# Qualitative Tier 2 Assessment

## Polyquaternium-33

In accordance with the Dawson River Release (DRR) Chemical Risk Assessment Framework (CRAF), chemicals assigned a Tier 2 designation require a hazard assessment and qualitative assessment of risk.

Consistent with National Industrial Chemