levels, wear an Air-line respirator or a Full-face Class P3 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE DELIQUESCENT PEARLS
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	1390°C
Melting point	318°C
Evaporation rate	NOT AVAILABLE
pH	13.5 (1 % solution)
Vapour density	NOT AVAILABLE
Specific gravity	2.12
Solubility (water)	1110 kg/m³ @ 20°C
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Highly exothermal reaction with strong acids. Reacts dangerously with acetic acid, allyl chloride, chlorine trifluoride, chloroform, methylic alcohol, chloronitrotoluene, chlorosulphonic acid, glyoxal, cyanohydrin, hydrochloric acid, hydrofluoric acid, hydroquinone, nitric acid, sulphuric acid and oleum, nitropropane, phosphorous, propiolactone, phosphorous pentoxide, tetrachlorobenzene, tetrahydrofuran, etc. Caustic soda forms salts with nitromethane and nitroparaffins that explode on impact. Heat is generated when mixed with water. Spattering and boiling can occur. Caustic soda solution reacts readily with various reducing sugars (ie: fructose, glactose, maltose, dry whey solids) to produce carbon monoxide. Caustic soda forms salts with nitromethane and nitroparaffins that explode on impact. Reacts with aluminium, tin, zinc and their alloys, copper, lead, etc. giving off hydrogen.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites), acids (e.g. nitric acid), metals, heat and ignition sources.

10.6 Hazardous decomposition products

Reacts with aluminium, tin, zinc and their alloys, copper, lead, etc. giving off hydrogen. When the product decomposes, toxic sodium oxide gases are evolved.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Highly corrosive. This product has the potential to cause serious adverse health effects. Use safe work practices to avoid eye or skin contact and inhalation. Over exposure may result in severe burns with corrosive tissue damage. Upon dilution, the potential for corrosive effects may be reduced.

SODIUM HYDROXIDE (1310-73-2):
LD50 (Intraperitoneal): 40 mg/kg (mouse)
LDLo (Ingestion): 1.57 mg/kg (human)

Additional ingredient toxicity values:

SODIUM HYDROXIDE (1310-73-2)

LD50 (intraperitoneal)	40 mg/kg (mouse)
LDLo (oral)	500 mg/kg (rabbit)

Skin

Causes severe burns. Contact may result in irritation, redness, pain, rash, dermatitis and skin burns.

Eye

Causes severe burns. Contact may result in irritation, lacrimation, pain, redness and corneal burns with possible permanent eye damage.

Sensitisation

Not classified as causing skin or respiratory sensitisation.

Mutagenicity

Insufficient data available to classify as a mutagen. Both the in vitro and the in vivo genetic toxicity tests indicated no evidence of mutagenic activity. Furthermore the substance is not expected to be systemically available in the body under normal handling and use conditions and for this reason additional testing is considered unnecessary (EU RAR, 2007).

Carcinogenicity

Not classified as a carcinogen. Insufficient data available to classify as a carcinogen. Systemic carcinogenicity is not expected to occur because the substance is not expected to be systemically available in the body under normal handling and use conditions.

Reproductive

Not classified as a reproductive toxin. Insufficient data available to classify as a reproductive toxin. The substance is not expected to be systemically available in the body under normal handling and use conditions and for this reason it can be stated that the substance will not reach the foetus nor reach male and female reproductive organs. The substance is not expected to be systemically available in the body under normal handling and use conditions and for this reason additional testing is considered unnecessary.

STOT - single exposure

Over exposure may result in irritation of the nose and throat, with coughing. High level exposure may result in breathing difficulties.

STOT - repeated exposure

Not classified as causing organ damage from repeated exposure.

Aspiration

This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

EC50 Ceriodaphnia: 40 mg/L.

No other valid studies available. The hazard of NaOH for the environment is caused by the hydroxyl ion (pH effect). For this reason the effect of NaOH on the organisms depends on the buffer capacity of the aquatic or terrestrial ecosystem (see also 3.1.2). Also the variation in acute toxicity for aquatic organisms can be explained for a significant extent by the variation in buffer capacity of the test medium. LC50 values ranged between 33 and 189 mg/L.

12.2 Persistence and degradability

Readily biodegradable. NaOH is a strong alkaline substance that dissociates completely in water to Na+ and OH-. High water solubility and low vapour pressure indicate that NaOH will be found predominantly in aquatic environment. This implies that it will not adsorb on particulate matter or surfaces. Atmospheric emissions as aerosols are rapidly neutralized by carbon dioxide and the salts will be washed out by rain.

12.3 Bioaccumulative potential

Does not bioaccumulate. Considering its high water solubility, NaOH is not expected to bioconcentrate in organisms. In addition, sodium is a naturally-occurring element that is prevalent in the environment and to which organisms are exposed regularly, for which they have some capacity to regulate the concentration in the organism.

12.4 Mobility in soil

High water solubility and mobility

12.5 Other adverse effects

WATER: If released to waterways, alkaline products may change the pH of the waterway. Fish will die if the pH reaches 10-11 (goldfish 10.9, bluegill 10.5). SOIL: May leach to groundwater with toxic effects on aquatic life as above. ATMOSPHERE: Not expected to reside in the atmosphere. Drops or particles released to atmosphere should be removed by gravity and/or be rained out.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Collect without generating dust. Place in clean, sealed containers and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required). The product can be neutralised using highly diluted hydrochloric acid, which should be added very slowly by specialised personnel wearing proper protection. Never neutralise the solid product.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	1823	1823	1823
14.2 Proper Shipping Name	SODIUM HYDROXIDE, SOLID	SODIUM HYDROXIDE, SOLID	SODIUM HYDROXIDE, SOLID
14.3 Transport hazard class	8	8	8
14.4 Packing Group	II	II	II

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code 2X

GTEPG 8A1

EmS F-A, S-B

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule Classified as a Schedule 6 (S6) Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **CIRCAL**

Synonyms CALCIUM CARBONATE ● LIMESTONE ● MARBLE ● OMYACARB ● RHEOCARB

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE ● WEIGHTING AGENT

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
CALCIUM CARBONATE	[redacted]	207-439-9	>96%
QUARTZ (CRYSTALLINE SILICA)	[redacted]	238-878-4	<1%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed
May cause irritation to the eyes, skin and respiratory system.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters
No fire or explosion hazard exists.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
If spilt, collect and reuse where possible. If reuse is not possible, contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Calcium carbonate (Limestone, Marble, Whiting)	SWA [AUS]	--	10	--	--
Quartz (respirable dust)	SWA [AUS]	--	0.1	--	--

Biological limits No Biological Limit Value allocated.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	When using large quantities or where heavy contamination is likely, wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	OFF-WHITE POWDER
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	825°C
Evaporation rate	NOT AVAILABLE
pH	9
Vapour density	NOT AVAILABLE
Specific gravity	2.7
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	840°C
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Calcium carbonate reacts with acids and acidic salts to generate gaseous carbon dioxide with effervescence (bubbling). The reaction with concentrated solutions of acids is rapid and exothermic. The effervesence can create extensive foaming. Ignites on contact with fluorine.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization will not occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with acids (e.g. nitric acid), fluorine, aluminium (hot) and ammonium salts. Incompatible with oxidising agents (e.g. hypochlorites).

10.6 Hazardous decomposition products

May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity This product is expected to be of low toxicity. Based on available data, the classification criteria are not met. LD50 (Ingestion) = 6450 mg/kg (rat).

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
CALCIUM CARBONATE	> 2000 mg/kg (rat)	> 2000 mg/kg (rat)	> 3.0 mg/L

Skin Not classified as a skin irritant. Contact may result in mild irritation, redness, pain and rash.

Eye Contact may result in irritation, lacrimation, pain and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Not classified as causing organ damage from single exposure. However, over exposure may result in irritation of the nose and throat, with coughing. High level exposure may result in breathing difficulties.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure. Chronic exposure to respirable silica may result in pulmonary fibrosis (silicosis). However, given the low levels present, over exposure is not anticipated.

Aspiration Not relevant.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Calcium carbonate occurs naturally in a wide variety of substances including limestone, marble and egg shells. It is not anticipated to cause adverse environmental effects.

12.2 Persistence and degradability

Dissolved calcium carbonate dissociates into calcium and carbonate ions. Calcium ions will be assimilated by living organisms in the water and the carbonate will become part of the carbon cycle.

12.3 Bioaccumulative potential

This product does not bioaccumulate.

12.4 Mobility in soil

Due to its limited solubility, calcium carbonate precipitates and deposits on the sediment.

12.5 Other adverse effects

Avoid contamination of drains and waterways.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

EXPOSURE CONTROL: If utilised in a closed system the potential for over exposure is reduced. If not used in a closed system, local exhaust ventilation is recommended to control exposure. Provide eye wash and safety shower in close proximity to points of potential exposure. Where the potential for an inhalation risk exists, an approved respirator may be required. Do not eat, store, consume food, tobacco or drink in areas where product is used.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **CITRIC ACID**

Synonyms 2-HYDROXY-1,2,3-PROPANETRICARBOXYLIC ACID ● CITRIC ACID ANHYDROUS ● CITRIC ACID MONOHYDRATE

1.2 Uses and uses advised against

Uses INDUSTRIAL APPLICATIONS

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Skin Corrosion/Irritation: Category 2
Serious Eye Damage / Eye Irritation: Category 2A
Specific Target Organ Toxicity (Single Exposure): Category 3 (Respiratory Irritation)

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **WARNING**

Pictograms

Hazard statements

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

Prevention statements

P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P264	Wash thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

Response statements

P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P321	Specific treatment is advised - see first aid instructions.
P362	Take off contaminated clothing and wash before re-use.

Storage statements

P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Disposal statements

P501	Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
CITRIC ACID	[redacted]	201-069-1	>99%
WATER	[redacted]	231-791-2	<1%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Irritating to the eyes, skin and respiratory system.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains or waterways.

5.2 Special hazards arising from the substance or mixture

Combustible. May evolve carbon oxides and hydrocarbons when heated to decomposition.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Ventilate area where possible.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from moisture, incompatible substances and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits No Biological Limit Value allocated.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	At high dust levels, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE CRYSTALLINE POWDER
Odour	ODOURLESS
Flammability	COMBUSTIBLE
Flash point	174°C
Boiling point	175°C (Decomposes)
Melting point	153°C

9.1 Information on basic physical and chemical properties

Evaporation rate	NOT AVAILABLE
pH	2.2 (0.1M Solution)
Vapour density	NOT AVAILABLE
Specific gravity	1.665
Solubility (water)	1330 kg/m³ @ 20°C
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT AVAILABLE
Lower explosion limit	NOT AVAILABLE
Partition coefficient	NOT AVAILABLE
Autoignition temperature	345°C
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and alkalis (e.g. sodium hydroxide).

10.6 Hazardous decomposition products

May evolve carbon oxides and hydrocarbons when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Based on available data, the classification criteria are not met.
LD50 (Ingestion): 3000 mg/kg (rat)
LD50 (Intraperitoneal): 290 mg/kg (rat)
LD50 (Intravenous): 42 mg/kg (mouse)
LDLo (Ingestion): 7000 mg/kg (rabbit)

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
CITRIC ACID	3000 mg/kg (rat)	> 2000 mg/kg (rat)	--

Additional ingredient toxicity values:

CITRIC ACID (77-92-9)

LD50 (intraperitoneal)	290 mg/kg (rat)
LD50 (intravenous)	42 mg/kg (mouse)
LDLo (oral)	7000 mg/kg (rabbit)

Skin Irritating to the skin. Contact may result in irritation, redness, rash and dermatitis.

Eye Irritating to the eyes. Contact may result in irritation, lacrimation, pain and redness. May result in burns with prolonged contact.

Sensitisation Not classified as causing skin or respiratory sensitisation. However, citric acid has the potential to cause allergic effects.

Mutagenicity Insufficient data available to classify as a mutagen.

Carcinogenicity	Insufficient data available to classify as a carcinogen.
Reproductive	Insufficient data available to classify as a reproductive toxin.
STOT - single exposure	Irritating to the respiratory system. Over exposure may result in irritation of the nose and throat, with coughing.
STOT - repeated exposure	Not classified as causing organ damage from repeated exposure.
Aspiration	This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

LC50 (Leuciscus idus melanotus): 440 mg/L/48hrs.
LC50 (Daphnia magna (Water flea)): 1.535 mg/L/24hrs.

12.2 Persistence and degradability

This product is readily biodegradable.

12.3 Bioaccumulative potential

This product does not bioaccumulate.

12.4 Mobility in soil

Citric acid is expected to have very high mobility in soil (HSDB).

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal	Neutralise with lime, anion exchanger or similar. For small amounts, absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule	A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).
Classifications	Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

SAFETY DATA SHEET

CleanTrol™ HD

A safety data sheet is not required for this product under Article 31 of REACH

Issuing Date 12-Jun-2019 **Revision Date** 12-Nov-2021 **Version** 1.1

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product Code NDF00549

Product Name CleanTrol™ HD

EC No 232-679-6

CAS No [redacted]

Chemical Name Starch

Pure substance/mixture Substance

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid loss control additive

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids S.p.A.
Via Salaria 1313/C
00138 ROMA (Italy)
For further information, please contact

Contact Point
Telephone: + 39 06 8856111
Fax: +39 06 8889363
Website: www.newpark.com

E-mail address hse-hqit@newpark.com

1.4. Emergency telephone number

Emergency Telephone - §45 - (EC)1272/2008	
Europe	**112**
Croatia	+385 1 7776 920 ; +385 01 2348 342 (Centar za kontrolu otrovanja, 24 sata)
France	+(33)-975181407
Germany	0800-181-7059; +(49)- 69643508409
Hungary	+(36)-18088425
Italy	800-789-767; +(39)-0245557031 Milano 24/24 Ospedale Niguarda Ca'grande Piazza ospedale maggiore 3 +39 0266101029

	Roma 24/24 Policlinico Gemelli Largo Agostino Gemelli 8 +39 063054343
Netherlands	+(31)-858880596
Romania	(+40)-37-6300026
Spain	900-868538; +(34)-931768545
Switzerland	145, (+41) 435082011
United Kingdom	+(44)-870-8200418

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.2. Label elements

This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]
Hazard statements
This substance is classified as not hazardous according to regulation (EC) 1272/2008 [CLP]

2.3. Other hazards

No information available.

SECTION 3: Composition/information on ingredients

3.1 Substances

Chemical name	Weight-%	REACH registration number	EC No	Classification according to Regulation (EC) No. 1272/2008 [CLP]	Specific concentration limit (SCL)	M-Factor	M-Factor (long-term)
Starch 9005-25-8	>95	No data available	232-679-6	No data available	-	-	-

Full text of H- and EUH-phrases: see section 16

Acute Toxicity Estimate
No information available

This product does not contain candidate substances of very high concern at a concentration >=0.1% (Regulation (EC) No. 1907/2006 (REACH), Article 59)

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water. In the case of skin irritation or allergic reactions see a physician.

Ingestion Clean mouth with water and drink afterwards plenty of water.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Large Fire CAUTION: Use of water spray when fighting fire may be inefficient.

Unsuitable extinguishing media Do not scatter spilled material with high pressure water streams.

5.2. Special hazards arising from the substance or mixture

Specific hazards arising from the chemical No information available.

Hazardous combustion products Carbon oxides.

5.3. Advice for firefighters

Special protective equipment and precautions for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

6.2. Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Take up mechanically, placing in appropriate containers for disposal.

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

6.4. Reference to other sections

Reference to other sections See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling Ensure adequate ventilation.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Identified uses
Risk Management Methods (RMM) The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Chemical name	European Union	Austria	Belgium	Bulgaria	Croatia
Starch 9005-25-8	-	-	TWA: 10 mg/m³	TWA: 10.0 mg/m³	TWA: 4 mg/m³ TWA: 10 mg/m³
Chemical name	Cyprus	Czech Republic	Denmark	Estonia	Finland
Starch 9005-25-8	-	TWA: 4.0 mg/m³	-	-	-
Chemical name	France	Germany	Germany MAK	Greece	Hungary
Starch 9005-25-8	-	-	-	TWA: 10 mg/m³ TWA: 5 mg/m³	-
Chemical name	Ireland	Italy	Italy REL	Latvia	Lithuania
Starch 9005-25-8	TWA: 10 mg/m³ TWA: 4 mg/m³ STEL: 30 mg/m³ STEL: 12 mg/m³	-	TWA: 10 mg/m³	-	-
Chemical name	Portugal	Romania	Slovakia	Slovenia	Spain
Starch 9005-25-8	TWA: 10 mg/m³	-	-	-	TWA: 10 mg/m³

Chemical name	Sweden	Switzerland	United Kingdom
Starch 9005-25-8	-	TWA: 3 mg/m³	TWA: 10 mg/m³ TWA: 4 mg/m³ STEL: 30 mg/m³ STEL: 12 mg/m³

Biological occupational exposure limits
This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls No information available.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	Solid
Appearance	Powder
Color	Off-white
Odor	No information available.
Odor threshold	No information available

Property	Values	Remarks • Method
Melting point / freezing point		No information available
Boiling point / boiling range		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		
Lower flammability limit:		
Flash point		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
pH	5 - 8	4% solution
pH (as aqueous solution)		No information available
Kinematic viscosity		No information available
Dynamic viscosity		No information available
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Vapor pressure		No information available
Relative density		No information available
Bulk density	30-40 lb/ft3	
Liquid Density		
Vapor density		No information available
Particle characteristics		No information available
Particle Size		
Particle Size Distribution		

9.2. Other information

9.2.1. Information with regard to physical hazard classes
Not applicable

9.2.2. Other safety characteristics
No information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity Not reactive under normal conditions.

10.2. Chemical stability

Stability Stable under normal conditions.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge None.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

10.4. Conditions to avoid

Conditions to avoid dust formation.

10.5. Incompatible materials

Incompatible materials Strong oxidizing agents.

10.6. Hazardous decomposition products

Hazardous Decomposition Products None known based on information supplied.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Numerical measures of toxicity
No information available

Acute toxicity

0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity.
0 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity.
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas).
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor).
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist).

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization None known.

Germ cell mutagenicity None known.

Carcinogenicity None known.

Reproductive toxicity None known.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard Not applicable.

11.2. Information on other hazards

11.2.1. Endocrine disrupting properties

Endocrine disrupting properties No information available.

11.2.2. Other information

Other adverse effects No information available.

SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity Contains 0 % of components with unknown hazards to the aquatic environment.

12.2. Persistence and degradability

Persistence and degradability No information available.

12.3. Bioaccumulative potential

Bioaccumulation No information available.

12.4. Mobility in soil

Mobility in soil No information available.

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

12.6. Endocrine disrupting properties

Endocrine disrupting properties No information available.

12.7. Other adverse effects
No information available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Waste codes / waste designations according to EWC / AVV Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information

IATA

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user Special Provisions	None

IMDG

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user Special Provisions	None
14.7 Maritime transport in bulk according to IMO instruments	No information available

RID

14.1 UN/ID no	Not Regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user Special Provisions	None

ADR

14.1 UN number or ID number	Not regulated
14.2 Proper shipping name	Not Regulated
14.3 Transport hazard class(es)	Not regulated
14.4 Packing Group	Not Regulated
14.5 Environmental hazard	Not applicable
14.6 Special precautions for user Special Provisions	None

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Water hazard class (WGK) slightly hazardous to water (WGK 1)

Italy
-D. LGs. 81/2008 (single text on the protection of health and safety in the workplace) and subsequent amendments and Directive 2009/161/EU-assessment of chemical risk under title IX
-Legislative Decree 3 April 2006, no 152 (environmental standards)
-"Seveso III Directive" – Legislative Decree of 26 June 2015, n° 105 (Implementation of the Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances)

European Union
Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Authorizations and/or restrictions on use:
This product does not contain substances subject to authorization (Regulation (EC) No. 1907/2006 (REACH), Annex XIV) This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

Persistent Organic Pollutants
Not applicable

Ozone-depleting substances (ODS) regulation (EC) 1005/2009
Not applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical Safety Report A Chemical Safety Assessment is not required for this substance

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend
SVHC: Substances of Very High Concern for Authorization:

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine’s PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Issuing Date 12-Jun-2019

Revision Date 12-Nov-2021

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006
Disclaimer
According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, as amended by Regulation (EU) No. 2015/830. This document is provided as an information resource relating exclusively to the product or material described herein. The information contained herein may not be applicable to other products/ materials or processes and may not be valid when this product/material is used in combination with any other product/material or process. The information provided in this document is compiled by Newpark Drilling Fluids LLC or its representatives from various sources including manufacturers, suppliers and other third-party sources, and is based on the information available as of the indicated date of preparation. As the conditions under which this product could be used will vary and may not be within the control of Newpark Drilling Fluids LLC there is no guarantee that the precautions outlined above will be sufficient for all individuals or situations. The buyer assumes all responsibility for using and handling the product in accordance with federal, state, provincial, or local regulations. For the product/ material described in this document, NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE.

End of Safety Data Sheet

SAFETY DATA SHEET

CleanVis™

Issue Date 12-Dec-2019 **Revision date** 13-Apr-2022 **Version** 1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name CleanVis™

Product Code NDF00653

Other means of identification

CAS No [redacted]

Chemical Name Xanthan Gum

Recommended use of the chemical and restrictions on use

Recommended Use Viscosifier

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Hazard statements
Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Other hazards which do not result in classification

General Hazards

May form combustible dust concentrations in air

This substance does not meet the PBT/vPvB criteria of REACH, annex XIII

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Chemical name	CAS No	Weight-%	REACH registration number
Xanthan Gum	[redacted]	100	Exempt

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid generation of dust. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid		
Appearance	Powder	**Odor**	No information available.
Color	White to Tan	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH		No information available
Melting point / freezing point		No information available
Boiling point / boiling range		No information available
Flash point		No information available
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.02-1.45	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Hyphen		No information available
Kinematic viscosity		Not applicable
Dynamic viscosity		Not applicable

Other information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials None known based on information supplied.

Hazardous decomposition products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

Unknown acute toxicity 100 % of the mixture consists of ingredient(s) of unknown toxicity
100 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
100 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration hazard	No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity	The environmental impact of this product has not been fully investigated.
Unknown aquatic toxicity	100 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability	Readily biodegradable.

Bioaccumulative potential

Bioaccumulation	No information available.

Mobility

Mobility in soil	No information available.
Mobility	No information available.

Other adverse effects

Other adverse effects	No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products	Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.
Contaminated packaging	Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not regulated

IATA

IMDG Not Regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Brunei Poison List Not applicable.

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 12-Dec-2019

Revision date 13-Apr-2022

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

Disclaimer

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End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **DEFOAM AP 400**

Synonyms DEFOAMER

1.2 Uses and uses advised against

Uses TREATMENT OF FOAMING IN DRILLING FLUIDS

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
POLYETHYLENE GLYCOL	[redacted]	500-038-2	45 to 60%
OCTAN-2-OL	[redacted]	204-667-0	40 to 55%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once).

First aid facilities None allocated.

4.2 Most important symptoms and effects, both acute and delayed
Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve carbon oxides and hydrocarbons when heated to decomposition.

5.3 Advice for firefighters
Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Ventilate area where possible. Contact emergency services where appropriate.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. Eliminate all sources of ignition.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Large storage areas should have appropriate ventilation systems.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear splash-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Type A (Organic vapour) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	CLEAR COLOURLESS LIQUID
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	100°C to 102°C
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	7 to 8
Vapour density	NOT AVAILABLE
Specific gravity	1.00 to 1.17
Solubility (water)	SOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

9.2 Other information

Freezing point	-7°C to 0°C

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites), acids (e.g. nitric acid), heat and ignition sources.

10.6 Hazardous decomposition products

May evolve carbon oxides and hydrocarbons when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
POLYETHYLENE GLYCOL	> 15,000 mg/kg (rat)	> 20,000 mg/kg (rabbit)	--
OCTAN-2-OL	--	2000 mg/kg (rat)	--

Skin Not classified as a skin irritant. Contact may cause temporary mild skin irritation.

Eye Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Not classified as causing organ damage from single exposure.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Dispose of to an approved landfill or waste processing site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **DYNAFIBER (TM) AP (F, M, C)**

Synonyms DYNAFIBER ● NDFT 376 ● NDFT 377

1.2 Uses and uses advised against

Uses LOST CIRCULATION MATERIAL

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
ORGANIC FIBRE(S)	[redacted]	232-674-9	100%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). Due to product form and application, ingestion is considered unlikely.

First aid facilities None allocated.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains or waterways.

5.2 Special hazards arising from the substance or mixture
Combustible. May evolve carbon oxides and hydrocarbons when heated to decomposition.

5.3 Advice for firefighters
Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Large storage areas should have appropriate ventilation systems.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Cellulose (paper fibre) (a)	SWA [AUS]	--	10	--	--

Biological limits
No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical explosion proof extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Not required under normal conditions of use.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	YELLOW TO BROWN SOLID
Odour	SLIGHT ODOUR
Flammability	COMBUSTIBLE
Flash point	NOT AVAILABLE
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	7 to 8
Vapour density	NOT AVAILABLE
Relative density	0.9 to 1.2
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT AVAILABLE
Lower explosion limit	NOT AVAILABLE
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites), acids (e.g. nitric acid), heat and ignition sources.

10.6 Hazardous decomposition products

May evolve carbon oxides and hydrocarbons when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
ORGANIC FIBRE(S)	> 5000 mg/kg (rat)	> 2000 mg/kg (rabbit)	> 5800 mg/m³/4 hours (rat)

Skin Not classified as a skin irritant. Skin irritation is not anticipated under normal conditions of use.

Eye Not classified as an eye irritant. Eye irritation is not anticipated under normal conditions of use.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Not classified as causing organ damage from single exposure.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration Not relevant.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Reuse or recycle where possible. Alternatively, ensure product is covered with moist soil to prevent dust generation and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

EXPOSURE STANDARDS - TIME WEIGHTED AVERAGES: Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: Strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation).

COMBUSTIBLE - EXPLOSIVE CARBONACEOUS DUST: Carbonaceous/organic dusts have the potential, with dispersion, to present an explosion hazard if an ignition source exists. All equipment used to handle, transfer or store this product MUST BE cleaned thoroughly prior to cutting, welding, drilling or exposure to any other form of heat or ignition sources. If bulk stored, containers should be ventilated on a routine basis to avoid vapour accumulation (where applicable, eg for flocculants).

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

SAFETY DATA SHEET

EvoCon® E

NDF00576 **Revision Date** 02-Aug-2019 **Version** 1

Section 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product Code NDF00576
Product Name EvoCon® E

Contains Poly(oxy-1,2-ethanediyl), alpha-octyl-omega-hydroxy-

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Lubricant

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point
Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

1.4. Emergency telephone number

Emergency telephone number 1800 127 406 (Australia); +64 4 917 9888 (International)

Section 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008

Serious eye damage/eye irritation	Category 1 - (H318)

Classification according to Directive 67/548/EEC or 1999/45/EC
Full text of R-phrases: see section 16

Hazard symbols
Not dangerous

2.2. Label elements

Product identifier
Contains Poly(oxy-1,2-ethanediyl), alpha-octyl-omega-hydroxy-

Signal word
Danger

Hazard statements
H318 - Causes serious eye damage
H227 - Combustible liquid

Precautionary Statements - EU (§28, 1272/2008)
P280 - Wear eye protection/ face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor

2.3. Other hazards
No information available

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Chemical name	CAS No.	Weight-%	Classification according to Directive 67/548/EEC or 1999/45/EC	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Poly(oxy-1,2-ethanediyl), alpha-octyl-omega-hydroxy-	[redacted]	70-90	-	Eye Dam. 1 (H318)

Full text of R-phrases: see section 16

Full text of H- and EUH-phrases: see section 16

Section 4: FIRST AID MEASURES

4.1. Description of first aid measures

Inhalation Remove to fresh air.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Ingestion Clean mouth with water and drink afterwards plenty of water.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIRE FIGHTING MEASURES

5.1. Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Small Fire	Dry chemical or CO2.
Large Fire	Move containers from fire area if you can do it without risk. Water spray or fog.

Unsuitable extinguishing media
No information available

5.2. Special hazards arising from the substance or mixture

Thermal decomposition can lead to release of irritating and toxic gases and vapors

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective suit. Use personal protective equipment as required.

Section 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions
Ensure adequate ventilation, especially in confined areas.

For emergency responders
Use personal protection recommended in Section 8.

6.2. Environmental precautions

See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for containment	Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	Take up mechanically, placing in appropriate containers for disposal.

6.4. Reference to other sections

See section 13 for more information.

Section 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Advice on safe handling
Ensure adequate ventilation, especially in confined areas.

General Hygiene Considerations
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions
Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Risk Management Methods (RMM)
The information required is contained in this Material Safety Data Sheet.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Derived No Effect Level (DNEL) No information available

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Controls Ensure adequate ventilation, especially in confined areas.

Personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Suitable protective clothing.

Environmental exposure controls No information available.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Physical state	Liquid		
Appearance	liquid	**Odor**	Alcohol
Color	yellow	**Odor threshold**	No data available

Property	**Values**	**Remarks • Method**
pH	4.5 - 7.5	
Melting point / freezing point		No data available
Boiling point / boiling range	> 90 °C / > 194 °F	
Flash point	> 93 °C / > 199.4 °F	
Evaporation rate		No data available
Flammability (solid, gas)		No data available
Flammability Limit in Air		
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Specific Gravity	1.005	
Water solubility	Dispersible	
Solubility(ies)		No information available
Partition coefficient		No data available
Autoignition temperature		No data available

Decomposition temperature		No data available
Kinematic viscosity	>70 cSt@25deg C	
Dynamic viscosity		No data available
Explosive properties	Not an explosive	
Oxidizing properties	Not applicable	

9.2. Other information

Softening point	Not applicable
Molecular weight	No data available
VOC Content (%)	Not applicable
Liquid Density	No data available
Bulk density	No information available

Section 10: STABILITY AND REACTIVITY

10.1. Reactivity

Stable under normal conditions.

10.2. Chemical stability

Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

10.3. Possibility of hazardous reactions

Possibility of Hazardous Reactions
None under normal processing.

10.4. Conditions to avoid

Extremes of temperature and direct sunlight.

10.5. Incompatible materials

Strong acids. Strong bases.

10.6. Hazardous decomposition products

None under normal use conditions.

Section 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute toxicity

Product Information
Product does not present an acute toxicity hazard based on known or supplied information.

National Regulations	No data available.
Eye contact	No data available.
Skin contact	No data available.
Ingestion	No data available.

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation	No information available.
Sensitization	No information available.
Germ cell mutagenicity	No information available.
Carcinogenicity	No information available.
Reproductive toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration hazard	No information available.

Section 12: ECOLOGICAL INFORMATION

12.1. Toxicity

12.2. Persistence and degradability

No information available.

12.3. Bioaccumulative potential

No information available.

12.4. Mobility in soil

Mobility in soil
No information available.

12.5. Results of PBT and vPvB assessment

No information available.

12.6. Other adverse effects

No information available

Section 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from residues/unused products	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated packaging	Improper disposal or reuse of this container may be dangerous and illegal.

Section 14: TRANSPORT INFORMATION

IMDG

14.1 UN/ID no	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.2 Proper shipping name	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.3 Hazard Class	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.4 Packing Group	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.5 Marine pollutant	Not applicable
14.6 Special Provisions	None
14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	No information available

RID

14.1 UN/ID no	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.2 Proper shipping name	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.3 Hazard Class	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.4 Packing Group	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

ADR

14.1 UN/ID no	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.2 Proper shipping name	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.3 Hazard Class	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.4 Packing Group	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

ICAO (air)

14.1 UN/ID no	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.2 Proper shipping name	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.3 Hazard Class	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.4 Packing Group	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid

14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

IATA

14.1 UN/ID no	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.2 Proper shipping name	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.3 Hazard Class	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.4 Packing Group	OTHER SHIPPING INFORMATION: This product when tested according to ASTM D4206 does not sustain combustion andaccording to 49 CFR 173.120(b)(3) is not regulated as a combustible liquid
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

HAZCHEM Emergency Action Code
No information available

Section 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations

Australia
See section 8 for national exposure control parameters

Carcinogenicity

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Does not comply
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

15.2. Chemical safety assessment

No information available

Section 16: OTHER INFORMATION

Full text of R-phrases referred to under sections 2 and 3
No information available

Full text of H-Statements referred to under section 3
H318 - Causes serious eye damage

Revision Date 02-Aug-2019

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer
According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, as amended by Regulation (EU) No. 2015/830.
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End of Safety Data Sheet

SAFETY DATA SHEET

EvoLube® G

NDF00150 **Revision Date** 30-Jul-2019 **Version** 1

Section 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product Code NDF00150
Product Name EvoLube® G

Contains Petroleum distillates, hydrotreated light

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Lubricant

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point
Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

1.4. Emergency telephone number

Emergency telephone number 1800 127 406 (Australia); +64 4 917 9888 (International)

Section 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008

Aspiration hazard	Category 1 - (H304)
Specific target organ toxicity (single exposure)	Category 3 - (H336)
Chronic aquatic toxicity	Category 2 - (H411)

Classification according to Directive 67/548/EEC or 1999/45/EC
Full text of R-phrases: see section 16

Hazard symbols
Xn - Harmful

R-code(s)
Xn;R65

2.2. Label elements

Product identifier

Contains Petroleum distillates, hydrotreated light

Signal word
Danger

Hazard statements
H304 - May be fatal if swallowed and enters airways
H336 - May cause drowsiness or dizziness
H411 - Toxic to aquatic life with long lasting effects
H335 - May cause respiratory irritation

Precautionary Statements - EU (§28, 1272/2008)
P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
P331 - Do NOT induce vomiting

2.3. Other hazards
Harmful to aquatic life

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Chemical name	CAS No.	Weight-%	Classification according to Directive 67/548/EEC or 1999/45/EC	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Petroleum distillates, hydrotreated light	[redacted]	15-40	Xn; R65	Asp. Tox. 1 (H304)

Full text of R-phrases: see section 16

Full text of H- and EUH-phrases: see section 16

Section 4: FIRST AID MEASURES

4.1. Description of first aid measures

General advice If symptoms persist, call a physician. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get in eyes, on skin, or on clothing.

Inhalation Remove to fresh air. Call a physician. If breathing is irregular or stopped, administer artificial respiration. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation.

Skin contact Wash skin with soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing before reuse. Get medical attention if irritation develops and persists.

Eye contact Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Keep eye wide open while rinsing. If symptoms persist, call a physician.

Ingestion Do NOT induce vomiting. Rinse mouth. Drink plenty of water. If symptoms persist, call a physician.

Self-protection of the first aider Use personal protective equipment as required.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms No information available.

4.3. Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIRE FIGHTING MEASURES

5.1. Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
No information available

5.2. Special hazards arising from the substance or mixture

Thermal decomposition can lead to release of irritating and toxic gases and vapors

Hazardous combustion products Carbon oxides.

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective suit. Use personal protective equipment as required.

Section 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions
Ensure adequate ventilation, especially in confined areas. Keep people away from and upwind of spill/leak.

For emergency responders
In the case of vapor formation use a respirator with an approved filter.

6.2. Environmental precautions

Prevent entry into waterways, sewers, basements or confined areas. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so. Dike to collect large liquid spills.

Methods for cleaning up Use personal protective equipment as required. Use a non-combustible material like vermiculite or sand to soak up the product and place into a container for later disposal. Use clean non-sparking tools to collect absorbed material.

6.4. Reference to other sections

See section 13 for more information.

Section 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Advice on safe handling
Wash contaminated clothing before reuse. Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling.

General Hygiene Considerations
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions
Keep container tightly closed in a dry and well-ventilated place. Keep out of the reach of children.

7.3. Specific end use(s)

Risk Management Methods (RMM)
The information required is contained in this Material Safety Data Sheet.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Chemical name	Australia	European Union	United Kingdom	France	Spain	Germany
Petroleum distillates, hydrotreated light 64742-47-8		-	-	-	-	TWA: 5 mg/m³ TWA: 50 ppm TWA: 350 mg/m³ Ceiling / Peak: 20 mg/m³ Ceiling / Peak: 100 ppm Ceiling / Peak: 700 mg/m³

Chemical name	Austria	Switzerland	Poland	Norway	Ireland
Petroleum distillates, hydrotreated light 64742-47-8	-	TWA: 50 ppm TWA: 350 mg/m³ TWA: 5 mg/m³ STEL: 100 ppm STEL: 700 mg/m³	-	-	-

Derived No Effect Level (DNEL) No information available

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Controls Ensure adequate ventilation, especially in confined areas.

Personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Suitable protective clothing.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Physical state	liquid		
Appearance	No information available	**Odor**	No information available
Color	yellow to dark amber	**Odor threshold**	No data available

Property	**Values**	**Remarks • Method**
pH		No data available
Melting point / freezing point		No data available
Boiling point / boiling range		No data available
Flash point	> 107 °C / > 225 °F	
Evaporation rate		No data available
Flammability (solid, gas)		No data available
Flammability Limit in Air		
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Specific Gravity	0.87-0.90	
Water solubility	Partially soluble	
Solubility(ies)		No information available
Partition coefficient		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity		No data available
Explosive properties	Not an explosive	
Oxidizing properties	Not applicable	

9.2. Other information

Softening point	Not applicable
Molecular weight	No data available
VOC Content (%)	Not applicable
Liquid Density	No data available
Bulk density	No information available

Section 10: STABILITY AND REACTIVITY

10.1. Reactivity

Stable under normal conditions.

10.2. Chemical stability

Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

10.3. Possibility of hazardous reactions

Possibility of Hazardous Reactions
None under normal processing.

10.4. Conditions to avoid

Extremes of temperature and direct sunlight. Incompatible materials.

10.5. Incompatible materials

Strong oxidizing agents.

10.6. Hazardous decomposition products

None under normal use conditions.

Section 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Acute toxicity

Product Information

Product does not present an acute toxicity hazard based on known or supplied information.

National Regulations	No data available.
Eye contact	No data available.
Skin contact	No data available.
Ingestion	No data available.

Unknown acute toxicity 0 % of the mixture consists of ingredient(s) of unknown toxicity.

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)	6,873.00 mg/kg
ATEmix (dermal)	5,614.00 mg/kg
ATEmix (inhalation-dust/mist)	14.86 mg/l

Component Information

Skin corrosion/irritation Irritating to skin.

Serious eye damage/eye irritation No information available.

Sensitization None known.

Germ cell mutagenicity None known.

Carcinogenicity No information available.

Reproductive toxicity None known.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Symptoms Vapors may cause drowsiness and dizziness.

Aspiration hazard None known.

Section 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Contains 0 % of components with unknown hazards to the aquatic environment

Chemical name	Algae/aquatic plants	Fish	Crustacea
Petroleum distillates, hydrotreated light	-	45: 96 h Pimephales promelas mg/L LC50 flow-through 2.2: 96 h Lepomis macrochirus mg/L LC50 static 2.4: 96 h Oncorhynchus mykiss mg/L LC50 static	4720: 96 h Den-dronereides heteropoda mg/L LC50

12.2. Persistence and degradability

No information available.

12.3. Bioaccumulative potential

.

12.4. Mobility in soil

Mobility in soil
No information available.

12.5. Results of PBT and vPvB assessment

No information available.

Chemical name	PBT and vPvB assessment
Petroleum distillates, hydrotreated light	The substance is not PBT / vPvB

12.6. Other adverse effects

No information available

Section 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from residues/unused products Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Improper disposal or reuse of this container may be dangerous and illegal.

Other Information Waste codes should be assigned by the user based on the application for which the product was used.

Section 14: TRANSPORT INFORMATION

IMDG

14.1 UN/ID no Not regulated
14.2 Proper shipping name Not regulated
14.3 Hazard Class Not regulated
14.4 Packing Group Not regulated
14.5 Marine pollutant Not applicable
14.6 Special Provisions None
14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code No information available

RID

14.1 UN/ID no	Not regulated
14.2 Proper shipping name	Not regulated
14.3 Hazard Class	Not regulated
14.4 Packing Group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

ADR

14.1 UN/ID no	Not regulated
14.2 Proper shipping name	Not regulated
14.3 Hazard Class	Not regulated
14.4 Packing Group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

ICAO (air)

14.1 UN/ID no	Not regulated
14.2 Proper shipping name	Not regulated
14.3 Hazard Class	Not regulated
14.4 Packing Group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

IATA

14.1 UN/ID no	Not regulated
14.2 Proper shipping name	Not regulated
14.3 Hazard Class	Not regulated
14.4 Packing Group	Not regulated
14.5 Environmental hazard	Not applicable
14.6 Special Provisions	None

HAZCHEM Emergency Action Code
No information available

Section 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations

Australia
See section 8 for national exposure control parameters

Carcinogenicity

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

15.2. Chemical safety assessment

No information available

Section 16: OTHER INFORMATION

Full text of R-phrases referred to under sections 2 and 3
R65 - Harmful: may cause lung damage if swallowed

Full text of H-Statements referred to under section 3
H304 - May be fatal if swallowed and enters airways

Revision Date 30-Jul-2019

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer
According to Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, as amended by Regulation (EU) No. 2015/830.
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End of Safety Data Sheet

SAFETY DATA SHEET

GageTrol™

Issue Date 15-Mar-2017 **Revision date** 23-Mar-2022 **Version** 1.1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name GageTrol™

Product Code NDF00018

Other means of identification

Pure substance/mixture Substance

Recommended use of the chemical and restrictions on use

Recommended Use filtration control agent

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label elements

Hazard statements
Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Other hazards which do not result in classification

General Hazards

This substance does not meet the PBT/vPvB criteria of REACH, annex XIII

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Chemical name	CAS No	Weight-%
Non-hazardous ingredients	-	100

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Dry chemical, CO2, water spray or regular foam.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Avoid generation of dust. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials Strong oxidizing agents Strong acids

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid		
Appearance	Powder	**Odor**	Slight.
Color	Off-white	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	9.0 - 10.5	4% solution
Melting point / freezing point		Not applicable
Boiling point / boiling range		Not applicable
Flash point		Not applicable
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.5	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Hyphen		No information available
Kinematic viscosity		Not applicable
Dynamic viscosity		Not applicable

Other information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	No information available
Bulk density	30-45 lb/ft3 (480-720 kg/m^3)
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials Strong oxidizing agents. Strong acids.

Hazardous decomposition products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

Unknown acute toxicity 100 % of the mixture consists of ingredient(s) of unknown toxicity
100 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
100 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
100 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity 0 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation No information available.

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not regulated

IATA Not Regulated

IMDG Not Regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Brunei Poison List Not applicable.

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 15-Mar-2017

Revision date 23-Mar-2022

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

SAFETY DATA SHEET

Idcide G50

Issue Date 31-May-2021 **Revision Date** 01-Jun-2021 **Version** 1.1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name Idcide G50

Product Code NDF00800

Other means of identification

UN Number UN2922

Recommended use of the chemical and restrictions on use

Recommended Use biocide

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Acute toxicity - Oral	Category 3 - (H301)
Acute toxicity - Inhalation (Dusts/Mists)	Category 2 - (H330)
Skin corrosion/irritation	Category 1 - (H314)
Serious eye damage/eye irritation	Category 1 - (H318)
Respiratory sensitization	Category 1 - (H334)
Skin sensitization	Category 1 - (H317)
Specific target organ toxicity (single exposure)	Category 3 - (H335)
Acute aquatic toxicity	Category 1 - (H400)
Chronic aquatic toxicity	Category 2 - (H411)

Label elements

Skull and crossbones
Health hazard
Corrosion
Environment

Signal word
Danger

Hazard statements
H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H317 - May cause an allergic skin reaction
H330 - Fatal if inhaled
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
H371 - May cause damage to organs
AUH071 - Corrosive to the respiratory tract

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear respiratory protection
Wear protective gloves/protective clothing/eye protection/face protection
In case of inadequate ventilation wear respiratory protection
Contaminated work clothing should not be allowed out of the workplace
Avoid release to the environment
Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
If skin irritation or rash occurs: Get medical advice/attention
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Do NOT induce vomiting
Collect spillage
Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other hazards
May be harmful in contact with skin
Very toxic to aquatic life with long lasting effects
Very toxic to aquatic life
General Hazards
No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Chemical name	CAS No.	Weight-%	REACH Registration Number
Glutaraldehyde	[redacted]	>=50	01-2119455549-26-XXXX
Methyl alcohol	[redacted]	<=2	01-2119433307-44-XXXX

Chemical name	CAS No	Weight-%
Non-hazardous ingredients	Proprietary	Balance

Section 4: FIRST AID MEASURES

Description of first aid measures

General advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur. May cause allergic respiratory reaction. If breathing has stopped, give artificial respiration. Get medical attention immediately. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Get immediate medical advice/attention. Remove to fresh air.

Eye contact Get immediate medical advice/attention. Remove contact lenses, if present and easy to do. Continue rinsing. Keep eye wide open while rinsing. Do not rub affected area. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention. May cause an allergic skin reaction.

Ingestion May produce an allergic reaction. Get immediate medical advice/attention. Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person.

Self-protection of the first aider Do not breathe vapor or mist. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Use personal protective equipment as required. See section 8 for more information.

Most important symptoms and effects, both acute and delayed

Symptoms Difficulty in breathing. Burning sensation. May cause allergy or asthma symptoms or breathing difficulties if inhaled. Coughing and/ or wheezing. Itching. Rashes. Hives.

Indication of any immediate medical attention and special treatment needed

Note to physicians Product is a corrosive material. Use of gastric lavage or emesis is contraindicated.

Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. May cause sensitization in susceptible persons. Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. In the event of fire and/or explosion do not breathe fumes.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code 2X

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Do not breathe vapor or mist. Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas.

Other Information Refer to protective measures listed in Sections 7 and 8.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains. Prevent further leakage or spillage if safe to do so.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not breathe vapor or mist. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use.

Conditions for safe storage, including any incompatibilities

Storage Conditions Protect from moisture. Store away from other materials. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep out of the reach of children. Store locked up.

Incompatible materials Strong oxidizing agents Strong acids Strong bases Incompatible with strong acids and bases Incompatible with oxidizing agents

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits

Chemical name	Australia
Glutaraldehyde 111-30-8	0.1 ppm Peak 0.41 mg/m^3 Peak
Methyl alcohol 67-56-1	200 ppm 262 mg/m^3 250 ppm STEL 328 mg/m^3 STEL

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Face protection shield.

Skin and body protection Long sleeved clothing. Chemical resistant apron. Wear suitable protective clothing.

Hand protection Impervious gloves. Wear suitable gloves.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	liquid	**Odor**	Pungent.
Color	colorless to light yellow	**Odor threshold**	No information available

Property	Values	Remarks • Method
pH	3.0 - 5.0	
Melting point / freezing point		
Boiling point / boiling range	101.5 °C	
Flash point		No information available
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.115-1.136	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		
Dynamic viscosity		

Other Information	
Softening point	No information available
Molecular weight	No information available
VOC Content (%)	51
Liquid Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid Excessive heat. Exposure to air or moisture over prolonged periods.

Incompatible materials

Incompatible materials Strong oxidizing agents. Strong acids. Strong bases. Incompatible with strong acids and bases. Incompatible with oxidizing agents.

Incompatible materials Acids. Bases. Oxidizing agent.

Hazardous Decomposition Products

Hazardous Decomposition Products Thermal decomposition can lead to release of irritating and toxic gases and vapors.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information

Inhalation	Fatal if inhaled. Corrosive by inhalation. Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Inhaled corrosive substances can lead to a toxic edema of the lungs. Pulmonary edema can be fatal. Specific test data for the substance or mixture is not available. May cause sensitization in susceptible persons. (based on components).
Eye contact	Causes burns. (based on components). Corrosive to the eyes and may cause severe damage including blindness. Specific test data for the substance or mixture is not available. Causes serious eye damage. May cause irreversible damage to eyes.
Skin contact	May cause irritation. May cause sensitization by skin contact. Specific test data for the substance or mixture is not available. Repeated or prolonged skin contact may cause allergic reactions with susceptible persons. (based on components). May be harmful in contact with skin.
Ingestion	Causes burns Ingestion causes burns of the upper digestive and respiratory tracts May cause severe burning pain in the mouth and stomach with vomiting and diarrhea of dark blood. Blood pressure may decrease. Brownish or yellowish stains may be seen around the mouth. Swelling of the throat may cause shortness of breath and choking May cause lung damage if swallowed May be fatal if swallowed and enters airways May cause additional affects as listed under "Inhalation" Specific test data for the substance or mixture is not available (based on components)
Symptoms	Difficulty in breathing. Redness. Burning. May cause blindness. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain, or flushing. Coughing and/ or wheezing. Itching. Rashes. Hives.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)	479.80 mg/kg
ATEmix (dermal)	3,214.30 mg/kg
ATEmix (inhalation-vapor)	3,181,980.5200 mg/l
ATEmix (inhalation-dust/mist)	0.100 mg/l

Unknown acute toxicity 0 % of the mixture consists of ingredient(s) of unknown toxicity

0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
0 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50

Glutaraldehyde	= 252 mg/kg (Rat)	= 1800 mg/kg (Rabbit)	= 23.5 ppm (Rat) 4 h = 40.1 ppm (Rat) 4 h
Methyl alcohol	= 6200 mg/kg (Rat)	= 15840 mg/kg (Rabbit)	= 22500 ppm (Rat) 8 h

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation MAY CAUSE SKIN IRRITATION.

Serious eye damage/eye irritation Classification based on data available for ingredients. Causes burns. Risk of serious damage to eyes.

Respiratory or skin sensitization May cause sensitization by inhalation. May cause sensitization by skin contact.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure Based on the classification criteria of the Globally Harmonized System as adopted in the country or region with which this safety data sheet complies, this product has been determined to cause systemic target organ toxicity from acute exposure. (STOT SE). May cause damage to organs if swallowed.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity

Unknown aquatic toxicity 0 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Glutaraldehyde	0.61: 72 h Desmodesmus subspicatus mg/L EC50 0.84: 96 h Desmodesmus subspicatus mg/L EC50	2.6 - 4.8: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 7.8 - 13: 96 h Oncorhynchus mykiss mg/L LC50 static 7.8 - 22: 96 h Lepomis macrochirus mg/L LC50 static 5.4: 96 h Pimephales promelas mg/L LC50 static	-	0.56 - 1.0: 48 h Daphnia magna mg/L EC50 Static 14: 48 h Daphnia magna mg/L EC50
Methyl alcohol	-	13500 - 17600: 96 h Lepomis macrochirus mg/L LC50 flow-through 18 - 20: 96 h Oncorhynchus mykiss mL/L LC50 static 19500 - 20700: 96 h Oncorhynchus mykiss	EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min	-

		mg/L LC50 flow-through 28200: 96 h Pimephales promelas mg/L LC50 flow-through 100: 96 h Pimephales promelas mg/L LC50 static		

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation

Component Information

Chemical name	Partition coefficient
Glutaraldehyde	0.22
Methyl alcohol	-0.77

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not Regulated
UN Number UN2922
Proper shipping name Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class 8
Subsidiary hazard class 6.1
Packing Group II

Hazchem code 2X

IATA
UN/ID no UN2922
Proper shipping name Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class 8
Subsidiary hazard class 6.1
Packing Group II

IMDG
UN/ID no UN2922

Proper shipping name	Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class	8
Subsidiary hazard class	6.1
Packing Group	II
EmS-No	F-A, S-A
Marine pollutant	Yes

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

Major hazard (accident/incident planning) regulation
Verify that license requirements are met

Hazardous chemical	Threshold quantity (T)
Materials that meet the criteria for Toxic in table 15.3	200

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Brunei Poison List Not applicable.

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 31-May-2021

Revision Date 01-Jun-2021

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

Disclaimer

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End of Safety Data Sheet

SAFETY DATA SHEET

Idcide G50

Issue Date 31-May-2021 **Revision Date** 01-Jun-2021 **Version** 1.1
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name Idcide G50

Product Code NDF00800

Other means of identification

UN Number UN2922

Recommended use of the chemical and restrictions on use

Recommended Use biocide

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number +(61)-290372994 (Australia); +(64)-98010034 (New Zealand)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Acute toxicity - Oral	Category 3 - (H301)
Acute toxicity - Inhalation (Dusts/Mists)	Category 2 - (H330)
Skin corrosion/irritation	Category 1 - (H314)
Serious eye damage/eye irritation	Category 1 - (H318)
Respiratory sensitization	Category 1 - (H334)
Skin sensitization	Category 1 - (H317)
Specific target organ toxicity (single exposure)	Category 3 - (H335)
Acute aquatic toxicity	Category 1 - (H400)
Chronic aquatic toxicity	Category 2 - (H411)

Label elements

Skull and crossbones
Health hazard
Corrosion
Environment

Signal word
Danger

Hazard statements
H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H317 - May cause an allergic skin reaction
H330 - Fatal if inhaled
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
H371 - May cause damage to organs
AUH071 - Corrosive to the respiratory tract

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear respiratory protection
Wear protective gloves/protective clothing/eye protection/face protection
In case of inadequate ventilation wear respiratory protection
Contaminated work clothing should not be allowed out of the workplace
Avoid release to the environment
Precautionary Statements - Response
Immediately call a POISON CENTER or doctor/physician
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
If skin irritation or rash occurs: Get medical advice/attention
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Do NOT induce vomiting
Collect spillage
Precautionary Statements - Storage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other hazards
May be harmful in contact with skin
Very toxic to aquatic life with long lasting effects
Very toxic to aquatic life
General Hazards
No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Chemical name	CAS No.	Weight-%	REACH Registration Number
Glutaraldehyde	[redacted]	>=50	01-2119455549-26-XXXX
Methyl alcohol	[redacted]	<=2	01-2119433307-44-XXXX

Chemical name	CAS No	Weight-%
Non-hazardous ingredients	Proprietary	Balance

Section 4: FIRST AID MEASURES

Description of first aid measures

General advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur. May cause allergic respiratory reaction. If breathing has stopped, give artificial respiration. Get medical attention immediately. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Get immediate medical advice/attention. Remove to fresh air.

Eye contact Get immediate medical advice/attention. Remove contact lenses, if present and easy to do. Continue rinsing. Keep eye wide open while rinsing. Do not rub affected area. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention. May cause an allergic skin reaction.

Ingestion May produce an allergic reaction. Get immediate medical advice/attention. Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person.

Self-protection of the first aider Do not breathe vapor or mist. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Use personal protective equipment as required. See section 8 for more information.

Most important symptoms and effects, both acute and delayed

Symptoms Difficulty in breathing. Burning sensation. May cause allergy or asthma symptoms or breathing difficulties if inhaled. Coughing and/ or wheezing. Itching. Rashes. Hives.

Indication of any immediate medical attention and special treatment needed

Note to physicians Product is a corrosive material. Use of gastric lavage or emesis is contraindicated.

Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. May cause sensitization in susceptible persons. Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. In the event of fire and/or explosion do not breathe fumes.

Hazardous combustion products Carbon oxides.

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code 2X

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Do not breathe vapor or mist. Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas.

Other Information Refer to protective measures listed in Sections 7 and 8.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains. Prevent further leakage or spillage if safe to do so.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Wash contaminated clothing before reuse.

General hygiene considerations Do not breathe vapor or mist. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use.

Conditions for safe storage, including any incompatibilities

Storage Conditions Protect from moisture. Store away from other materials. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep out of the reach of children. Store locked up.

Incompatible materials Strong oxidizing agents Strong acids Strong bases Incompatible with strong acids and bases Incompatible with oxidizing agents

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits

Chemical name	Australia
Glutaraldehyde 111-30-8	0.1 ppm Peak 0.41 mg/m^3 Peak
Methyl alcohol 67-56-1	200 ppm 262 mg/m^3 250 ppm STEL 328 mg/m^3 STEL

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Face protection shield.

Skin and body protection Long sleeved clothing. Chemical resistant apron. Wear suitable protective clothing.

Hand protection Impervious gloves. Wear suitable gloves.

Respiratory protection When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	liquid	**Odor**	Pungent.
Color	colorless to light yellow	**Odor threshold**	No information available

Property	Values	Remarks • Method
pH	3.0 - 5.0	
Melting point / freezing point		
Boiling point / boiling range	101.5 °C	
Flash point		No information available
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	1.115-1.136	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		
Dynamic viscosity		

Other Information	
Softening point	No information available
Molecular weight	No information available
VOC Content (%)	51
Liquid Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid Excessive heat. Exposure to air or moisture over prolonged periods.

Incompatible materials

Incompatible materials Strong oxidizing agents. Strong acids. Strong bases. Incompatible with strong acids and bases. Incompatible with oxidizing agents.

Incompatible materials Acids. Bases. Oxidizing agent.

Hazardous Decomposition Products

Hazardous Decomposition Products Thermal decomposition can lead to release of irritating and toxic gases and vapors.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information

Inhalation	Fatal if inhaled. Corrosive by inhalation. Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Inhaled corrosive substances can lead to a toxic edema of the lungs. Pulmonary edema can be fatal. Specific test data for the substance or mixture is not available. May cause sensitization in susceptible persons. (based on components).
Eye contact	Causes burns. (based on components). Corrosive to the eyes and may cause severe damage including blindness. Specific test data for the substance or mixture is not available. Causes serious eye damage. May cause irreversible damage to eyes.
Skin contact	May cause irritation. May cause sensitization by skin contact. Specific test data for the substance or mixture is not available. Repeated or prolonged skin contact may cause allergic reactions with susceptible persons. (based on components). May be harmful in contact with skin.
Ingestion	Causes burns Ingestion causes burns of the upper digestive and respiratory tracts May cause severe burning pain in the mouth and stomach with vomiting and diarrhea of dark blood. Blood pressure may decrease. Brownish or yellowish stains may be seen around the mouth. Swelling of the throat may cause shortness of breath and choking May cause lung damage if swallowed May be fatal if swallowed and enters airways May cause additional affects as listed under "Inhalation" Specific test data for the substance or mixture is not available (based on components)
Symptoms	Difficulty in breathing. Redness. Burning. May cause blindness. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain, or flushing. Coughing and/ or wheezing. Itching. Rashes. Hives.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)	479.80 mg/kg
ATEmix (dermal)	3,214.30 mg/kg
ATEmix (inhalation-vapor)	3,181,980.5200 mg/l
ATEmix (inhalation-dust/mist)	0.100 mg/l

Unknown acute toxicity 0 % of the mixture consists of ingredient(s) of unknown toxicity

0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
0 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
0 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50

Glutaraldehyde	= 252 mg/kg (Rat)	= 1800 mg/kg (Rabbit)	= 23.5 ppm (Rat) 4 h = 40.1 ppm (Rat) 4 h
Methyl alcohol	= 6200 mg/kg (Rat)	= 15840 mg/kg (Rabbit)	= 22500 ppm (Rat) 8 h

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation MAY CAUSE SKIN IRRITATION.

Serious eye damage/eye irritation Classification based on data available for ingredients. Causes burns. Risk of serious damage to eyes.

Respiratory or skin sensitization May cause sensitization by inhalation. May cause sensitization by skin contact.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure Based on the classification criteria of the Globally Harmonized System as adopted in the country or region with which this safety data sheet complies, this product has been determined to cause systemic target organ toxicity from acute exposure. (STOT SE). May cause damage to organs if swallowed.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity

Unknown aquatic toxicity 0 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Glutaraldehyde	0.61: 72 h Desmodesmus subspicatus mg/L EC50 0.84: 96 h Desmodesmus subspicatus mg/L EC50	2.6 - 4.8: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 7.8 - 13: 96 h Oncorhynchus mykiss mg/L LC50 static 7.8 - 22: 96 h Lepomis macrochirus mg/L LC50 static 5.4: 96 h Pimephales promelas mg/L LC50 static	-	0.56 - 1.0: 48 h Daphnia magna mg/L EC50 Static 14: 48 h Daphnia magna mg/L EC50
Methyl alcohol	-	13500 - 17600: 96 h Lepomis macrochirus mg/L LC50 flow-through 18 - 20: 96 h Oncorhynchus mykiss mL/L LC50 static 19500 - 20700: 96 h Oncorhynchus mykiss	EC50 = 39000 mg/L 25 min EC50 = 40000 mg/L 15 min EC50 = 43000 mg/L 5 min	-

		mg/L LC50 flow-through 28200: 96 h Pimephales promelas mg/L LC50 flow-through 100: 96 h Pimephales promelas mg/L LC50 static		

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation

Component Information

Chemical name	Partition coefficient
Glutaraldehyde	0.22
Methyl alcohol	-0.77

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not Regulated
UN Number UN2922
Proper shipping name Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class 8
Subsidiary hazard class 6.1
Packing Group II

Hazchem code 2X

IATA
UN/ID no UN2922
Proper shipping name Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class 8
Subsidiary hazard class 6.1
Packing Group II

IMDG
UN/ID no UN2922

Proper shipping name	Corrosive liquid, toxic, n.o.s. (Contains Glutaraldehyde)
Hazard Class	8
Subsidiary hazard class	6.1
Packing Group	II
EmS-No	F-A, S-A
Marine pollutant	Yes

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

Major hazard (accident/incident planning) regulation
Verify that license requirements are met

Hazardous chemical	Threshold quantity (T)
Materials that meet the criteria for Toxic in table 15.3	200

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Brunei Poison List Not applicable.

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 31-May-2021

Revision Date 01-Jun-2021

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

Disclaimer

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End of Safety Data Sheet

SAFETY DATA SHEET

INCORR

Issue Date 28-Sep-2016 **Revision Date** 04-Jan-2018 **Version** 2
EN

Section 1: IDENTIFICATION: PRODUCT INDENTIFIER AND CHEMICAL IDENTITY

Product identifier

Product Name INCORR

Product Code NDF00204

Other means of identification

Pure substance/mixture Mixture

Recommended use of the chemical and restrictions on use

Recommended Use Corrosion inhibitor

Uses advised against No information available

Details of manufacturer or importer

Supplier
Newpark Drilling Fluids (Australia) LTD
11 Alacrity Place
Henderson, WA, 6166
Australia

For further information, please contact

Contact Point Telephone: +61 8 9410 8200
Fax: +61 8 9410 8299
Website: www.newpark.com

Emergency telephone number

Emergency telephone number 1800 127 406 (Australia); +64 4 917 9888 (International)

Section 2: HAZARD(S) IDENTIFICATION

GHS - Classification

Serious eye damage/eye irritation	Category 2 - (H319)

Label elements

Signal word
Warning

Hazard statements
H319 - Causes serious eye irritation

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention

Other hazards
General Hazards
No information available

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS, IN ACCORDANCE WITH SCHEDULE 8

Substance

Not applicable

Mixture

Chemical Name	CAS No	Weight-%
Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	[redacted]	10-30
Poly(oxy-1,2-ethanediyl), alpha-hydro-omega-hydroxy-, mono(2-(4,5-dihydro-2-nortall-oil alkyl-1H-imidazol-1-yl)ethyl) ethers	[redacted]	5-10
Acetic acid	[redacted]	1-5
Non-hazardous ingredients	Proprietary	Balance

Section 4: FIRST AID MEASURES

Description of first aid measures

Emergency telephone number Poisons Information Center, Australia: 13 11 26
Poisons Information Center, New Zealand: 0800 764 766

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

Section 5: FIREFIGHTING MEASURES

Suitable Extinguishing Media

Suitable extinguishing media
Carbon dioxide (CO2). Water spray (fog).

Unsuitable extinguishing media No information available.

Specific hazards arising from the chemical

Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous combustion products Carbon oxides. Nitrogen oxides (NOx).

Special protective actions for fire-fighters

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Hazchem code Not Listed.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system. Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: HANDLING AND STORAGE, INCLUDING HOW THE CHEMICAL MAY BE SAFELY USED

Precautions for safe handling

Advice on safe handling Wash contaminated clothing before reuse. Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling.

General hygiene considerations Do not eat, drink or smoke when using this product. Wash hands before breaks and after work.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials Strong oxidizing agents

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Control parameters

Exposure Limits .

Chemical Name	Australia
Acetic acid 64-19-7	10 ppm 25 mg/m^3 15 ppm STEL 37 mg/m^3 STEL

Biological occupational exposure limits Not applicable

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear suitable protective clothing.

Respiratory protection In case of inadequate ventilation wear respiratory protection.

Environmental exposure controls Do not allow into any sewer, on the ground or into any body of water.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Liquid		
Appearance	liquid	**Odor**	Slight.
Color	No information available	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	7 - 9	
Melting point / freezing point		No information available
Boiling point / boiling range	100 °C	
Flash point	> 100 °C	
Evaporation rate		No information available
Flammability (solid, gas)		Not applicable
Flammability Limit in Air		No information available
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	0.95-1.05	
Water solubility	Soluble in water	
Solubility(ies)		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		
Dynamic viscosity		

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Density	No information available
Bulk density	No information available
Particle Size	No information available
Particle Size Distribution	No information available

Section 10: STABILITY AND REACTIVITY

Reactivity

Reactivity No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Possibility of Hazardous Reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials Strong oxidizing agents.

Hazardous Decomposition Products

Hazardous Decomposition Products None known based on information supplied.

Section 11: TOXICOLOGICAL INFORMATION

Acute toxicity

Information on likely routes of exposure

Product Information .

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available

Symptoms No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral) 7,023.00 mg/kg

ATEmix (dermal) 26,500.00 mg/kg
ATEmix (inhalation-dust/mist) 285.00 mg/l

Unknown acute toxicity 28 % of the mixture consists of ingredient(s) of unknown toxicity
5 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
25 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
28 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
28 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
25 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	= 1500 mg/kg (Rat)	-	-
Acetic acid	= 3310 mg/kg (Rat)	= 1060 mg/kg (Rabbit)	= 11.4 mg/L (Rat) 4 h

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation Irritating to skin.

Serious eye damage/eye irritation Risk of serious damage to eyes.

Respiratory or skin sensitization May cause an allergic skin reaction.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity

Ecotoxicity The environmental impact of this product has not been fully investigated.

Unknown aquatic toxicity 5 % of the mixture consists of component(s) of unknown hazards to the aquatic environment.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Acetic acid	-	75: 96 h Lepomis macrochirus mg/L LC50 static 79: 96 h Pimephales promelas mg/L LC50 static	EC50 = 8.8 mg/L 15 min EC50 = 8.8 mg/L 25 min EC50 = 8.8 mg/L 5 min	47: 24 h Daphnia magna mg/L EC50 65: 48 h Daphnia magna mg/L EC50 Static

Persistence and degradability

Persistence and degradability No information available.

Bioaccumulative potential

Bioaccumulation .

Component Information

Chemical Name	Partition coefficient
Acetic acid	-0.31

Mobility

Mobility in soil No information available.

Mobility No information available.

Other adverse effects

Other adverse effects No information available.

Section 13: DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

Section 14: TRANSPORT INFORMATION

ADG Not regulated

IATA Not regulated

IMDG Not regulated

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No information available

Section 15: REGULATORY INFORMATION

Regulatory information

National regulations

Australia
See section 8 for national exposure control parameters

Standard for Uniform Scheduling of Medicines and Poisons (SUSMP)
No poisons schedule number allocated

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies

ENCS	Does not comply
IECSC	Does not comply
KECL	Does not comply
PICCS	Does not comply
AICS	Does not comply
NZIoC	Does not comply

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

International Regulations

Ozone-depleting substances (ODS) Not applicable

Persistent Organic Pollutants Not applicable

Export Notification requirements Not applicable

Section 16: ANY OTHER RELEVANT INFORMATION

Issue Date 28-Sep-2016

Revision Date 04-Jan-2018

Revision Note
No information available.

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation
C	Carcinogen		

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End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **MAGNESIUM OXIDE**

Synonyms CALCINED MAGNESIA ● MAGNESIA ● MAGOXI16 / 27 - PRODUCT CODE

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE ● PH INDICATOR

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
MAGNESIUM OXIDE	[redacted]	215-171-9	>94%
CALCIUM OXIDE	[redacted]	215-138-9	<3.5%
SILICON DIOXIDE (SILICA, AMORPHOUS)	[redacted]	231-545-4	<2.5%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed
See Section 11 for more detailed information on health effects and symptoms.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture
Non flammable. May evolve magnesium oxides when heated to decomposition.

5.3 Advice for firefighters
Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Ventilate area where possible.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure product is adequately labelled, protected from physical damage and sealed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Calcium oxide	SWA [AUS]	--	2	--	--
Calcium oxide	SWA [Proposed]	--	1	--	--
Fumed silica (respirable dust)	SWA [AUS]	--	2	--	--
Magnesium oxide (fume)	SWA [AUS]	--	10	--	--

Biological limits
No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	Not required under normal conditions of use.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE GRANULES
Odour	ODOURLESS
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	3600°C
Melting point	2800°C
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Specific gravity	3.6 - 3.7
Solubility (water)	SLIGHTLY SOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

9.2 Other information

% Volatiles	0 %

10. STABILITY AND REACTIVITY

10.1 Reactivity
Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability
Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions
Polymerization is not expected to occur.

10.4 Conditions to avoid
Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible (violently) with interhalogens (e.g. bromine pentafluoride, chlorine trifluoride) and phosphorus pentachloride. May ignite or explode when heated with aluminium powder. Also incompatible with acids (e.g. nitric acid) and dampness as material hydrates.

10.6 Hazardous decomposition products

May evolve magnesium oxides when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity Based on available data, the classification criteria are not met.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
SILICON DIOXIDE (SILICA, AMORPHOUS)	3160 mg/kg (rat)	--	--

Skin Contact may result in irritation, redness, rash and dermatitis.

Eye Contact may result in irritation, lacrimation, pain and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity Not classified as a mutagen.

Carcinogenicity Not classified as a carcinogen.

Reproductive Not classified as a reproductive toxin.

STOT - single exposure Not classified as causing organ damage from single exposure. However, over exposure may result in irritation of the nose and throat, with coughing.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration Not classified as causing aspiration.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No information provided.

12.2 Persistence and degradability

The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Not expected to bioaccumulate.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal For small amounts, cover with moist sand, vermiculite or similar to avoid dust hazard and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information if disposing of large quantities (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safework Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals.

Inventory listings **AUSTRALIA: AICS (Australian Inventory of Chemical Substances)**
All components are listed on AICS, or are exempt.

16. OTHER INFORMATION

Additional information

EXPOSURE STANDARDS - TIME WEIGHTED AVERAGES: Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: Strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation).

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

SAFETY DATA SHEET

NDFT 325

Issue Date 11-Jul-2019 **Revision Date** 14-Sep-2020 **Version** 2.1

1. IDENTIFICATION

Product identifier

Product Name NDFT 325

Other means of identification

Product Code NDF00247

UN/ID no UN 1993

Synonyms None

Recommended use of the chemical and restrictions on use

Recommended Use Corrosion inhibitor

Uses advised against No information available

Details of the supplier of the safety data sheet

Supplier
Newpark Drilling Fluids
635 6th Avenue S.W.
Suite 300
Calgary, AB T2P 0T5

Emergency telephone number

Emergency Telephone Chemtrec - US +1 (800) 424-9300
Chemtrec - International +1 (703) 527-3887

2. HAZARDS IDENTIFICATION

Classification

Skin corrosion/irritation	Category 1 - (H314)
Serious eye damage/eye irritation	Category 1 - (H318)
Flammable liquids	Category 3

Label elements

Danger

Hazard statements
Causes severe skin burns and eye damage
Flammable liquid and vapor

Appearance liquid **Physical state** liquid **Odor** No information available

Precautionary Statements - Prevention
Do not breathe dusts or mists
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ ventilating / lighting/ . / equipment
Use only non-sparking tools
Take precautionary measures against static discharge

Precautionary Statements - Response
Immediately call a POISON CENTER or doctor
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower
Wash contaminated clothing before reuse
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Ingestion
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam to extinguish

Precautionary Statements - Storage
Store locked up
Store in a well-ventilated place. Keep cool

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other Information
May be harmful if swallowed. May be harmful in contact with skin. Harmful to aquatic life with long lasting effects.

Unknown acute toxicity 65 % of the mixture consists of ingredient(s) of unknown toxicity
0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
43 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
65 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
48 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
60 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Not applicable.

Mixture

Chemical name	CAS No.	Weight-%	Hazardous Material Information Review Act registry number (HMIRA registry #)	Date HMIRA filed and date exemption granted (if applicable)
Amine 2	Trade Secret	28-30	-	-
Ethanamine, N-ethyl-N-hydroxy-	[redacted]	17-19	-	-
Amine 1	Trade Secret	10-13	-	-
Ethanolamine	[redacted]	4-5	-	-

4. FIRST AID MEASURES

Description of first aid measures

General advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Inhalation Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur. Get immediate medical advice/attention. Get medical attention immediately if symptoms occur.

Eye contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention. Wash off immediately with soap and plenty of water for at least 15 minutes. Get medical attention if irritation develops and persists.

Ingestion Immediate medical attention is required. Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention. Call a physician.

Self-protection of the first aider Remove all sources of ignition. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Use personal protective equipment as required. See section 8 for more information. Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed

Symptoms Burning sensation.

Indication of any immediate medical attention and special treatment needed

Note to physicians Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media Dry chemical. Carbon dioxide (CO2). Water spray. Alcohol resistant foam.

Unsuitable extinguishing media CAUTION: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical Risk of ignition. Keep product and empty container away from heat and sources of ignition. In the event of fire, cool tanks with water spray. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous combustion products Carbon oxides. Nitrogen oxides (NOx).

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge Yes.

Special protective equipment and precautions for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Evacuate personnel to safe areas. Use personal protective equipment as required. See section 8 for more information. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Pay attention to flashback. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Attention! Corrosive material.

Other Information Ventilate the area. Refer to protective measures listed in Sections 7 and 8.

Environmental precautions

Environmental precautions Refer to protective measures listed in Sections 7 and 8. Prevent further leakage or spillage if safe to do so. Prevent product from entering drains. Should not be released into the environment. Do not allow to enter into soil/subsoil.

Methods and material for containment and cleaning up

Methods for containment Stop leak if you can do it without risk. Do not touch or walk through spilled material. A vapor suppressing foam may be used to reduce vapors. Dike far ahead of spill to collect runoff water. Keep out of drains, sewers, ditches and waterways. Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.

Methods for cleaning up Take precautionary measures against static discharges. Dam up. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Use personal protection equipment. Avoid contact with skin and eyes. Avoid breathing vapors or mists. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Take precautionary measures against static discharges. Use grounding and bonding connection when transferring this material to prevent static

discharge, fire or explosion. Use with local exhaust ventilation. Use spark-proof tools and explosion-proof equipment. Keep in an area equipped with sprinklers. Use according to package label instructions. Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment. Handle product only in closed system or provide appropriate exhaust ventilation. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash before reuse.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Keep in properly labeled containers. Do not store near combustible materials. Keep in an area equipped with sprinklers. Store in accordance with the particular national regulations. Store in accordance with local regulations. Protect from moisture. Store locked up. Keep out of the reach of children. Store away from other materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Limits .

Chemical name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethanamine, N-ethyl-N-hydroxy- 3710-84-7	TWA: 2 ppm	-	-
Amine 1	TWA: 5 mg/m³	-	-
Ethanolamine 141-43-5	STEL: 6 ppm TWA: 3 ppm	TWA: 3 ppm TWA: 6 mg/m³ (vacated) TWA: 3 ppm (vacated) TWA: 8 mg/m³ (vacated) STEL: 6 ppm (vacated) STEL: 15 mg/m³	IDLH: 30 ppm TWA: 3 ppm TWA: 8 mg/m³ STEL: 6 ppm STEL: 15 mg/m³

Chemical name	Alberta	British Columbia	Ontario TWA	Quebec
Ethanamine, N-ethyl-N-hydroxy- 3710-84-7			TWA: 2 ppm	
Amine 1	TWA: 5 mg/m³	TWA: 5 mg/m³	TWA: 0.5 ppm TWA: 3.1 mg/m³	TWA: 5 mg/m³
Ethanolamine 141-43-5	TWA: 3 ppm TWA: 7.5 mg/m³ STEL: 6 ppm STEL: 15 mg/m³	TWA: 3 ppm STEL: 6 ppm	TWA: 3 ppm STEL: 6 ppm	TWA: 3 ppm TWA: 7.5 mg/m³ STEL: 6 ppm STEL: 15 mg/m³

Other Information Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles. Face protection shield.

Hand protection Wear suitable gloves. Impervious gloves.

Skin and body protection	Wear suitable protective clothing. Long sleeved clothing. Chemical resistant apron. Antistatic boots.
Respiratory protection	No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.
General hygiene considerations	Do not eat, drink or smoke when using this product. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product. Wash hands before breaks and after work. Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Remove and wash contaminated clothing and gloves, including the inside, before re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	liquid	**Color**	brown
Odor	No information available	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	11.5	
Melting point / freezing point	-20 °C / -4 °F	
Boiling point / boiling range		No information available
Flash point	> 40 °C / > 104 °F	
Evaporation rate		No information available
Flammability (solid, gas)		No information available
Flammability Limit in Air		No information available
Upper flammability limit:		
Lower flammability limit:		
Vapor pressure		No information available
Vapor density		No information available
Specific Gravity	1.00 - 1.10	
Water solubility		No information available
Solubility in other solvents		No information available
Partition coefficient		No information available
Autoignition temperature		No information available
Decomposition temperature		No information available
Kinematic viscosity		No information available
Dynamic viscosity		No information available
Explosive properties	No information available	
Oxidizing properties	No information available	

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	1.04-1.06 g/cm3
Bulk density	No information available

10. STABILITY AND REACTIVITY

Reactivity	No information available.
Chemical stability	Stable under normal conditions.
Possibility of Hazardous Reactions	None under normal processing.
Conditions to avoid	Heat, flames and sparks. Exposure to air or moisture over prolonged periods.

Incompatible materials Acids. Bases. Oxidizing agent. Strong acids. Strong bases. Strong oxidizing agents.

Hazardous Decomposition Products Thermal decomposition can lead to release of irritating and toxic gases and vapors.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Inhalation Specific test data for the substance or mixture is not available. Corrosive by inhalation. (based on components). Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Inhaled corrosive substances can lead to a toxic edema of the lungs. Pulmonary edema can be fatal.

Eye contact Specific test data for the substance or mixture is not available. Causes burns. (based on components). Corrosive to the eyes and may cause severe damage including blindness. Severely irritating to eyes. Causes serious eye damage. May cause burns. May cause irreversible damage to eyes.

Skin contact Specific test data for the substance or mixture is not available. May cause irritation. May be harmful in contact with skin.

Ingestion Specific test data for the substance or mixture is not available. Causes burns. (based on components). Ingestion causes burns of the upper digestive and respiratory tracts. May cause severe burning pain in the mouth and stomach with vomiting and diarrhea of dark blood. Blood pressure may decrease. Brownish or yellowish stains may be seen around the mouth. Swelling of the throat may cause shortness of breath and choking. May cause lung damage if swallowed. May be fatal if swallowed and enters airways. Ingestion may cause irritation to mucous membranes. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. May be harmful if swallowed.

Information on toxicological effects

Symptoms Redness. Burning. May cause blindness. Coughing and/ or wheezing.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral)	2,961.00
ATEmix (dermal)	3,235.00
ATEmix (inhalation-dust/mist)	12.00
ATEmix (inhalation-vapor)	34.00

Unknown acute toxicity 65 % of the mixture consists of ingredient(s) of unknown toxicity
0 % of the mixture consists of ingredient(s) of unknown acute oral toxicity
43 % of the mixture consists of ingredient(s) of unknown acute dermal toxicity
65 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (gas)
48 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (vapor)
60 % of the mixture consists of ingredient(s) of unknown acute inhalation toxicity (dust/mist)

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Amine 2	= 1500 mg/kg (Rat)	-	-
Ethanamine, N-ethyl-N-hydroxy- 3710-84-7	= 2190 mg/kg (Rat)	= 1300 mg/kg (Rabbit)	= 11.44 mg/L (Rat) 4 h

Amine 1	= 4190 mg/kg (Rat)	> 20000 mg/kg (Rabbit)	-
Ethanolamine 141-43-5	= 1720 mg/kg (Rat)	= 1000 mg/kg (Rabbit)	-

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation MAY CAUSE SKIN IRRITATION.

Component Information					
Amine 2					
Method	Species	Exposure route	Effective dose	Exposure time	Results
OECD 404	Rabbit	Dermal		4 hours	non-irritant

Serious eye damage/eye irritation Classification based on data available for ingredients. Causes burns. Risk of serious damage to eyes.

Component Information					
Amine 2					
Method	Species	Exposure route	Effective dose	Exposure time	Results
OPPTS: 870.2400	Rabbit	Eye			Irritant

Respiratory or skin sensitization No information available.

Component Information			
Amine 2			
Method	Species	Exposure route	Results
OECD 406	Guinea pig	Dermal	Not a skin sensitizer

Germ cell mutagenicity No information available.

Component Information		
Amine 2		
Method	Species	Results
OECD 474	in vivo	Not mutagenic

Carcinogenicity No information available.

Chemical name	ACGIH	IARC	NTP	OSHA
Amine 1	-	Group 3	-	-

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Target Organ Effects Central nervous system, Eyes, Respiratory system, Skin.

Aspiration hazard No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity The environmental impact of this product has not been fully investigated.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Amine 2	-	45: 96 h Oncorhynchus mykiss mg/L LC50 semi-static	-	-

Amine 1	169: 96 h Desmodesmus subspicatus mg/L EC50 216: 72 h Desmodesmus subspicatus mg/L EC50	10600 - 13000: 96 h Pimephales promelas mg/L LC50 flow-through 450 - 1000: 96 h Lepomis macrochirus mg/L LC50 static 1000: 96 h Pimephales promelas mg/L LC50 static	-	-
Ethanolamine 141-43-5	15: 72 h Desmodesmus subspicatus mg/L EC50	114 - 196: 96 h Oncorhynchus mykiss mg/L LC50 static 300 - 1000: 96 h Lepomis macrochirus mg/L LC50 static 227: 96 h Pimephales promelas mg/L LC50 flow-through 3684: 96 h Brachydanio rerio mg/L LC50 static 200: 96 h Oncorhynchus mykiss mg/L LC50 flow-through	EC50 = 110 mg/L 17 h EC50 = 12200 mg/L 2 h EC50 = 13.7 mg/L 30 min	65: 48 h Daphnia magna mg/L EC50

Persistence and degradability No information available.

Component Information			
Ethanolamine (141-43-5)			
Method	Exposure time	Value	Results
OECD Test No. 301A: Ready Biodegradability: DOC Die-Away Test (TG 301 A)	21 days	90	Readily biodegradable

Bioaccumulation .

Chemical name	Partition coefficient
Amine 1	-2.53
Ethanolamine 141-43-5	-1.91

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Waste from residues/unused products Should not be released into the environment. Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Empty containers pose a potential fire and explosion hazard. Do not cut, puncture of weld containers.

US EPA Waste Number D001.

14. TRANSPORT INFORMATION

DOT

UN/ID no	UN 1993
Proper shipping name	Flammable liquid, n.o.s. (Contains Ethanamine,N-ethyl-N-hydroxy,)
Hazard class	3
Packing Group	III

TDG

UN/ID no	UN 1993
Proper shipping name	Flammable liquid, n.o.s. (Contains Ethanamine,N-ethyl-N-hydroxy,)
Hazard Class	3
Packing Group	III

IATA

UN/ID no	UN 1993
Proper shipping name	Flammable liquid, n.o.s. (Contains Ethanamine,N-ethyl-N-hydroxy,)
Hazard Class	3
Packing Group	III

IMDG

UN/ID no	UN 1993
Proper shipping name	Flammable liquid, n.o.s. (Contains Ethanamine,N-ethyl-N-hydroxy,)
Hazard Class	3
Packing Group	III

15. REGULATORY INFORMATION

Regulatory information

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer	Not applicable
The Stockholm Convention on Persistent Organic Pollutants	Not applicable
The Rotterdam Convention	Not applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Does not comply
PICCS	Does not comply
AICS	Complies
NZIoC	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	Yes
Fire hazard	Yes
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

US State Regulations

Chemical name	New Jersey	Massachusetts	Pennsylvania
hydroxylamine 2	X	Not reviewed	X
Ethanolamine 141-43-5	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA	**Health hazards** 3	**Flammability** 2	**Instability** 0	**Physical and chemical properties** -
HMIS	**Health hazards** 3	**Flammability** 2	**Physical hazards** 0	**Personal protection** X

Issue Date 11-Jul-2019

Revision Date 14-Sep-2020

Revision Note No information available.

Disclaimer
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End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **NEWPAC LV/RD**

Synonyms NEWPAC RD ● POLICELL RG ● RHEOPAC LV ● RHEOPAC R ● RHEOPAC R/LV/UL/RD/LVD ● RHEOPAC UL

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SODIUM CARBOXYMETHYL CELLULOSE	[redacted]	618-378-6	>88%
SODIUM CHLORIDE	[redacted]	231-598-3	<1.8%
WATER	[redacted]	231-791-2	<10%
SODIUM GLYCOLATE	[redacted]	212-730-9	<0.7%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If

swallowed, do not induce vomiting. Ingestion is considered unlikely due to product form.

First aid facilities Normal washroom facilities should be available.

4.2 Most important symptoms and effects, both acute and delayed

Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains or waterways.

5.2 Special hazards arising from the substance or mixture

Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition. Finely divided dust may form explosive mixtures with air.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled and tightly closed when not in use.

7.3 Specific end uses

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas. Maintain dust levels below the recommended exposure standard.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	WHITE OR YELLOWISH POWDER/GRANULES
Odour	SLIGHT ODOUR
Flammability	COMBUSTIBLE
Flash point	NOT AVAILABLE
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	6.0 to 8.5 (1 % solution)
Vapour density	NOT AVAILABLE
Solubility (water)	SOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT AVAILABLE
Lower explosion limit	NOT AVAILABLE
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated.
Toxicity Data available on the ingredients:
SODIUM CARBOXYMETHYL CELLULOSE (9004-32-4)
LD50 (Ingestion): 16000 mg/kg (guinea pig)
LD50 (Skin): > 2000 mg/kg (rabbit)
TDLo (Ingestion): 140 mg/kg (rat)
SODIUM CHLORIDE (7647-14-5)
LC50 (Inhalation): > 42000 mg/m3/1 hour (rat)
LD50 (Ingestion): 3000 mg/kg (rat)
LD50 (Intraperitoneal): 2602 mg/kg (mouse)
LD50 (Intravenous): 645 mg/kg (mouse)
LD50 (Skin): > 10000 mg/kg (rabbit)
LD50 (Subcutaneous): 3000 mg/kg (mouse)
LDLo (Ingestion): 8000 mg/kg (rabbit)
LDLo (Intravenous): 300 mg/kg (guinea pig)
LDLo (Subcutaneous): 2160 mg/kg (guinea pig)
TDLo (Ingestion): 12357 mg/kg (human)
SODIUM GLYCOLATE (2836-32-0)
LD50 (Ingestion): 6700 mg/kg (mouse)
LDLo (Ingestion): 500 mg/kg (cat)

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
SODIUM CARBOXYMETHYL CELLULOSE	16000 mg/kg (guinea pig)	> 2000 mg/kg (rabbit)	--
SODIUM CHLORIDE	3000 mg/kg (rat)	> 10000 mg/kg (rabbit)	> 42000 mg/m³/1 hour (rat)
SODIUM GLYCOLATE	6700 mg/kg (mouse)	--	--

Additional ingredient toxicity values:

SODIUM CARBOXYMETHYL CELLULOSE (9004-32-4)
TDLo (oral) 140 mg/kg (rat)

SODIUM CHLORIDE (7647-14-5)
LD50 (intraperitoneal) 2602 mg/kg (mouse)
LD50 (intravenous) 645 mg/kg (mouse)
LD50 (subcutaneous) 3000 mg/kg (mouse)
LDLo (intravenous) 300 mg/kg (guinea pig)
LDLo (oral) 8000 mg/kg (rabbit)
LDLo (subcutaneous) 2160 mg/kg (guinea pig)
TDLo (oral) 12357 mg/kg (human)

SODIUM GLYCOLATE (2836-32-0)
LDLo (oral) 500 mg/kg (cat)

Skin Not classified as a skin irritant. Contact may result in mild irritation.

Eye Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity No evidence of mutagenic effects.

Carcinogenicity No evidence of carcinogenic effects.

Reproductive No relevant or reliable studies were identified.

STOT - single exposure Not classified as causing organ damage from single exposure.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

LC50 (Fresh Water Trout) > 21,000 ppm/96hrs.
LC50 (Salt Water Stickel Back) > 56,000 ppm/96hrs.

12.2 Persistence and degradability

No information provided.

12.3 Bioaccumulative potential

Not expected to bioaccumulate.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

This product is not anticipated to cause adverse effects to animal or plant life if released to the environment in small quantities.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

HALLIBURTON

SAFETY DATA SHEET

OXYGON™

Revision Date: 25-Mar-2020 **Revision Number:** 31

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name OXYGON™

Other means of Identification

Synonyms None

Hazardous Material Number: HM003723

Recommended use of the chemical and restrictions on use

Recommended Use Oxygen Scavenger

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Not classified

Label elements, including precautionary statements

Hazard Pictograms

Signal Word Not Hazardous

Hazard Statements: Not Classified

Precautionary Statements

Prevention None
Response None
Storage None
Disposal None

Contains

Substances	**CAS Number**
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA

Other hazards which do not result in classification
This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not classified

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Symptoms caused by exposure
No significant hazards expected.

Medical Attention and Special Treatment
Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Specific hazards arising from the chemical
Special exposure hazards in a fire
Not applicable

Special protective equipment and precautions for fire fighters
Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Avoid creating or inhaling dust. Avoid contact with eyes, skin, or clothing. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

Other Guidelines

No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring

Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

Appropriate engineering controls

Engineering Controls Use in a well ventilated area.

Personal protective equipment (PPE)

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Environmental Exposure Controls Do not allow material to contaminate ground water system.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Solid Powder	**Color**	White
Odor:	Odorless	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	5.5-8 (5%)
Freezing Point / Range	No data available
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Upper flammability limit	0.5 oz/ft3
Lower flammability limit	0.28 oz/ft3
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.2
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	640 °C / 1184 °F
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%)	No data available
Bulk Density	45-65 lbs/ft3

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
None anticipated
10.5. Incompatible materials
Strong oxidizers.
10.6. Hazardous decomposition products
Carbon monoxide and carbon dioxide.

11. Toxicological Information

Information on routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

Symptoms related to exposure
Most Important Symptoms/Effects
No significant hazards expected.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation

Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

Immediate, delayed and chronic health effects from exposure

Inhalation May cause mild respiratory irritation.
Eye Contact May cause mechanical irritation to eye.
Skin Contact None known.
Ingestion None known.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels
No data available

Interactive effects
None known.

Data limitations
No data available

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Contains no hazardous substances in concentrations above cut-off values according to	NA	No information available

the competent authority		

12.4. Mobility in soil

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Bury in a licensed landfill according to federal, state, and local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Special precautions during transport

None

HazChem Code

None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory All components are listed on the AICS or are subject to a relevant exemption, permit, or

	assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 25-Mar-2020

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
None

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
NZ CCID

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **POLYDRILL**

Synonyms POLY DRILL

1.2 Uses and uses advised against

Uses ADDITIVE ● DRILLING FLUID ADDITIVE

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website http://www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
SULPHONATED ORGANIC POLYMER	-	-	100%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting. Ingestion is considered unlikely due to product form.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed
Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media
Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains or waterways.

5.2 Special hazards arising from the substance or mixture
Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition. Finely divided dust may form explosive mixtures with air.

5.3 Advice for firefighters
Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code
None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions
Prevent product from entering drains and waterways.

6.3 Methods of cleaning up
Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled and tightly closed when not in use.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	RED BROWN POWDER
Odour	CHARACTERISTIC ODOUR
Flammability	COMBUSTIBLE
Flash point	NOT RELEVANT
Boiling point	> 370°C
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	7 to 9 (150 g/L)
Vapour density	NOT AVAILABLE
Relative density	1.8
Solubility (water)	320 g/L
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products

May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity Acute oral toxicity: LD50 (rat) > 5000 mg/kg (low toxicity). Under normal conditions of use, adverse health

effects are not anticipated.

Information available for the ingredients:

Ingredient	Oral LD50	Dermal LD50	Inhalation LC50
SULPHONATED ORGANIC POLYMER	> 5000 mg/kg (rat)	--	--

Skin Not classified as a skin irritant. Contact may result in mild irritation.

Eye Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.

Sensitisation Not classified as causing skin or respiratory sensitisation.

Mutagenicity No evidence of mutagenic effects.

Carcinogenicity No evidence of carcinogenic effects.

Reproductive No relevant or reliable studies were identified.

STOT - single exposure Not classified as causing organ damage from single exposure.

STOT - repeated exposure Not classified as causing organ damage from repeated exposure.

Aspiration This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Oncorhynchus mykiss (Rainbow Trout) LC 50 (96 Hr) is 4,430 mg/L.
Pseudomonas putida EC 10 (growth inhibition) is > 32,000 mg/L.

12.2 Persistence and degradability

This product is not readily biodegradable.

12.3 Bioaccumulative potential

No information provided.

12.4 Mobility in soil

No information provided.

12.5 Other adverse effects

No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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[End of SDS]

SAFETY DATA SHEET

EvoLube® TR

NDF00132 **Revision Date** 22-Oct-2015 **Version** 1

1. IDENTIFICATION

Product identifier
Product Name EvoLube® TR

Recommended use of the chemical and restrictions on use
Recommended Use Lubricant

Details of the supplier of the safety data sheet
Supplier
Newpark Drilling Fluids LLC
21920 Merchants Way
Katy, Texas 77449
Tel: +1 (800)-444-0682
http://www.newpark.com/

Emergency telephone number
Emergency Telephone Chemtrec - US +1 (800) 424-9300
Chemtrec - International +1 (703) 527-3887

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute toxicity - Oral	Category 4 - (H302)
Acute toxicity - Inhalation (Dusts/Mists)	Category 4 - (H332)
Serious eye damage/eye irritation	Category 1 - (H318)
Carcinogenicity	Category 2 - (H351)
Specific target organ toxicity (repeated exposure)	Category 2 - (H373)

Label elements

Emergency Overview

Danger

Hazard statements
H302 - Harmful if swallowed
H318 - Causes serious eye damage
H332 - Harmful if inhaled
H351 - Suspected of causing cancer
H373 - May cause damage to organs through prolonged or repeated exposure

Appearance No information available **Physical state** liquid **Odor** No information available

Precautionary statements
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P330 - Rinse mouth
P261 - Avoid breathing dust/fume/gas/mist/vapors/spray
P271 - Use only outdoors or in a well-ventilated area
P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P312 - Call a POISON CENTER or doctor/physician if you feel unwell
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor/physician
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P281 - Use personal protective equipment as required
P308 + P313 - IF exposed or concerned: Get medical advice/attention
P405 - Store locked up
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P314 - Get medical advice/attention if you feel unwell
P501 - Dispose of contents/ container to an approved waste disposal plant
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P501 - Dispose of contents/container to industrial incineration plant

Hazards not otherwise classified (HNOC)
Not applicable

Other Information
May be harmful in contact with skin. Causes mild skin irritation.

Unknown acute toxicity 84 % of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Chemical Name	CAS No.	Weight-%
Triethylene glycol, monobutyl ether	143-22-6	7 - 13*
2-Butoxyethanol	111-76-2	3 - 7*
Diethanolamine	111-42-2	1 - 5*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

General advice In case of accident or unwellness, seek medical advice immediately (show directions for use or safety data sheet if possible).

Eye contact Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Keep eyes wide open while rinsing. If symptoms persist, call a physician.

Skin contact Wash skin with soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing before reuse. Get medical attention if irritation develops and persists.

Inhalation Remove to fresh air. If not breathing, give artificial respiration. If symptoms persist, call a physician.

Ingestion Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Do not induce vomiting without medical advice. If symptoms persist, call a physician.

Self-protection of the first aider Use personal protective equipment as required.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media CAUTION: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical
No information available.

Hazardous combustion products Carbon oxides, Nitrogen oxides (NOx)

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation, especially in confined areas. Keep people away from and upwind of spill/leak.

For emergency responders In the case of vapor formation use a respirator with an approved filter.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so. Dike to collect large liquid spills.

Methods for cleaning up Use personal protective equipment as required. Use a non-combustible material like vermiculite or sand to soak up the product and place into a container for later disposal. Use clean non-sparking tools to collect absorbed material.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Wash contaminated clothing before reuse.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

Incompatible materials Strong acids. Strong oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
2-Butoxyethanol 111-76-2	TWA: 20 ppm	TWA: 50 ppm TWA: 240 mg/m³ (vacated) TWA: 25 ppm (vacated) TWA: 120 mg/m³ (vacated) S* S*	IDLH: 700 ppm TWA: 5 ppm TWA: 24 mg/m³
Diethanolamine 111-42-2	TWA: 1 mg/m³ inhalable fraction and vapor S*	(vacated) TWA: 3 ppm (vacated) TWA: 15 mg/m³	TWA: 3 ppm TWA: 15 mg/m³

NIOSH IDLH Immediately Dangerous to Life or Health

Other Information Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Appropriate engineering controls

Engineering Controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection Tight sealing safety goggles.

Skin and body protection Wear protective gloves and protective clothing.

Respiratory protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	liquid		
Appearance	No information available	**Odor**	No information available
Color	clear to Pale yellow	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	8.9	5% solution
Melting point / freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	> 93 °C / > 200 °F	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	0.94	
Water solubility	No information available	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Explosive properties	No information available	
Oxidizing properties	No information available	

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Density	No information available
Bulk density	No information available

10. STABILITY AND REACTIVITY

Reactivity
No data available

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
Hazardous polymerization does not occur.

Conditions to avoid
Extremes of temperature and direct sunlight. Incompatible materials.

Incompatible materials
Strong acids. Strong oxidizing agents.

Hazardous Decomposition Products
None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information No data available

Inhalation No data available.

Eye contact No data available.

Skin contact No data available.

Ingestion No data available.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Triethylene glycol, monobutyl ether 143-22-6	= 5300 mg/kg (Rat)	= 3480 mg/kg (Rabbit)	-
2-Butoxyethanol 111-76-2	= 470 mg/kg (Rat)	= 99 mg/kg (Rabbit)	= 450 ppm (Rat) 4 h
Diethanolamine 111-42-2	= 620 µL/kg (Rat) = 0.62 mL/kg (Rat)	= 7640 µL/kg (Rabbit)	-

Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.
Germ cell mutagenicity No information available.
Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
2-Butoxyethanol 111-76-2	A3	Group 3	-	-
Diethanolamine 111-42-2	A3	Group 2B	-	X

ACGIH (American Conference of Governmental Industrial Hygienists)
A3 - Animal Carcinogen
IARC (International Agency for Research on Cancer)
Group 2B - Possibly Carcinogenic to Humans
Not classifiable as a human carcinogen
OSHA (Occupational Safety and Health Administration of the US Department of Labor)
X - Present

Reproductive toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Chronic toxicity May cause adverse effects on the bone marrow and blood-forming system. May cause adverse liver effects.
Target Organ Effects blood, Central nervous system, Eyes, Hematopoietic System, kidney, liver, Respiratory system, Skin.
Aspiration hazard No information available.

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral) 500.00 mg/kg
ATEmix (dermal) 2,022.00 mg/kg mg/l
ATEmix (inhalation-dust/mist) 1.50 mg/l
ATEmix (inhalation-vapor) 450.00 mg/l

12. ECOLOGICAL INFORMATION

Ecotoxicity

84 % of the mixture consists of component(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea

Triethylene glycol, monobutyl ether 143-22-6	500: 72 h Desmodesmus subspicatus mg/L EC50	2200 - 4600: 96 h Leuciscus idus mg/L LC50 static 2400: 96 h Pimephales promelas mg/L LC50 static 2400: 96 h Pimephales promelas mg/L LC50	500: 48 h Daphnia magna mg/L EC50
2-Butoxyethanol 111-76-2	-	2950: 96 h Lepomis macrochirus mg/L LC50 1490: 96 h Lepomis macrochirus mg/L LC50 static	1000: 48 h Daphnia magna mg/L EC50 1698 - 1940: 24 h Daphnia magna mg/L EC50
Diethanolamine 111-42-2	7.8: 72 h Desmodesmus subspicatus mg/L EC50 2.1 - 2.3: 96 h Pseudokirchneriella subcapitata mg/L EC50	4460 - 4980: 96 h Pimephales promelas mg/L LC50 flow-through 1200 - 1580: 96 h Pimephales promelas mg/L LC50 static 600 - 1000: 96 h Lepomis macrochirus mg/L LC50 static	55: 48 h Daphnia magna mg/L EC50

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Mobility
No information available.

Chemical Name	Partition coefficient
Triethylene glycol, monobutyl ether 143-22-6	0.51
2-Butoxyethanol 111-76-2	0.81
Diethanolamine 111-42-2	-2.18

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Do not reuse container. Dispose of in accordance with federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT Not regulated.

TDG Not regulated

MEX Not regulated

ICAO (air) Not regulated

IATA Not regulated

IMDG Not regulated

RID Not regulated

ADR Not regulated

ADN Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies
NZIoC	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

Chemical Name	SARA 313 - Threshold Values %
Triethylene glycol, monobutyl ether - 143-22-6	1.0
2-Butoxyethanol - 111-76-2	1.0
Diethanolamine - 111-42-2	1.0

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	Yes
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	Reportable Quantity (RQ)
Diethanolamine 111-42-2	100 lb	-	RQ 100 lb final RQ RQ 45.4 kg final RQ

US State Regulations

California Proposition 65

This product contains the following Proposition 65 chemicals

Chemical Name	California Proposition 65
Diethanolamine - 111-42-2	Carcinogen

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Vegetable oil	-	-	X
Triethylene glycol, monobutyl ether 143-22-6	X	-	X
2-Butoxyethanol 111-76-2	X	X	X
Diethanolamine 111-42-2	X	X	X

U.S. EPA Label Information
EPA Pesticide Registration Number Not applicable

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR
WHMIS Hazard Class

D2A - Very toxic materials 

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA		HMIS	
Health hazards	2	**Health hazards**	2
Flammability	1	**Flammability**	1
Instability	0	**Physical hazards**	0
Physical and Chemical Properties	-	**Personal protection**	X

Revision Date 22-Oct-2015

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End of Safety Data Sheet

RADIAGREEN EBL

Safety Data Sheet

according to Regulation (EC) No. 1907/2006 (REACH) with its amendment Regulation (EU) 2015/830

Issue date: 31/07/2021 Revision date: 08/03/2021 Supersedes version of: 08/03/2021 Version: 2.19

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture (UVCB)

Generic name : RADIAGREEN EBL

REACH number : all the ingredients of this product in the scope of Regulation 1907/2006/EC (REACH), if not exempted, have been registered.

C&L notification reference no : all the ingredients of this product in the scope of Regulation 1272/2008/EC (CLP), if not exempted, have been notified to the C&L Inventory.

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Main use category : Industrial use

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

OLEON N.V.
Assenedestraat 2
9940 Ertvelde - Belgium
T +32 9 341 10 11 - F +32 9 341 10 00
info@oleon.com - www.oleon.com
E-mail address of competent person responsible for the SDS : sds@oleon.com

1.4. Emergency telephone number

Emergency number : 24/7 EMERGENCY NUMBER (SGS ERS; Oleon contract nr 76858)
+32 3 575 55 55 (worldwide); +1 888 765 6554 (USA tollfree)

Country	Official advisory body	Address	Emergency number	Comment
	World directory of poisons centres (Yellow Tox) WHO-OMS	Website	http://www.who.int/gho/phe/chemical_safety/poisons_centres/en/	

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Serious eye damage/eye irritation Not classified — Conclusive but not sufficient for classification

Full text of H- and EUH-statements: see section 16

Adverse physicochemical, human health and environmental effects

Not classified as dangerous according to the criteria of Australian NOHSC (not hazardous; not dangerous goods). According to ABNT NBR 14725-2, no labeling obligation.

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

EUH-statements : EUH210 - Safety data sheet available on request.

2.3. Other hazards

Other hazards which do not result in classification : None under normal conditions.

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Fatty esters (Constituent)		> 60	Not classified
Specialities (Constituent)		< 40	Not classified

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : If you feel unwell, seek medical advice.

First-aid measures after inhalation : Remove victim to fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Rinse with water. Soap may be used. Take victim to a doctor if irritation persists.

First-aid measures after eye contact : Rinse with water. Consult an ophtalmologist if irritation persists.

First-aid measures after ingestion : Rinse mouth thoroughly with water. Call a poison center or a doctor if you feel unwell.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects : Unlikely to cause harmful effects.

4.3. Indication of any immediate medical attention and special treatment needed

No supplementary information available.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : AFFF foam. BC powder. Carbon dioxide. Dry sand. Dry chemical powder. Adapt extinguishing media to the environment.

Unsuitable extinguishing media : Solid water jet ineffective as extinguishing medium.

5.2. Special hazards arising from the substance or mixture

Fire hazard : DIRECT FIRE HAZARD: Combustible. INDIRECT FIRE HAZARD: Heating increases the fire hazard. Temperature above flashpoint: higher fire/explosion hazard.

Explosion hazard : No direct explosion hazard.

Reactivity in case of fire : On burning: release of (carbon monoxide - carbon dioxide).

5.3. Advice for firefighters

Other information : No supplementary information available.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Mark the danger area. Exposure to heat: have neighbourhood close doors and windows. Exposure to fire/heat: consider evacuation. Wash contaminated clothes.

6.1.1. For non-emergency personnel

Protective equipment : See "Material-Handling" to select protective clothing.

6.1.2. For emergency responders

Protective equipment : Use protective measures listed in Section 8.

6.2. Environmental precautions

Prevent soil and water pollution.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Clean contaminated surfaces with an excess of water and soap solution. Take up liquid spill into inert absorbent material, e.g.: dry sand/earth/vermiculite or powdered limestone.

Other information : No supplementary information available.

6.4. Reference to other sections

Handle waste materials in accordance with the provisions of Section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Smoking, eating and drinking should be prohibited in areas of storage and use.
Handling temperature	: ≥ 10 °C above melting point
Hygiene measures	: Wash hands before break and at end of works. Good standard of personal hygiene.

7.2. Conditions for safe storage, including any incompatibilities

Information on mixed storage	: KEEP SUBSTANCE AWAY FROM: heat sources.
Storage area	: Keep container in a well-ventilated place. Store at ambient temperature. Keep out of direct sunlight. Meet the legal requirements.
Special rules on packaging	: SPECIAL REQUIREMENTS: closing. correctly labelled. meet the legal requirements.
Packaging materials	: No supplementary information available.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Personal protective equipment:

Gloves. Protective clothing. Safety glasses.

Materials for protective clothing:
GIVE GOOD RESISTANCE: nitrile rubber

Personal protective equipment symbol(s):

Other information:

NOHSC Exposure Standards: no exposure standard applicable according to HSIS.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance (room temperature)	: Liquid.
Colour	: Yellow to amber.
Odour	: Sweet. characteristic.
Odour threshold	: No data available
pH	: 5 – 8
Relative evaporation rate (butylacetate=1)	: No data available
Melting point	: < -15 °C
Freezing point	: No data available
Boiling point	: > 250 °C
Flash point	: > 200 °C (ASTM D92)
Auto-ignition temperature	: > 300 °C
Decomposition temperature	: > Flash point
Flammability (solid, gas)	: No data available
Vapour pressure	: No supplementary information available
Relative vapour density at 20 °C	: No data available
Relative density	: No data available

Density	: ca. 983.2 kg/m³ (20°C) ca. 969.3 kg/m³ (40°C) ca. 927.7 kg/m³ (100°C)
Solubility	: Insoluble in water.
Partition coefficient n-octanol/water (Log Pow)	: > 5
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available
Explosive properties	: Product is not explosive.
Oxidising properties	: No data available
Explosive limits	: No data available

9.2. Other information

VOC content	: < 0.1 % (1999/13/EC; 2004/42/EC; 2010/75/EU)
Other properties	: Oily. Soluble in oils/fats. soluble in most organic solvents. Insoluble in water.

SECTION 10: Stability and reactivity

10.1. Reactivity
On burning: release of (carbon monoxide - carbon dioxide).

10.2. Chemical stability
Stable under normal conditions.

10.3. Possibility of hazardous reactions
No additional information available

10.4. Conditions to avoid
No supplementary information available.

10.5. Incompatible materials
No supplementary information available.

10.6. Hazardous decomposition products
No supplementary information available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral)	: Not classified
Acute toxicity (dermal)	: Not classified
Acute toxicity (inhalation)	: Not classified

RADIAGREEN EBL	
LD50 oral rat	> 5000 mg/kg Non-toxic

Fatty esters	
LD50 oral rat	> 5000 mg/kg Non-toxic

Specialities	
LD50 oral rat	> 2000 mg/kg
LD50 dermal rabbit	> 2000 mg/kg

Skin corrosion/irritation	: Not classified pH: 5 – 8
Serious eye damage/irritation	: Not classified pH: 5 – 8
Respiratory or skin sensitisation	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified

STOT-single exposure	: Not classified
STOT-repeated exposure	: Not classified
Aspiration hazard	: Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general	: According to literature: no environmental hazard.
Ecology - air	: No supplementary information available.
Ecology - water	: No bioaccumulation data available
Hazardous to the aquatic environment, short-term (acute)	: Not classified
Hazardous to the aquatic environment, long-term (chronic)	: Not classified

12.2. Persistence and degradability

Fatty esters	
Biodegradation	88.1 % (OECD 301B- BfB report OL58506.01.01 - 02/2006)

12.3. Bioaccumulative potential

RADIAGREEN EBL	
Partition coefficient n-octanol/water (Log Pow)	> 5

Fatty esters	
Partition coefficient n-octanol/water (Log Pow)	> 5

12.4. Mobility in soil

No additional information available

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Disposal	: Prevent dispersion by covering with dry absorbent,Scoop solid spill into closing containers,Scoop absorbed substance into closing containers,Clean contaminated surfaces with an excess of water and soap solution,Wash clothing and equipment after handling
Regional legislation (waste)	: No supplementary information available.
Ecology - waste materials	: Do not discharge into drains or the environment. Remove to an authorized waste treatment plant.
European List of Waste (LoW) code	: No supplementary information available

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN / RID

ADR	IMDG	IATA	ADN	RID
14.1. UN number				
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
14.2. UN proper shipping name				
Not classified as dangerous in the meaning of transport regulations (including Australian DG Code)	Not applicable	Not applicable	Not applicable	Not applicable

14.3. Transport hazard class(es)				
Not applicable	-	Not applicable	Not applicable	Not applicable
14.4. Packing group				
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
14.5. Environmental hazards				
Dangerous for the environment : No	Dangerous for the environment : No Marine pollutant : No	Dangerous for the environment : No	Dangerous for the environment : No	Dangerous for the environment : No
Marine pollutant: no				

14.6. Special precautions for user

Overland transport

Transport regulations (ADR) : Not subject

Transport by sea

Transport regulations (IMDG) : Not subject

Air transport

Transport regulations (IATA) : Not subject

Inland waterway transport

No data available

Rail transport

Transport regulations (RID) : Not subject

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

Contains no REACH substances with Annex XVII restrictions

Contains no substance on the REACH candidate list

Contains no REACH Annex XIV substances

Contains no substance subject to Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals.

Contains no substance subject to Regulation (EU) No 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

VOC content : < 0.1 % (1999/13/EC; 2004/42/EC; 2010/75/EU)

15.1.2. National regulations

Chemical inventories : Compliant with AICS, DSL, EU REACh, IECSC, NZIoC

KKDIK number (Turkey) : all the ingredients of this product in the scope of KKDIK, if not exempted, have been (pre-)registered.

Germany

Regulatory reference : Not classified according to Regulation Governing Systems for Handling Substances Hazardous to Waters (AwSV)

Hazardous Incident Ordinance (12. BImSchV) : Is not subject of the 12. BImSchV (Hazardous Incident Ordinance)

Netherlands

ABM category : B(4) - low hazard for aquatic organisms

SZW-lijst van kankerverwekkende stoffen : None of the components are listed

SZW-lijst van mutagene stoffen	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Borstvoeding	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Vruchtbaarheid	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Ontwikkeling	: None of the components are listed

Denmark

Danish product registration number	: 3462615

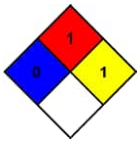
Switzerland

Storage class (LK)	: LK 10/12 - Liquids

15.2. Chemical safety assessment

No additional information available

SECTION 16: Other information

Training advice	: No supplementary information available.
SDS changed sections	: 15 - Regulatory information
SDS Reason for revision	: No supplementary information available
Chem. inventories legend	: AICS = Australian Inventory of Chemical Substances DSL = Canadian Domestic Sustances List ECST = Existing Chemical Substances Inventory of Taiwan EU REACh = European Union REACH Regulation 1907/2006 IECSC = Inventory of Existing Chemicals Substances in China KECL = Korean Existing Chemical List NZIoC = New Zealand Inventory of Chemicals TSCA = USA Toxic Substances Control Act VNCI = Vietnam National Chemicals Inventory
NFPA health hazard	: 0 - Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.
NFPA fire hazard	: 1 - Materials that must be preheated before ignition can occur.
NFPA reactivity	: 1 - Materials that in themselves are normally stable but can become unstable at elevated temperatures and pressures.
NFPA image	: 
Other information	: No supplementary information available.

Full text of H- and EUH-statements:	
EUH210	Safety data sheet available on request.
Eye Dam./Irrit. Not classified	Serious eye damage/eye irritation Not classified

SDS EU Oleon Annex II

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

RADIAGREEN EME SALT

Safety Data Sheet

according to Regulation (EC) No. 1907/2006 (REACH) with its amendment Regulation (EU) 2015/830

Issue date: 31/07/2021 Revision date: 15/03/2021 Supersedes version of: 15/03/2021 Version: 2.17

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture

Generic name : RADIAGREEN EME SALT

REACH number : all the ingredients of this product in the scope of Regulation 1907/2006/EC (REACH), if not exempted, have been registered.

C&L notification reference no : all the ingredients of this product in the scope of Regulation 1272/2008/EC (CLP), if not exempted, have been notified to the C&L Inventory.

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Main use category : Industrial use

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

OLEON N.V.
Assenedestraat 2
9940 Ertvelde - Belgium
T +32 9 341 10 11 - F +32 9 341 10 00
info@oleon.com - www.oleon.com
E-mail address of competent person responsible for the SDS : sds@oleon.com

1.4. Emergency telephone number

Emergency number : 24/7 EMERGENCY NUMBER (SGS ERS; Oleon contract nr 76858)
+32 3 575 55 55 (worldwide); +1 888 765 6554 (USA tollfree)

Country	Official advisory body	Address	Emergency number	Comment
	World directory of poisons centres (Yellow Tox) WHO-OMS	Website	http://www.who.int/gho/phe/chemical_safety/poisons_centres/en/	

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Serious eye damage/eye irritation Not classified — Conclusive but not sufficient for classification

Full text of H- and EUH-statements: see section 16

Adverse physicochemical, human health and environmental effects

Not classified as dangerous according to the criteria of Australian NOHSC (not hazardous; not dangerous goods). According to ABNT NBR 14725-2, no labeling obligation.

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

No labelling applicable

2.3. Other hazards

Other hazards which do not result in classification : None under normal conditions.

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Fatty esters (Constituent)		> 60	Not classified
Specialities (Constituent)		< 40	Not classified

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : If you feel unwell, seek medical advice.

First-aid measures after inhalation : Remove victim to fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Rinse with water. Soap may be used. Take victim to a doctor if irritation persists.

First-aid measures after eye contact : Rinse with water. Consult an ophtalmologist if irritation persists.

First-aid measures after ingestion : Rinse mouth thoroughly with water. Call a poison center or a doctor if you feel unwell.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects : Unlikely to cause harmful effects.

4.3. Indication of any immediate medical attention and special treatment needed

No supplementary information available.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : AFFF foam. BC powder. Carbon dioxide. Dry sand. Dry chemical powder. Adapt extinguishing media to the environment.

Unsuitable extinguishing media : Solid water jet ineffective as extinguishing medium.

5.2. Special hazards arising from the substance or mixture

Fire hazard : DIRECT FIRE HAZARD: Combustible. INDIRECT FIRE HAZARD: Heating increases the fire hazard. Temperature above flashpoint: higher fire/explosion hazard.

Explosion hazard : No direct explosion hazard.

Reactivity in case of fire : On burning: release of (carbon monoxide - carbon dioxide).

5.3. Advice for firefighters

Other information : No supplementary information available.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Mark the danger area. Exposure to heat: have neighbourhood close doors and windows. Exposure to fire/heat: consider evacuation. Wash contaminated clothes.

6.1.1. For non-emergency personnel

Protective equipment : See "Material-Handling" to select protective clothing.

6.1.2. For emergency responders

Protective equipment : Use protective measures listed in Section 8.

6.2. Environmental precautions

Prevent soil and water pollution.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Clean contaminated surfaces with an excess of water and soap solution. Take up liquid spill into inert absorbent material, e.g.: dry sand/earth/vermiculite or powdered limestone.

Other information : No supplementary information available.

6.4. Reference to other sections

Handle waste materials in accordance with the provisions of Section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Smoking, eating and drinking should be prohibited in areas of storage and use.
Handling temperature	: ≥ 10 °C above melting point
Hygiene measures	: Wash hands before break and at end of works. Good standard of personal hygiene.

7.2. Conditions for safe storage, including any incompatibilities

Information on mixed storage	: KEEP SUBSTANCE AWAY FROM: heat sources.
Storage area	: Keep container in a well-ventilated place. Store at ambient temperature. Keep out of direct sunlight. Meet the legal requirements.
Special rules on packaging	: SPECIAL REQUIREMENTS: closing. correctly labelled. meet the legal requirements.
Packaging materials	: No supplementary information available.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Exposure controls

Personal protective equipment:

Gloves. Protective clothing. Safety glasses.

Materials for protective clothing:
GIVE GOOD RESISTANCE: nitrile rubber

Personal protective equipment symbol(s):

Other information:

NOHSC Exposure Standards: no exposure standard applicable according to HSIS.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance (room temperature)	: Liquid.
Colour	: Yellow to amber.
Odour	: Sweet. characteristic.
Odour threshold	: No data available
pH	: 5 – 8
Relative evaporation rate (butylacetate=1)	: No data available
Melting point	: < -10 °C
Freezing point	: No data available
Boiling point	: > 250 °C
Flash point	: > 200 °C (ASTM D92)
Auto-ignition temperature	: > 300 °C
Decomposition temperature	: > Flash point
Flammability (solid, gas)	: No data available
Vapour pressure	: No supplementary information available
Relative vapour density at 20 °C	: No data available
Relative density	: No data available

Density	: ca. 1002.4 kg/m³ (20°C) ca. 987.5 kg/m³ (40°C) ca. 942.6 kg/m³ (100°C)
Solubility	: Insoluble in water.
Partition coefficient n-octanol/water (Log Pow)	: > 5
Viscosity, kinematic	: ca. 120 mm²/s (40°C)
Viscosity, dynamic	: No data available
Explosive properties	: Product is not explosive.
Oxidising properties	: No data available
Explosive limits	: No data available

9.2. Other information

VOC content	: < 0.1 % (1999/13/EC; 2004/42/EC; 2010/75/EU)
Other properties	: Oily. Soluble in oils/fats. soluble in most organic solvents. Insoluble in water.

SECTION 10: Stability and reactivity

10.1. Reactivity
On burning: release of (carbon monoxide - carbon dioxide).

10.2. Chemical stability
Stable under normal conditions.

10.3. Possibility of hazardous reactions
No additional information available

10.4. Conditions to avoid
No supplementary information available.

10.5. Incompatible materials
No supplementary information available.

10.6. Hazardous decomposition products
No supplementary information available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral)	: Not classified
Acute toxicity (dermal)	: Not classified
Acute toxicity (inhalation)	: Not classified

RADIAGREEN EME SALT	
LD50 oral rat	> 5000 mg/kg Non-toxic

Fatty esters	
LD50 oral rat	> 5000 mg/kg Non-toxic

Specialities	
LD50 oral rat	> 2000 mg/kg
LD50 dermal rabbit	> 2000 mg/kg

Skin corrosion/irritation	: Not classified pH: 5 – 8
Serious eye damage/irritation	: Not classified pH: 5 – 8
Respiratory or skin sensitisation	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified

STOT-single exposure	: Not classified
STOT-repeated exposure	: Not classified
Aspiration hazard	: Not classified

RADIAGREEN EME SALT	
Viscosity, kinematic	ca. 120 mm^2/s (40°C)

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general	: According to literature: no environmental hazard.
Ecology - air	: No supplementary information available.
Ecology - water	: No bioaccumulation data available
Hazardous to the aquatic environment, short-term (acute)	: Not classified
Hazardous to the aquatic environment, long-term (chronic)	: Not classified

12.2. Persistence and degradability

Fatty esters	
Biodegradation	88.1 % (OECD 301B- BfB report OL58506.01.01 - 02/2006)

12.3. Bioaccumulative potential

RADIAGREEN EME SALT	
Partition coefficient n-octanol/water (Log Pow)	> 5

Fatty esters	
Partition coefficient n-octanol/water (Log Pow)	> 5

12.4. Mobility in soil

No additional information available

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Disposal	: Prevent dispersion by covering with dry absorbent,Scoop solid spill into closing containers,Scoop absorbed substance into closing containers,Clean contaminated surfaces with an excess of water and soap solution,Wash clothing and equipment after handling
Regional legislation (waste)	: No supplementary information available.
Ecology - waste materials	: Do not discharge into drains or the environment. Remove to an authorized waste treatment plant.
European List of Waste (LoW) code	: No supplementary information available

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN / RID

ADR	IMDG	IATA	ADN	RID
14.1. UN number				
UN No dangerous good in sense of transport regulations (including Australian DG Code)	Not applicable	Not applicable	Not applicable	Not applicable

14.2. UN proper shipping name				
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Transport document description				
UN No dangerous good in sense of transport regulations (including Australian DG Code)	Not applicable	Not applicable	Not applicable	Not applicable
14.3. Transport hazard class(es)				
Not applicable	-	Not applicable	Not applicable	Not applicable
14.4. Packing group				
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
14.5. Environmental hazards				
Dangerous for the environment : No	Dangerous for the environment : No Marine pollutant : No	Dangerous for the environment : No	Dangerous for the environment : No	Dangerous for the environment : No
Marine pollutant: no				

14.6. Special precautions for user

Overland transport

Transport regulations (ADR) : Not subject

Transport by sea

Transport regulations (IMDG) : Not subject

Air transport

Transport regulations (IATA) : Not subject

Inland waterway transport

No data available

Rail transport

Transport regulations (RID) : Not subject

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

Contains no REACH substances with Annex XVII restrictions

Contains no substance on the REACH candidate list

Contains no REACH Annex XIV substances

Contains no substance subject to Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals.

Contains no substance subject to Regulation (EU) No 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

VOC content : < 0.1 % (1999/13/EC; 2004/42/EC; 2010/75/EU)

15.1.2. National regulations

Chemical inventories : Compliant with AICS, DSL, EU REACh, IECSC, NZIoC

KKDIK number (Turkey) : all the ingredients of this product in the scope of KKDIK, if not exempted, have been (pre-)registered.

Germany

Regulatory reference	: Not classified according to Regulation Governing Systems for Handling Substances Hazardous to Waters (AwSV)
Hazardous Incident Ordinance (12. BImSchV)	: Is not subject of the 12. BImSchV (Hazardous Incident Ordinance)

Netherlands

ABM category	: A(4) - low hazard for aquatic organisms, may have longterm hazardous effects in aquatic environment
SZW-lijst van kankerverwekkende stoffen	: None of the components are listed
SZW-lijst van mutagene stoffen	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Borstvoeding	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Vruchtbaarheid	: None of the components are listed
SZW-lijst van reprotoxische stoffen – Ontwikkeling	: None of the components are listed

Denmark

Danish product registration number	: 2319737

Switzerland

Storage class (LK)	: LK 10/12 - Liquids

15.2. Chemical safety assessment

No additional information available

SECTION 16: Other information

Training advice	: No supplementary information available.
SDS changed sections	: 15 - Regulatory information
SDS Reason for revision	: No supplementary information available
Chem. inventories legend	: AICS = Australian Inventory of Chemical Substances DSL = Canadian Domestic Sustances List ECST = Existing Chemical Substances Inventory of Taiwan EU REACh = European Union REACH Regulation 1907/2006 IECSC = Inventory of Existing Chemicals Substances in China KECL = Korean Existing Chemical List NZIoC = New Zealand Inventory of Chemicals TSCA = USA Toxic Substances Control Act VNCI = Vietnam National Chemicals Inventory
Other information	: No supplementary information available.

Full text of H- and EUH-statements:	
Eye Dam./Irrit. Not classified	Serious eye damage/eye irritation Not classified

SDS EU Oleon Annex II

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

HALLIBURTON

SAFETY DATA SHEET

SODIUM BROMIDE BRINE

Revision Date: 11-Feb-2021 **Revision Number:** 35

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name SODIUM BROMIDE BRINE

Other means of Identification

Synonyms None

Hazardous Material Number: HM003762

Recommended use of the chemical and restrictions on use

Recommended Use Additive

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Not classified

Label elements, including precautionary statements

Hazard Pictograms

Signal Word Not Hazardous

Hazard Statements: Not Classified

Precautionary Statements

Prevention None
Response None
Storage None
Disposal None

Contains

Substances	**CAS Number**
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA

Other hazards which do not result in classification
This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).
This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	NF	Not classified

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, move victim to fresh air and seek medical attention.
Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin Wash with soap and water. Get medical attention if irritation persists.
Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Symptoms caused by exposure
No significant hazards expected.

Medical Attention and Special Treatment
Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Specific hazards arising from the chemical
Special exposure hazards in a fire
Decomposition in fire may produce harmful gases.

Special protective equipment and precautions for fire fighters
Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid contact with skin, eyes and clothing.

6.2. Environmental precautions
Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling
Handling Precautions
Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse. Ensure adequate ventilation. Use appropriate protective equipment.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities
Storage Information
Store away from oxidizers. Store away from acids. Store in a cool, dry location. Keep container closed when not in use.
Other Guidelines
No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring
Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

Appropriate engineering controls
Engineering Controls Use in a well ventilated area.

Personal protective equipment (PPE)
Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions None known.
Environmental Exposure Controls Do not allow material to contaminate ground water system.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Liquid
Color Clear colorless
Odor: Odorless
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	No data available
Freezing Point / Range	No data available
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.44 - 1.5
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
None anticipated
10.5. Incompatible materials
Strong oxidizers.
10.6. Hazardous decomposition products
Carbon monoxide and carbon dioxide.

11. Toxicological Information

Information on routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

Symptoms related to exposure
Most Important Symptoms/Effects
No significant hazards expected.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according	NA	No data available	No data available	No data available

to the competent authority				

Immediate, delayed and chronic health effects from exposure

Inhalation May cause mild respiratory irritation.
Eye Contact May cause mechanical irritation to eye.
Skin Contact None known.
Ingestion Irritation of the mouth, throat, and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels
No data available

Interactive effects
Skin disorders. Central nervous system disorders.

Data limitations
No data available

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable

Special precautions during transport

None

HazChem Code

None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AIIC or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or

Chemicals	assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 11-Feb-2021

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
None

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/

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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

ALDACIDE® G ANTIMICROBIAL

Revision Date: 13-Oct-2017 **Revision Number:** 2

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name ALDACIDE® G ANTIMICROBIAL

Other means of Identification

Synonyms None

Hazardous Material Number: HB003462

Recommended use of the chemical and restrictions on use

Recommended Use Biocide

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Acute Oral Toxicity	Category 4 - H302
Acute inhalation toxicity - vapor	Category 3 - H331
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Respiratory Sensitization	Category 1 - H334
Skin Sensitization	Category 1 - H317
Reproductive Toxicity	Category 1B - H360
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Acute Aquatic Toxicity	Category 1 - H400

Chronic Aquatic Toxicity	Category 3 - H412

Label elements, including precautionary statements

Hazard Pictograms

Signal Word DANGER

Hazard Statements:
H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H317 - May cause an allergic skin reaction
H318 - Causes serious eye damage
H331 - Toxic if inhaled
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335 - May cause respiratory irritation
H360 - May damage fertility or the unborn child
H400 - Very toxic to aquatic life
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements

Prevention
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P272 - Contaminated work clothing should not be allowed out of the workplace
P273 - Avoid release to the environment
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P281 - Use personal protective equipment as required
P285 - In case of inadequate ventilation wear respiratory protection

Response
P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P330 - Rinse mouth
P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P363 - Wash contaminated clothing before reuse
P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P310 - Immediately call a POISON CENTER or doctor/physician
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P391 - Collect spillage

Storage
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

Contains

Substances	**CAS Number**
Glutaraldehyde	111-30-8
Methanol	67-56-1

Other hazards which do not result in classification
This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Glutaraldehyde	111-30-8	10 - 30%	Acute Tox. 3 (H301) Acute Tox. 2 (H330) Skin Corr. 1B (H314) Eye Corr. 1 (H318) Resp. Sens. 1 (H334) Skin Sens. 1 (H317) STOT SE 3 (H335) Aquatic Acute 1 (H400) Aquatic Chronic 2 (H411)
Methanol	67-56-1	0.1 - 1%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Repr. 1B (H360) STOT SE 1 (H370) Flam. Liq. 2 (H225)

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.

Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause allergic skin reaction. May cause allergic respiratory reaction. May cause respiratory irritation. Harmful if swallowed. Toxic if inhaled. Potential reproductive hazard. May cause birth defects.

Medical Attention and Special Treatment

Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Specific hazards arising from the chemical

Special exposure hazards in a fire

Decomposition in fire may produce harmful gases.

Special protective equipment and precautions for fire fighters

Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Ensure adequate ventilation. Avoid breathing vapors. Avoid contact with skin, eyes and clothing. Evacuate all persons from the area. Use only competent persons for cleanup.

6.2. Environmental precautions
Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling
Handling Precautions
Use appropriate protective equipment. Ensure adequate ventilation. Avoid breathing vapors. Avoid breathing mist. Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities
Storage Information
Store away from acids. Store away from alkalis. Store in a well ventilated area. Keep container closed when not in use. Store locked up. Product has a shelf life of 36 months.
Other Guidelines
No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring
Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Glutaraldehyde	111-30-8	0.1 ppm	Not applicable
Methanol	67-56-1	TWA: 200 ppm TWA: 262 mg/m^3 STEL: 250 ppm STEL: 328 mg/m^3	TWA: 200 ppm STEL: 250 ppm

Appropriate engineering controls
Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation. If vapors are strong enough to be irritating to the nose or eyes, the TLV is probably being exceeded and special ventilation or respiratory protection maybe required.

Personal protective equipment (PPE)
Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.
Organic vapor respirator.

Hand Protection	Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
Skin Protection	Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls	Do not allow material to contaminate ground water system

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Liquid	**Color**	Clear light yellow
Odor:	Sharp	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	3.1-4.5
Freezing Point / Range	(-5) - (-10) °C
Melting Point / Range	No data available
Boiling Point / Range	100.5 °C / 213 °F
Flash Point	No data available
Evaporation rate	0.9
Vapor Pressure	0.2 mmHg
Vapor Density	0.8
Specific Gravity	1.064
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	-0.333
Autoignition Temperature	> 275 °C / > 527 °F
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%)	No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
Keep away from heat, sparks and flame.
10.5. Incompatible materials
Strong acids. Strong alkalis.
10.6. Hazardous decomposition products
Carbon monoxide and carbon dioxide.

11. Toxicological Information

Information on routes of exposure

Principle Route of Exposure	Eye or skin contact, inhalation; Ingestion.

Symptoms related to exposure

Most Important Symptoms/Effects

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause allergic skin reaction. May cause allergic respiratory reaction. May cause respiratory irritation. Harmful if

swallowed. Toxic if inhaled. Potential reproductive hazard. May cause birth defects.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Glutaraldehyde	111-30-8	50 mg/kg (Guinea Pig)	560 µL/kg (Rabbit)	0.28-0.5 mg/L (Rat) 4h
Methanol	67-56-1	300 mg/kg-bw (human) < 790 to 13,000 mg/kg (rat)	1000 mg/kg-bw (human) 17,100 mg/kg (rabbit)	10 mg/L (human, 4h, vapor)

Immediate, delayed and chronic health effects from exposure

Inhalation Toxic if inhaled. Causes severe respiratory irritation. May cause allergic respiratory reaction. Inhalation of vapors may result in skin sensitization.

Eye Contact Causes severe eye irritation which may damage tissue.

Skin Contact Causes severe burns. May cause an allergic skin reaction.

Ingestion Harmful if swallowed. Causes burns of the mouth, throat and stomach.

Chronic Effects/Carcinogenicity Prolonged or repeated exposure can cause delayed kidney damage.

Exposure Levels
No data available

Interactive effects
Skin disorders. Lung disorders. Liver disorders.

Data limitations
No data available

Substances	CAS Number	Skin corrosion/irritation
Glutaraldehyde	111-30-8	Causes severe skin irritation with tissue destruction. (Rabbit)
Methanol	67-56-1	Non-irritating to the skin (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Glutaraldehyde	111-30-8	Causes severe eye irritation which may damage tissue. (Rabbit)
Methanol	67-56-1	Non-irritating to the eye (Rabbit)

Substances	CAS Number	Skin Sensitization
Glutaraldehyde	111-30-8	Skin sensitizer in guinea pig.
Methanol	67-56-1	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Glutaraldehyde	111-30-8	May cause sensitization by inhalation
Methanol	67-56-1	No information available

Substances	CAS Number	Mutagenic Effects
Glutaraldehyde	111-30-8	In vivo tests did not show mutagenic effects.
Methanol	67-56-1	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.

Substances	CAS Number	Carcinogenic Effects
Glutaraldehyde	111-30-8	Did not show carcinogenic effects in animal experiments
Methanol	67-56-1	No data of sufficient quality are available.

Substances	CAS Number	Reproductive toxicity
Glutaraldehyde	111-30-8	Not a confirmed teratogen or embryotoxin.
Methanol	67-56-1	Experiments have shown reproductive toxicity effects on laboratory animals

Substances	CAS Number	STOT - single exposure
Glutaraldehyde	111-30-8	No information available
Methanol	67-56-1	May cause disorder and damage to the Central Nervous System (CNS)

Substances	CAS Number	STOT - repeated exposure
Glutaraldehyde	111-30-8	May cause disorder and damage to the Kidney

Methanol	67-56-1	No data of sufficient quality are available.

Substances	CAS Number	Aspiration hazard
Glutaraldehyde	111-30-8	Not applicable
Methanol	67-56-1	Not applicable

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Glutaraldehyde	111-30-8	EC50(72h): 0.61 mg/L (Desmodesmus subspicatus) EC50(72h): 0.5 mg/L (Skeletonema costatum)	LC50(96h): 10 mg/L (Lepomis macrochirus) NOEC(97d): 1.6 mg/L (Oncorhynchus mykiss) LC50(96h): 3.5 mg/L (Oncorhynchus mykiss) LC50(96h): 60 mg/L (Scophthalmus maximus)	EC50 (17h) 6.65 mg/L (Pseudomonas putida)	EC50(48h): 0.35 mg/L (Daphnia magna) EC50(48h): 0.7 mg/L (Acartia tonsa) NOEC(21d): 0.13 mg/L (Daphnia magna) EC50(48h): 0.1 mg/L (Acartia tonsa)
Methanol	67-56-1	EC50 (96 h) =22000 mg/L (Pseudokirchnerella subcapitata) NOEC (8 d) =8000 mg/L (Scenedesmus quadricauda)	LC50 (96 h) =15400 mg/L (Lepomis macrochirus) EC50 (200 h) =14536 mg/L (Oryzias latipes)	IC50 (3h) > 1000 mg/L (activated sludge)	EC50 (96 h) =18260 mg/L (Dapnia magna) NOEC (21 d) =208 mg/L (Dapnia magna)

12.2. Persistence and degradability

Readily biodegradable

Substances	CAS Number	Persistence and Degradability
Glutaraldehyde	111-30-8	Readily biodegradable (75% @ 28d)
Methanol	67-56-1	Readily biodegradable (95% @ 20d)

12.3. Bioaccumulative potential

Does not bioaccumulate.

Substances	CAS Number	Log Pow
Glutaraldehyde	111-30-8	-0.36
Methanol	67-56-1	Not Bioaccumulative; BCF=1

12.4. Mobility in soil

Substances	CAS Number	Mobility
Glutaraldehyde	111-30-8	Potential for mobility in soil is high (Koc between 50 and 150). Given its very low Henry'sconstant (3.3E-08 atm*m3/mole; 25 °C Measured), volatilization from natural bodies of water or moist soil is not expected to be an important fate process.
Methanol	67-56-1	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	UN3265
UN proper shipping name:	Corrosive Liquid, Acidic, Organic, N.O.S. (Contains Glutaraldehyde)
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Marine Pollutant

IMDG/IMO

UN Number	UN3265
UN proper shipping name:	Corrosive Liquid, Acidic, Organic, N.O.S. (Contains Glutaraldehyde)
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Marine Pollutant
EMS:	EmS F-A, S-B

IATA/ICAO

UN Number	UN3265
UN proper shipping name:	Corrosive Liquid, Acidic, Organic, N.O.S. (Contains Glutaraldehyde)
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Marine Pollutant

Special precautions during transport

None

HazChem Code

2X

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
EINECS (European Inventory of Existing Chemical Substances)	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number

S6

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply
Basel Convention - Hazardous Waste:	Does not apply

16. Other information

Date of preparation or review

Revision Date: 13-Oct-2017

Revision Note

Full text of H-Statements referred to under sections 2 and 3
H301 - Toxic if swallowed
H302 - Harmful if swallowed
H314 - Causes severe skin burns and eye damage
H317 - May cause an allergic skin reaction
H318 - Causes serious eye damage
H330 - Fatal if inhaled
H331 - Toxic if inhaled
H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335 - May cause respiratory irritation
H400 - Very toxic to aquatic life
H411 - Toxic to aquatic life with long lasting effects
H412 - Harmful to aquatic life with long lasting effects

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
NZ CCID

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End of Safety Data Sheet

SDS no. PID18698
Version 2
Revision date 04/Feb/2019
Supersedes date None

Safety Data Sheet
ALPINE SPOTTING BEADS*

1. Identification of the Substance/Preparation and of the Company/Undertaking

1.1 Product identifier

Product name ALPINE SPOTTING BEADS*

Product code PID18698

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Lubricant.

Uses advised against Consumer use

1.3 Details of the supplier of the safety data sheet

Supplier
ALPINE SPECIALTY CHEMICALS
A Business Unit of M-I L.L.C.
P.O. Box 42842
Houston, TX 77242
www.alpinespecialtychemicals.com
Telephone: 1 281-561-1511

E-mail address MISDS@slb.com

Prepared by
Global Regulatory Compliance - Chemicals (GRC - Chemicals)

1.4 Emergency Telephone Number

Emergency telephone (24 Hour) Asia Pacific +65 3158 1074, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, USA +1 281 561 1600, Canada +1 800 579 7421, Argentina: +54 11 5984 3690, Brazil : 0800-720-8000/0800-777-2323 (WGRA)

2. Hazards Identification

2.1 Classification of the substance or mixture

GHS - Classification

Health hazards

Reproductive toxicity	Category 2
Specific target organ toxicity - Repeated exposure	Category 1

Environmental hazards Not classified

Physical Hazards Not classified

2.2 Label elements

Signal word
DANGER

Hazard Statements
H361 - Suspected of damaging fertility or the unborn child
H372 - Causes damage to organs through prolonged or repeated exposure

Precautionary Statements
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P308 + P313 - IF exposed or concerned: Get medical advice/attention

P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P405 - Store locked up
P501 - Dispose of contents/ container to an approved waste disposal plant

Unknown acute toxicity 94% of the mixture consists of ingredient(s) of unknown toxicity.

3. Composition/information on Ingredients

3.1 Substances

Not applicable

3.2 Mixtures

Not applicable

Chemical Name	CAS No	Weight-%
Styrene	100-42-5	0 - 3

Comments
The exact percentage (concentration) of composition has been withheld as a trade secret The product contains other ingredients which do not contribute to the overall classification.

4. First Aid Measures

4.1 First aid measures

Inhalation — If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Ingestion — Rinse mouth. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.

Skin contact — Wash skin thoroughly with soap and water. Get medical attention if irritation persists.

Eye Contact — Promptly wash eyes with lots of water while lifting eye lids. Remove contact lenses, if worn. Get medical attention if any discomfort continues.

4.2. Most important symptoms and effects, both acute and delayed

General advice — The severity of the symptoms described will vary dependant of the concentration and the length of exposure. If adverse symptoms develop, the casualty should be transferred to hospital as soon as possible.

Symptoms

Inhalation — Please see Section 11. Toxicological Information for further information.

Ingestion — Please see Section 11. Toxicological Information for further information.

Skin contact — Please see Section 11. Toxicological Information for further information.

Eye contact — Please see Section 11. Toxicological Information for further information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician — Treat symptomatically

5. Fire-Fighting Measures

5.1 Extinguishing media

Suitable extinguishing media
Water Fog, Alcohol Foam, CO_2, Dry Chemical.

Extinguishing media which must not be used for safety reasons
None known.

5.2. Special hazards arising from the substance or mixture

Unusual fire and explosion hazards
None known.

5.3 Advice for firefighters

Special protective equipment for fire-fighters
As in any fire, wear self-contained breathing apparatus and full protective gear.

Special Fire-Fighting Procedures
Containers close to fire should be removed immediately or cooled with water.

6. Accidental Release Measures

6.1. Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. See also section 8. If spilled, take caution, as material can cause surfaces to become very slippery.

6.2 Environmental precautions

The product should not be allowed to enter drains, water courses or the soil.

Environmental exposure controls
Avoid release to the environment. Local authorities should be advised if significant spillages cannot be contained.

6.3 Methods and material for containment and cleaning up

Methods for containment
Cover powder spill with plastic sheet or tarp to minimize spreading. Prevent further leakage or spillage if safe to do so.

Methods for cleaning up
Sweep up and shovel into suitable containers for disposal. After cleaning, flush away traces with water.

6.4 Reference to other sections

See section 13 for more information.

7. Handling and Storage

7.1 Precautions for safe handling

Handling
Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Avoid dust formation. If spilled, take caution, as material can cause surfaces to become very slippery. Not to be used by pregnant workers and workers who have recently given birth or who are breastfeeding.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/precautions Ensure adequate ventilation. Keep airborne concentrations below exposure limits.

Storage precautions Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from moisture. Avoid contact with:. Strong oxidizing agents.

Packaging materials Use specially constructed containers only.

8. Exposure Controls/Personal Protection

8.1 Control parameters

Chemical Name	ACGIH TLV	OSHA PEL	Argentina - Occupational Exposure Limits - TWAs (CMPs)	Brazil - Occupational Exposure Limits - TWAs (LTs)	Mexico - Occupational Exposure Limits - TWAs (LMPE-PPTs)
Styrene	20 ppm	100 ppm TWA 200 ppm C	20 ppm TWA	78 ppm TWA LT; 328 mg/m³ TWA LT	50 ppm TWA VLE-PPT; 215 mg/m³ TWA VLE-PPT

IDLH (Immediately Dangerous to Life or Health)
This product contains substance(s) classified as Immediately Dangerous to Life or Health (IDLH) by the US National Institute for Occupational Safety and Health (NIOSH). The purpose of establishing an IDLH value is to ensure that the worker can escape from a given contaminated environment in the event of failure of the most protective respiratory protection equipment. In the event of failure of respiratory protection equipment every effort should be made to exit immediately.

Chemical Name	IDLH (Immediately Dangerous to Life or Health)
Styrene 100-42-5	700 ppm IDLH

8.2 Exposure controls

A risk assessment is recommended to be performed by a qualified and trained personnel to analyze the worksite and recommends the appropriate controls such as engineering controls, work practice controls, and administrative controls as primary means of reducing employee exposure. When there is a remaining hazards after applying the primary controls, Personal Protective Equipment (PPE) must be used.

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Engineering Controls
Ensure adequate ventilation. Mechanical ventilation or local exhaust ventilation is required.

Personal protective equipment

Eye protection	Safety glasses with side-shields.
Hand protection	Use protective gloves made of: Nitrile Neoprene Frequent change is advisable
Respiratory Protection	All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent.If exposed to airborne mist/aerosol of this product, use an organic vapor cartridge with a P-95 pre-filter attached. In work environments containing oil mist/aerosol, use an organic vapor cartridge with a P-95 pre-filter attached.If exposed to vapors from this product, use a NIOSH/MSHA-approved respirator with an organic vapor cartridge.
Skin and body protection	Wear suitable protective clothing, Eye wash and emergency shower must be available at the work place.
Hygiene Measures	Wash hands before eating, drinking or smoking, Remove and wash contaminated clothing before re-use.

9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties

Physical state	Solid
Appearance	No information available
Color	Various
Odor	Odorless
Odor threshold	Not applicable

Property	Values	Remarks
pH		
pH @ dilution		
Melting / freezing point	No information available	
Boiling point/range	No information available	

Flash point	No information available	PMCC
Evaporation rate (BuAc =1)	No information available	
Flammability (solid, gas)	Not applicable	
Flammability Limit in Air		
Upper flammability limit	No information available	
Lower flammability limit	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific gravity	1.08 - 1.50	
Bulk density	No information available	
Water solubility	Insoluble in water	
Solubility in other solvents	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
log Pow	No information available	
Explosive properties	None known	
Oxidizing properties	None known.	

9.2 Other information

Pour point	No information available
Molecular weight	No information available
VOC content(%)	None
Density	No information available

Comments
The data listed above are typical physical and chemical properties and should not be construed as product specification.

10. Stability and Reactivity

10.1 Reactivity

No specific reactivity hazards associated with this product.

10.2 Chemical stability

Stable under normal temperature conditions and recommended use.

10.3 Possibility of Hazardous Reactions

Hazardous polymerization
Hazardous polymerization does not occur.

10.4 Conditions to avoid

Protect from moisture.

10.5 Incompatible materials

Strong oxidizing agents.

10.6 Hazardous decomposition products

See Section 5.2.

11. Toxicological Information

11.1 Information on toxicological effects

Acute toxicity

Inhalation Inhalation of dust in high concentration may cause irritation of respiratory system.

Eye contact Dust may cause mechanical irritation.

Skin contact Prolonged contact may cause redness and irritation. Components of the product may be absorbed into the body through the skin.

Ingestion Ingestion may cause stomach discomfort.

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Styrene	= 1000 mg/kg (Rat)	No data available	= 11.7 mg/L (Rat) 4 h

Chemical Name	IARC Group 1 or 2	ACGIH - Carcinogens	OSHA listed carcinogens	NTP
Styrene	Group 2B; Monograph 82 [2002] 2B Group 2B; Monograph 60 [1994]	A4 Not Classifiable as a Human Carcinogen	Present	Reasonably Anticipated To Be A Human Carcinogen

Sensitization This product does not contain any components suspected to be sensitizing.

Mutagenic effects This product does not contain any known or suspected mutagens.

Carcinogenicity This product does not contain any known or suspected carcinogens.

Reproductive toxicity Product is or contains a chemical which is a known or suspected reproductive hazard.

Developmental toxicity Not known to cause birth defects or have a deleterious effect on a developing fetus.

Routes of exposure Inhalation.

Routes of entry Inhalation. Skin absorption.

Specific target organ toxicity - Single exposure Not classified

Specific target organ toxicity - Repeated exposure Category 1.

Target organ effects Hearing organs.

Aspiration hazard Not applicable.

12. Ecological Information

12.1 Toxicity

Toxicity to algae
This product is not considered toxic to algae.

Toxicity to fish
This product is not considered toxic to fish.

Toxicity to daphnia and other aquatic invertebrates
This product is not considered toxic to invertebrates.

Chemical Name	Toxicity to fish	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates
Styrene	19.03 - 33.53 mg/L LC50 Lepomis macrochirus 96 h 6.75 - 14.5 mg/L LC50 Pimephales promelas 96 h 58.75 - 95.32 mg/L LC50 Poecilia reticulata 96 h 3.24 - 4.99 mg/L LC50 Pimephales promelas 96 h	= 1.4 mg/L EC50 Pseudokirchneriella subcapitata 72 h = 0.72 mg/L EC50 Pseudokirchneriella subcapitata 96 h 0.46 - 4.3 mg/L EC50 Pseudokirchneriella subcapitata 72 h 0.15 - 3.2 mg/L EC50 Pseudokirchneriella subcapitata 96 h	3.3 - 7.4 mg/L EC50 Daphnia magna 48 h

12.2 Persistence and degradability

Not readily biodegradable.

12.3 Bioaccumulative potential

Bioaccumulation is unlikely.

12.4 Mobility

Insoluble in water.

12.5 Results of PBT and vPvB assessment

This preparation contains no substance considered to be persistent, bioaccumulating nor toxic (PBT)
This preparation contains no substance considered to be very persistent nor very bioaccumulating (vPvB)

12.6 Other adverse effects.

None known.

Endocrine disruptor information

13. Disposal Considerations

13.1 Waste treatment methods

Disposal Method Disposal should be made in accordance with federal, state and local regulations.

Contaminated packaging Empty containers should be taken for local recycling, recovery or waste disposal.

14. Transport information

14.1. UN number

UN No. (DOT) Not regulated
UN No. (MT/ANTT) Not regulated
UN No. (TDG) Not regulated
UN/ID No. (ADR/RID/ADN/ADG) Not regulated
UN No. (IMDG/ANTAQ) Not regulated

UN No. (ICAO/ANAC)	Not regulated
UN No. (DPC)	Not regulated

14.2. UN proper shipping name
The product is not covered by international regulation on the transport of dangerous goods

14.3 Hazard class(es)

DOT Hazard class	Not regulated
ANTT Hazard class	Not regulated
TDG Hazard class	Not regulated
ADR/RID/ADN/ADG Hazard class	Not regulated
IMDG/ANTAQ Hazard class	Not regulated
ICAO/ANAC Hazard class/division	Not regulated
DPC Hazard class	Not regulated

14.4 Packing group

DOT Packing group	Not regulated
ANTT Packing group	Not regulated
TDG Packing group	Not regulated
ADR/RID/ADN/ADG Packing group	Not regulated
IMDG/ANTAQ Packing group	Not regulated
ICAO/ANAC Packing group	Not regulated
DPC Packing group	Not regulated

14.5 Environmental hazard
No

14.6 Special precautions
Not applicable

14.7 Transport in bulk according to Annex I/II of MARPOL 73/78 and the IBC Code
Please contact MISDS@slb.com for info regarding transport in Bulk.

15. Regulatory Information

International inventories

USA (TSCA)	Complies
Canada (DSL)	Complies
Philippines (PICCS)	Complies
Japan (ENCS)	Complies
China (IECSC)	Complies
Australia (AICS)	Complies
Korean (KECL)	Complies
New Zealand (NZIoC)	Complies

Europe - REACH
All products supplied from the European Economic Area (EEA) are compliant with the REACH Regulation EC 1907/2006.For products supplied from the EEA, Schlumberger and/or its suppliers have pre-registered and is registering all of the substances that it and/or its suppliers manufactures in or imports into the EEA that are subject to Title II of the REACH Regulation. All products supplied from outside the EEA are subject to REACH only if imported into the EEA. The importer of the products must comply with REACH for each imported substance. Contact REACH@slb.com for REACH information.

U.S. Federal and State Regulations

SARA 311/312 Hazard Categories
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications. Under the amended regulations at 40 CFR 370, EPCRA 311/312 Tier II reporting for the 2017 calendar year will need to be consistent with updated hazard classifications.

Chemical Name	SARA 302 / TPQs	SARA 313	CERCLA RQ
Styrene	N/A	0.1 %	1000 lb final RQ 454 kg final RQ

California Proposition 65

WARNING

This product can expose you to chemicals including those listed below, which is [are] known to the State of California to cause cancer, birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Chemical Name	California Proposition 65
Styrene 100-42-5	Cancer

16. Other Information

Revision date	04/Feb/2019
Version	2
This SDS has been revised in the following section(s)	1, 2, 3, 8, 11, 15, 16
HMIS classification	
Health	1*
Flammability	1
Physical hazard	0
PPE	E

*A mark of M-I L.L.C., a Schlumberger Company

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HALLIBURTON

SAFETY DATA SHEET

BaraCor® 95

Revision Date: 18-Jun-2020 **Revision Number:** 49

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name BaraCor® 95

Other means of Identification

Synonyms None

Hazardous Material Number: HM003499

Recommended use of the chemical and restrictions on use

Recommended Use pH Control

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Acute Oral Toxicity	Category 4 - H302
Acute toxicity - Dermal	Category 4 - H312
Acute inhalation toxicity - vapor	Category 4 - H332
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Acute Aquatic Toxicity	Category 3 - H402
Chronic Aquatic Toxicity	Category 3 - H412

Label elements, including precautionary statements

Hazard Pictograms

Signal Word DANGER

Hazard Statements:
H302 - Harmful if swallowed
H312 - Harmful in contact with skin
H314 - Causes severe skin burns and eye damage
H318 - Causes serious eye damage
H332 - Harmful if inhaled
H335 - May cause respiratory irritation
H402 - Harmful to aquatic life
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements

Prevention
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P273 - Avoid release to the environment
P280 - Wear protective gloves/protective clothing/eye protection/face protection

Response
P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P330 - Rinse mouth
P302 + P352 - IF ON SKIN: Wash with plenty of water.
P312 - Call a POISON CENTER/doctor/physician if you feel unwell
P363 - Wash contaminated clothing before reuse
P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P310 - Immediately call a POISON CENTER or doctor/physician
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P391 - Collect spillage

Storage
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

Contains

Substances	**CAS Number**
Monoethanolamine	141-43-5

Other hazards which do not result in classification
This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).
This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Monoethanolamine	141-43-5	60 - 100%	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Acute Tox. 4 (H332) Skin Corr. 1B (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) Aquatic Acute 2 (H401) Aquatic Chronic 3 (H412) Flam. Liq. 4 (H227)

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, move victim to fresh air and seek medical attention.

Eyes Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.

Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Symptoms caused by exposure

Causes severe skin burns and eye damage. May cause respiratory irritation. Harmful if inhaled. Harmful in contact with skin. Harmful if swallowed.

Medical Attention and Special Treatment

Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Specific hazards arising from the chemical

Special exposure hazards in a fire

Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce harmful gases. Do not allow runoff to enter waterways.

Special protective equipment and precautions for fire fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation. Evacuate all persons from the area.

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas. Consult local authorities.

6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Use appropriate protective equipment. Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Store away from acids. Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 36 months.

Other Guidelines

No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring

Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Monoethanolamine	141-43-5	TWA: 3 ppm TWA: 7.5 mg/m^3 STEL: 6 ppm STEL: 15 mg/m^3	TWA: 3 ppm STEL: 6 ppm

Appropriate engineering controls

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment (PPE)

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. In high concentrations, supplied air respirator or a self-contained breathing apparatus. (EN137:2006, 2)

Hand Protection Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Nitrile gloves. (>= 8 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

Skin Protection Rubber apron. Rubber boots.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

Environmental Exposure Controls No information available

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Liquid
Color Colorless
Odor: Amine
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	12
Freezing Point / Range	-13 °C
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	130 °C / 266 °F
Flash Point	96 °C / 205 °F (PMCC)
Evaporation rate	0.1
Vapor Pressure	0.2 mmHg @ 20°C
Vapor Density	2.1 (air = 1)
Specific Gravity	1.02
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	-1.9
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
None anticipated
10.5. Incompatible materials
Strong acids. Strong oxidizers.
10.6. Hazardous decomposition products
Ammonia. Carbon monoxide and carbon dioxide. Hydrocarbons.

11. Toxicological Information

Information on routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

Symptoms related to exposure

Most Important Symptoms/Effects

Causes severe skin burns and eye damage. May cause respiratory irritation. Harmful if inhaled. Harmful in contact with skin. Harmful if swallowed.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Monoethanolamine	141-43-5	1089 mg/kg-bw (rat)	1025 mg/kg-bw (rabbit)	>1.3 mg/L (rat, 6 h, vapor) (saturated)

Immediate, delayed and chronic health effects from exposure

Inhalation Harmful if inhaled. Causes severe respiratory irritation.
Eye Contact Causes eye damage.
Skin Contact Harmful in contact with skin. Causes severe burns.
Ingestion Harmful if swallowed. Causes burns of the mouth, throat and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels
No data available

Interactive effects
Skin disorders. Lung disorders. Liver and kidney disorders.

Data limitations
No data available

Substances	CAS Number	Skin corrosion/irritation
Monoethanolamine	141-43-5	Skin, rabbit: Corrosive to skin Causes severe skin burns

Substances	CAS Number	Serious eye damage/irritation
Monoethanolamine	141-43-5	Eye, rabbit: Corrosive to eyes Causes severe eye irritation. Will damage tissue.

Substances	CAS Number	Skin Sensitization
Monoethanolamine	141-43-5	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Monoethanolamine	141-43-5	No information available

Substances	CAS Number	Mutagenic Effects
Monoethanolamine	141-43-5	In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Monoethanolamine	141-43-5	No data of sufficient quality are available.

Substances	CAS Number	Reproductive toxicity
Monoethanolamine	141-43-5	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Monoethanolamine	141-43-5	May cause respiratory irritation.

Substances	CAS Number	STOT - repeated exposure
Monoethanolamine	141-43-5	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Monoethanolamine	141-43-5	Not applicable

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Monoethanolamine	141-43-5	EC50 (72 h) =2.5 mg/L (Pseudokirchneriella subcapitata) EC50 (72 h) =24.7 mg/L	LC50 (96 h) =170 mg/L (Carassius auratus) NOEC (14 d) >100 mg/L (Oryzias latipes)	No information available	EC50 (48 h) =65 mg/L (Daphnia magna) NOEC (21 d) =0.85 mg/L (Daphnia magna)

		(Phaeodactylum tricornutum)			

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Monoethanolamine	141-43-5	Readily biodegradable (92% @ 28d)

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Monoethanolamine	141-43-5	Log Pow =-1.91

12.4. Mobility in soil

Substances	CAS Number	Mobility
Monoethanolamine	141-43-5	KOC = 0.2725 KOC = 1.167

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number UN2491
UN proper shipping name: Ethanolamine Solution
Transport Hazard Class(es): 8
Packing Group: III
Environmental Hazards: Not applicable

IMDG/IMO

UN Number UN2491
UN proper shipping name: Ethanolamine Solution
Transport Hazard Class(es): 8
Packing Group: III
Environmental Hazards: Not applicable
EMS: EmS F-A, S-B

IATA/ICAO

UN Number UN2491
UN proper shipping name: Ethanolamine Solution
Transport Hazard Class(es): 8
Packing Group: III
Environmental Hazards: Not applicable

Special precautions during transport

None

HazChem Code
2X

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 18-Jun-2020

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
H302 - Harmful if swallowed
H312 - Harmful in contact with skin
H314 - Causes severe skin burns and eye damage
H332 - Harmful if inhaled
H335 - May cause respiratory irritation
H412 - Harmful to aquatic life with long lasting effects

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter

NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/

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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

BaraCor® W-991

Revision Date: 18-Jan-2022 **Revision Number:** 4

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 7th Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name BaraCor® W-991

Other means of Identification

Synonyms None

Hazardous Material Number: HM009362

Recommended use of the chemical and restrictions on use

Recommended Use Corrosion Inhibitor

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Non-Hazardous according to the criteria of the 7th Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Not classified

Label elements, including precautionary statements

Hazard Pictograms

Signal Word Not Hazardous

Hazard Statements: Not Classified

Precautionary Statements

Prevention None
Response None
Storage None
Disposal None

Contains

Substances	**CAS Number**
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA

Other hazards which do not result in classification
None known

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not classified

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Flush skin with large amounts of water. If irritation persists, get medical attention.

Ingestion Rinse mouth with water many times. Get medical attention, if symptoms occur

Symptoms caused by exposure
No significant hazards expected.

Medical Attention and Special Treatment
Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
Do NOT spray pool fires directly with water. A solid stream of water directed into hot burning liquid can cause splattering.

Specific hazards arising from the chemical
Special exposure hazards in a fire
Decomposition in fire may produce harmful gases.

Special protective equipment and precautions for fire fighters
Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Do not breathe dust/fume/gas/mist/vapors/spray.

6.2. Environmental precautions
None known.

6.3. Methods and material for containment and cleaning up
Dike far ahead of liquid spill for later disposal. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

7. Handling and storage

7.1. Precautions for safe handling
Handling Precautions
Use appropriate protective equipment. Ensure adequate ventilation. Avoid contact with eyes, skin, or clothing.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities
Storage Information
Store in a cool well ventilated area.
Other Guidelines
No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring
Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

Appropriate engineering controls

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

Personal protective equipment (PPE)

Personal Protective Equipment	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.
Hand Protection	Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
Skin Protection	Not normally necessary.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.
Environmental Exposure Controls	No information available

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Liquid
Color Red brown
Odor: Characteristic
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	7 - 9 (1 % solution)
Freezing Point / Range	No data available
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	> 121 °C / > 250 °F (PMCC)
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.24 - 1.34
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
None anticipated
10.5. Incompatible materials
Strong oxidizers.
10.6. Hazardous decomposition products
Carbon oxides. Oxides of phosphorus. Phosphines. Oxides of nitrogen.

11. Toxicological Information

Information on routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

Symptoms related to exposure
Most Important Symptoms/Effects
No significant hazards expected.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above	NA	No data available	No data available	No data available

cut-off values according to the competent authority				

Immediate, delayed and chronic health effects from exposure

Inhalation May cause mild respiratory irritation.
Eye Contact May cause mild eye irritation.
Skin Contact May cause mild skin irritation.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels
No data available

Interactive effects
No data available

Data limitations
No data available

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Dispose in accordance with local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable

Special precautions during transport

None

HazChem Code

None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AIIC or are subject to a relevant exemption, permit, or assessment certificate.

New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 18-Jan-2022

Revision Note
Initial Release

Full text of H-Statements referred to under sections 2 and 3
None

Additional information: For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

BaraScav™ W-480

Revision Date: 24-Oct-2017 **Revision Number:** 3

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name BaraScav™ W-480

Other means of Identification

Synonyms None

Hazardous Material Number: HM008410

Recommended use of the chemical and restrictions on use

Recommended Use Hydrogen Sulfide Scavenger

Uses advised against Consumer use

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Acute inhalation toxicity - vapor	Category 4 - H332
Serious Eye Damage/Irritation	Category 2 - H319
Skin Sensitization	Category 1 - H317
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372
Acute Aquatic Toxicity	Category 3 - H402

Label elements, including precautionary statements

Hazard Pictograms

Signal Word DANGER

Hazard Statements:
H317 - May cause an allergic skin reaction
H319 - Causes serious eye irritation
H332 - Harmful if inhaled
H335 - May cause respiratory irritation
H372 - Causes damage to organs through prolonged or repeated exposure
H402 - Harmful to aquatic life

Precautionary Statements

Prevention
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P272 - Contaminated work clothing should not be allowed out of the workplace
P273 - Avoid release to the environment
P280 - Wear protective gloves/eye protection/face protection

Response
P302 + P352 - IF ON SKIN: Wash with plenty of water.
P333 + P313 - If skin irritation or rash occurs: Get medical advice/attention
P363 - Wash contaminated clothing before reuse
P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P312 - Call a POISON CENTER/doctor/physician if you feel unwell
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention
P314 - Get medical attention/advice if you feel unwell

Storage
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

Contains

Substances	**CAS Number**
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4

Other hazards which do not result in classification
This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).
This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	10 - 30%	Acute Tox. 4 (H302) Acute Tox. 2 (H330) Skin Sens. 1 (H317) STOT SE 3 (H335)

			STOT RE 1 (H372) Aquatic Acute 2 (H401)

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, move victim to fresh air and seek medical attention.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if irritation persists.

Ingestion Rinse mouth with water many times. Get medical attention if symptoms occur

Symptoms caused by exposure

Causes eye irritation. May cause allergic skin reaction. May cause respiratory irritation. Harmful if inhaled. May cause damage to organs through prolonged or repeated exposure.

Medical Attention and Special Treatment

Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Specific hazards arising from the chemical

Special exposure hazards in a fire

Decomposition in fire may produce harmful gases.

Special protective equipment and precautions for fire fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid breathing vapors. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information
Store away from oxidizers. Store away from acids. Store away from direct sunlight. Keep container closed when not in use.
Other Guidelines
No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring
Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Not applicable	Not applicable

Appropriate engineering controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits. Ensure adequate ventilation, especially in confined areas

Personal protective equipment (PPE)
Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.
Organic vapor respirator.

Hand Protection Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
Skin Protection Wear protective clothing appropriate for the work environment.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions None known.
Environmental Exposure Controls Do not allow material to contaminate ground water system

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties
Physical State: Liquid
Odor: Characteristic
Color Clear light yellow
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	9.5 - 11
Freezing Point / Range	-35 °C
Melting Point / Range	No data available
Boiling Point / Range	100 °C / 212 °F
Flash Point	> 100 °C / > 212 °F PMCC
Evaporation rate	No data available
Vapor Pressure	17.5 mmHg @ 20°C
Vapor Density	No data available
Specific Gravity	1.02 - 1.05
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	> 200 °C / > 392 °F
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity

Not expected to be reactive.

10.2. Chemical stability

Stable

10.3. Possibility of hazardous reactions

Will Not Occur

10.4. Conditions to avoid

Avoid contact with metals such as aluminum, tin, lead, brass, bronze, copper, and zinc. Keep away from heat, sparks and flame.

10.5. Incompatible materials

Strong oxidizers. Reducing agents. Strong acids.

10.6. Hazardous decomposition products

Acetic acid. Oxides of nitrogen. Oxides of sulfur. Formaldehyde. Carbon monoxide and carbon dioxide.

11. Toxicological Information

Information on routes of exposure

Principle Route of Exposure Eye or skin contact, inhalation. Ingestion.

Symptoms related to exposure

Most Important Symptoms/Effects

Causes eye irritation. May cause allergic skin reaction. May cause respiratory irritation. Harmful if inhaled. May cause damage to organs through prolonged or repeated exposure.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	763 mg/kg (Rat) 1000 mg/kg (Rat)	2000 mg/kg (Rat) > 4000 mg/kg (Rat) > 3500 mg/kg (Rabbit)	0.371 mg/L (Rat) 4h

Immediate, delayed and chronic health effects from exposure

Inhalation Harmful if inhaled. May cause respiratory irritation.

Eye Contact Causes eye irritation.

Skin Contact May cause an allergic skin reaction. May cause mild skin irritation.

Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity Prolonged or repeated exposure may cause lung damage.

Exposure Levels

No data available

Interactive effects

Skin disorders.

Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Not irritating to skin in rabbits.

Substances	CAS Number	Serious eye damage/irritation
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Eye, rabbit: Causes mild eye irritation.

Substances	CAS Number	Skin Sensitization
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Skin sensitizer in guinea pig.

Substances	CAS Number	Respiratory Sensitization
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	No information available

Substances	CAS Number	Mutagenic Effects
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	While some in vitro tests were positive and/or equivocal, in vivo results were negative.

Substances	CAS Number	Carcinogenic Effects
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	No data of sufficient quality are available.

Substances	CAS Number	Reproductive toxicity
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Did not show teratogenic effects in animal experiments. Animal testing did not show any effects on fertility.

Substances	CAS Number	STOT - single exposure
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	May cause respiratory irritation.

Substances	CAS Number	STOT - repeated exposure
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Causes damage to organs through prolonged or repeated exposure: (Lungs)

Substances	CAS Number	Aspiration hazard
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Not applicable

12. Ecological Information

Ecotoxicity

Product Ecotoxicity Data

Harmful to aquatic life

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	EC50 (72h) 6.66 mg/L (Desmodesmus subspicatus)	LC50 (96h) 16.07 mg/L (Brachydanio rerio)	EC50 (0.5h) 550 mg/L (Activated sludge, domestic)	EC50 (48h) 11.9 mg/L (Daphnia magna)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	Readily biodegradable (90-100% @ 8d)

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	-2

12.4. Mobility in soil

Substances	CAS Number	Mobility
Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine	4719-04-4	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods
Follow all applicable community, national or regional regulations regarding waste management methods.

Disposal of any contaminated packaging
Follow all applicable national or local regulations.

Environmental regulations
Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Special precautions during transport
None

HazChem Code
None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
EINECS (European Inventory of Existing Chemical Substances)	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply
Basel Convention - Hazardous Waste:	Does not apply

16. Other information

Date of preparation or review

Revision Date: 24-Oct-2017

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
H302 - Harmful if swallowed
H317 - May cause an allergic skin reaction
H319 - Causes serious eye irritation
H330 - Fatal if inhaled
H332 - Harmful if inhaled
H335 - May cause respiratory irritation
H372 - Causes damage to organs through prolonged or repeated exposure
H401 - Toxic to aquatic life
H402 - Harmful to aquatic life

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
OSHA
ECHA C&L

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

CALCIUM CHLORIDE - POWDER

Revision Date: 15-Mar-2022 **Revision Number:** 44

1. Product Identifier & Identity for the Chemical

Statement of Hazardous Nature Hazardous according to the criteria of the 7th Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

1.1. Product Identifier

Product Name CALCIUM CHLORIDE - POWDER

Other means of Identification

Synonyms None

Hazardous Material Number: HM001502

Recommended use of the chemical and restrictions on use

Recommended Use Accelerator

Uses advised against No information available

Supplier's name, address and phone number

Manufacturer/Supplier Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 1 800 686 951
Fax Number: 61 (08) 9455 5300

E-mail Address fdunexchem@halliburton.com

Emergency phone number

+ 61 1 800 686 951
Global Incident Response Access Code: 334305
Contract Number: 14012

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

2. Hazard Identification

Statement of Hazardous Nature Hazardous according to the criteria of the 7th Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

Classification of the hazardous chemical

Serious Eye Damage/Irritation	Category 2 - H319

Label elements, including precautionary statements

Hazard Pictograms

Signal Word WARNING

Hazard Statements: H319 - Causes serious eye irritation

Precautionary Statements

Prevention P264 - Wash face, hands and any exposed skin thoroughly after handling
P280 - Wear eye protection/face protection

Response P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention

Storage None

Disposal None

Contains

Substances	**CAS Number**
Calcium chloride, dihydrate	10035-04-8

Other hazards which do not result in classification

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Calcium chloride, dihydrate	10035-04-8	60 - 100%	Eye Irrit. 2A (H319)

4. First aid measures

Description of necessary first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Symptoms caused by exposure

Causes eye irritation. Causes mild skin irritation. May be harmful if swallowed.

Medical Attention and Special Treatment

Notes to Physician Treat symptomatically

5. Fire Fighting Measures

Suitable extinguishing equipment

Suitable Extinguishing Media

All standard fire fighting media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Specific hazards arising from the chemical

Special exposure hazards in a fire

None anticipated

Special protective equipment and precautions for fire fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Use appropriate protective equipment. Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Store in a cool, dry location.

Other Guidelines

No information available

8. Exposure Controls/Personal Protection

Control parameters - exposure standards, biological monitoring

Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Calcium chloride, dihydrate	10035-04-8	Not applicable	Not applicable

Appropriate engineering controls

Engineering Controls Use in a well ventilated area.

Personal protective equipment (PPE)

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational

	exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	None known.
Environmental Exposure Controls	Do not allow material to contaminate ground water system.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Solid	**Color**	White
Odor:	Odorless	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	10
Freezing Point / Range	No data available
Melting Point / Range	No data available
Pour Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	-
Vapor Density	No data available
Specific Gravity	2.1
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

Molecular Weight	147.02 (g/mole)
VOC Content (%)	No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.
10.2. Chemical stability
Stable
10.3. Possibility of hazardous reactions
Will Not Occur
10.4. Conditions to avoid
None anticipated
10.5. Incompatible materials
None known.
10.6. Hazardous decomposition products
None known.

11. Toxicological Information

Information on routes of exposure

Principle Route of Exposure Eye or skin contact, inhalation.

Symptoms related to exposure

Most Important Symptoms/Effects

Causes eye irritation. Causes mild skin irritation. May be harmful if swallowed.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Calcium chloride, dihydrate	10035-04-8	2301 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	No data available

Immediate, delayed and chronic health effects from exposure

Inhalation May cause mild respiratory irritation.

Eye Contact Causes eye irritation.

Skin Contact Causes mild skin irritation.

Ingestion May be harmful if swallowed. Irritation of the mouth, throat, and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Exposure Levels

No data available

Interactive effects

Skin disorders.

Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Calcium chloride, dihydrate	10035-04-8	Causes mild skin irritation (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Calcium chloride, dihydrate	10035-04-8	May cause moderate to severe eye irritation. (Rabbit)

Substances	CAS Number	Skin Sensitization
Calcium chloride, dihydrate	10035-04-8	No data of sufficient quality are available.

Substances	CAS Number	Respiratory Sensitization
Calcium chloride, dihydrate	10035-04-8	No information available

Substances	CAS Number	Mutagenic Effects
Calcium chloride, dihydrate	10035-04-8	In vitro tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Calcium chloride, dihydrate	10035-04-8	No information available

Substances	CAS Number	Reproductive toxicity
Calcium chloride, dihydrate	10035-04-8	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Calcium chloride, dihydrate	10035-04-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Calcium chloride, dihydrate	10035-04-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Calcium chloride, dihydrate	10035-04-8	Not applicable

12. Ecological Information

Ecotoxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Calcium chloride, dihydrate	10035-04-8	EC50 (72h) 2900 mg/L (Pseudokirchnerella subcapitata) EC50 (72h) >4000 mg/L (Pseudokirchnerella subcapitata)	LC50 (96h) 4630 mg/L (Pimephales promelas)	NOEC 2000 mg/L (Activated sludge, industrial)	EC50 (48h) 1285 mg/L (Daphnia magna) EC16 (21d) 320 mg/L (Daphnia magna) ErC50 (21d) 610 mg/L (Daphnia magna) LC50 (48h) 1285 mg/L (Daphnia magna) LC50 (48h) 2400 mg/L (Daphia magna)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Calcium chloride, dihydrate	10035-04-8	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Calcium chloride, dihydrate	10035-04-8	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Calcium chloride, dihydrate	10035-04-8	No information available

12.6. Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

Safe handling and disposal methods

Bury in a licensed landfill according to federal, state, and local regulations.

Disposal of any contaminated packaging

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

Environmental regulations

Not applicable

14. Transport Information

Transportation Information

Australia ADG

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not applicable

Special precautions during transport
None

HazChem Code
None Allocated

15. Regulatory Information

Safety, health and environmental regulations specific for the product

International Inventories

Australian AICS Inventory	All components are listed on the AIIC or are subject to a relevant exemption, permit, or assessment certificate.
New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian Domestic Substances List (DSL)	All components listed on inventory or are exempt.

Poisons Schedule number
None Allocated

International Agreements

Montreal Protocol - Ozone Depleting Substances:	Does not apply.
Stockholm Convention - Persistent Organic Pollutants:	Does not apply
Rotterdam Convention - Prior Informed Consent:	Does not apply.
Basel Convention - Hazardous Waste:	Does not apply.

16. Other information

Date of preparation or review

Revision Date: 15-Mar-2022

Revision Note
SDS sections updated:
2

Full text of H-Statements referred to under sections 2 and 3
H319 - Causes serious eye irritation

Additional information: For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key abreviations or acronyms used

bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
PBT – Persistent Bioaccumulative and Toxic
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
vPvB – very Persistent and very Bioaccumulative
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data

www.ChemADVISOR.com/
OSHA
ECHA C&L
NZ CCID

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Appendix K

Chemical Risk Assessment – Packer Fluid and Lubricants

AECOM

Client Name: Tamboran B2 Pty Ltd
Project Name: Chemical Risk Assessment

Packer Fluid Recipe - NaBR

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Sodium Bromide	7647-15-6	8,160 kg	0.072	Fluid density	Acute Toxicity: 96hr LC50 fish >440 mg/L LC50value invertebrates >1000 mg/L EC50value algae: 440 mg/L Chronic toxicity: NOEC fish: 10 mg/L 16 day NOEC invertebrates: 2.8 mg/L	Based on chronic: Low	N.A.(Inorganic)	N.A. (Inorganic)	Tier 1 (NICNAS IMAP)	Poses no unreasonable risk to human health or the environment based on Tier I assessment under the NICNAS IMAP assessment framework	NA	NA	NA	NA	NA
Glutaraldehyde	111-30-8	40 kg	0.00015	Biocide	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproduct'n Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 1	The risk was classified as moderate based on chronic data, however the substance is readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Methanol	67-56-1	40 kg	0.00001	Biocide	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	Not bioaccumulative based on the Log Kow of -0.74	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
BARACOR W-991*	Unknown	416 ltr	0.002	Corrosion inhibitor	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
Triazine based biocide C572,2',2"-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethanol	4719-04-4	208 ltr	0.0015	H2S scavenger	LC50 for fish 240.04 mg/L LC50 for invertebrates 60.67 mg/L EC50 for freshwater algae: 6.6 mg/L	Based on acute: High	Expected to be readily biodegradable.	Not bioaccumulative	Tier 1	The risk was classified as high based on acute data, however the substance is readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
OXYGON*	Unknown	25 kg	0.0005	Oxygen scavenger	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
													Total Risk	**NA**	The chronic health risks associated with potential exposure to COPC identified in flowback water, where the NaBR Packer Fluid recipe is used and assuming 100% mass recovery are considered to be low and acceptable.

Notes
* Chemical composition and information not provided to AECOM due to proprietary controls by the chemical manufacturer
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
BCF - Bioconcentration Factor
NA - Not Applicable

NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Calcium Chloride	10043-52-4	8,304 kg	0.15	Fluid density	Acute Toxicity 96-hr LC50 value was 4,630 mg/L in fathead minnow (Pimephales promelas) 48-hr EC50 was 1,062 mg/L for Daphnia magna 72-hr EC50 = >4,000 for fresh water algae 72-hr EC50 = 2,900 mg/L for fresh water algae (biomass) Chronic Toxicity 21-day NOEC = 160 mg/L for Daphnia magna	Based on acute and chronic: Low	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Not applicable (inorganic salt, ionic species ubiquitous in environment)	Tier 1	The risk was classified as low based on chronic data and acute data. The substance is inorganic and ubiquitous in the environment. The exposure concentration is below the respective ecotoxicity values A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Glutaraldehyde	111-30-8	40 kg	0.00015	Biocide	96 h acute Bluegill sunfish LC50 = 11.2 mg/L 48 h acute Oyster larvae LC550 = 2.1 mg/L 96 h acute Green crabs LC50 = 465 mg/L 96 h acute Grass shrimp LC50 = 41 mg/L 48 acute Daphnia magna LC50 = 0.35 mg/L 48 acute Daphnia magna LC50 = 16.3 mg/L 21 d reproductn Daphnia magna LOEC = 4.3 mg/L, NOEC = 2.1 mg/L 96 h algal growth inhibition Selenastrum capricornutum ILm = 3.9 mg/L (median inhibitory limit) 96 h algal growth inhibition Scenedesmus subspicatus EC50 = 1.0 mg/L Bacterial inhibition Sewage microbes IC50 = 25-34 mg/L	Based on Chronic: Moderate	Readily biodegradable	No based on the Log Pow of -0.01	Tier 1	The risk was classified as moderate based on chronic data . The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Methanol	67-56-1	40 kg	0.000005	Biocide	LC50s ranged from 15,400 to 29,400 mg/L (fish) 24-hour and 48-hour EC50s were > 10,000 mg/L (Daphnia) 28 days NOEC was 446.7 mg/L (fish) 21 days NOEC was 208 mg/L (invertebrates)	Based on Chronic: Low	Readily biodegradable	Not bioaccumulative based on the Log Kow of -0.74	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Ethanolamine	141-43-5	1000 ltr	0.003	Corrosion inhibitor	Acute toxicity: 96 h LC50 (fish): 105 mg/L 48 h EC50 (invertebrates): 27.04 mg/L 72 h ErC50 (algae): 2.8 mg/L Chronic toxicity: 41 d NOEC (fish): 1.24 mg/L 21 d NOEC (invertebrates): 0.85 mg/L 72 h ErC10 (algae): 0.7 mg/L	Based on chronic: Low	Expected to be readily biodegradable	Not bioaccumulative	Tier 1	The risk was classified as low based on chronic data and it is expected to be readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Triazine based biocide C572,2',2''-(hexahydro-1,3, 5-triazine-1,3,5-triyl) triethanol	4719-04-4	208 ltr	0.0015	H2S scavenger	LC50 for fish 240.04 mg/L LC50 for invertebrates 60.67 mg/L EC50 for freshwater algae: 6.6 mg/L	Based on acute: High	Expected to be readily biodegradable.	Not bioaccumulative	Tier 1	The risk was classified as high based on actue data. However it is expected to be readily biodegradable and not bioaccummulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
OXYGON*	Unknown	25 kg	0.0005	Oxygen scavenger	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
													Total Risk	**NA**	The chronic health risks associated with potential exposure to COPC identified in flowback water, where the CaCL2 Packer Fluid recipe is used and assuming 100% mass recovery are considered to be low and acceptable.

Notes
* Chemical composition and information not provided to AECOM due to proprietary controls by the chemical manufacturer
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
BCF - Bioconcentration Factor
NA - Not Applicable
NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021

AECOM

Lubricant Recipe

Client Name: Tamboran B2 Pty Ltd
Project Name: Chemical Risk Assessment

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity[1]	Toxicity[2]	Biodegradation[1,3]	Bioaccummulative[1]	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Tier 2 Assessment Worker Aerosol Inhalation Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment[1]
Triethylene glycol, monobutyl ether,	143-22-6	14,500 L	0.00273	Lubricant	Acute Toxicity: 96hr LC50 fish:2400 mg/L 48 hr LC50 invertebrates:2210 mg/L EC50 algae: 500 mg/L Chronic toxicity: 30 day NOEC fish: 805 mg/L 30 day NOEC invertebrates: 314 mg/L	Based on acute and chronic: Low	Readily biodegradable	Based on a log Kow value <4.5 the substance is not bioaccumulative.	Tier 1 (NICNAS IMAP)	Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework	NA	NA	NA	NA	NA
2-Butoxyethanol	111-76-2	14,500 L	0.00147	Lubricant	Acute Aquatic - Fish -96-hr LC50 Oncorhynchus mykiss - 1,464 mg/L -96-hr LC50 Pimephales promelas - range from 1,580 mg/L - 2,137 mg/L -96 hr LC50 - Lepomis machrochirus - 1,490 mg/L Acute Aquatic - Invertebrate -48-hr EC50 Daphnia magna - range from - 881 mg/L - 2,650 mg/L Acute Aquatic - Algae and other aquatic plants -72-hr EC50 Pseudokirchneriella subcapitata - 911 mg/L -72-hr EC50 Selenastrum capricornutum - 720 mg/L Chronic Aquatic - Fish -21-day NOEC Brachydanio rerio - > 100 mg/L Chronic Aquatic - Invertebrate - 21-day NOEC Daphnia magna - 100 mg/L	Based on acute and chronic: Low	Readily biodegradable	Based on a log Kow value greater than 3, and a maximum BCF value of under 800 the substance is not bioaccumulative.	Tier 1	The risk was classified as low based on chronic and acute data. The substance is expected to be readily biodegradable and not bioaccumulative. The exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Diethanolamine	111-42-2	14,500 L	0.00105	Lubricant	Fish 96-h LC50 = 1370 mg/l Invertebrates 48-h EC50 = 55 mg/l Pseudokirchneriella subcapitata 96-h ErC50 = 2.2 mg/l Microorganisms 16-h TTC = 16 mg/l Daphnia magna, the NOEC (21 days) was 0.78 mg/l	Based on Chronic: High	Readily biodegradable	No. Based on a measured log Kow of -2.18 and a calculated BCF of 3.16	Tier 1	The risk was classified as high based on chronic data. However the substance is expected to be readily biodegradable and not bioaccumulative and the exposure concentration is below the respective ecotoxicity values. A Tier 2 assessment is not required.	NA	NA	NA	NA	NA
Fatty Esters (Radiagreen EME)*	Unknown	4,800L	Unknown	Lubricant	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
Fatty Esters (Radiagreen EBL)*	Unknown	4,800L	Unknown	Lubricant	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
Styrene**	100-42-5	Unknown	Unknown	Lubricant	Acute Toxicity: 96hr LC50 fish:10 mg/L 96 hr LC50 invertebrates:9.5 mg/L 96 hr EC50 algae: 6.3 mg/L Chronic toxicity: 21 day NOEC invertebrates: 1.0 mg/L	Based on acute and chronic: High	Readily biodegradable	Based on a log Kow value 3 the substance is not bioaccumulative.	Not assessed as concentration is unknown	NA	NA	NA	NA	NA	NA
Sulphonated organic polymer (Polydrill)*	Unknown	Unknown	Unknown	Drilling Fluid Additive	--	Based on information provided in the SDS, this substance is classified as not hazardous .	--	--	Tier 1	NA	NA	NA	NA	NA	NA
													Total Risk	**NA**	The chronic health risks associated with potential exposure to COPC identified in flowback water, where the lubricant recipe is used and assuming 100% mass recovery are considered to be low and acceptable.

Notes
* Chemical composition and information not provided to AECOM due to proprietary controls by the chemical manufacturer
** Chemical concentration not provided to AECOM due to proprietary controls by the chemical manufacturer
Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
1 - Please refer to the individual toxicity profiles for further detail.
2 - Toxicity assessed using NT (2021)
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NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021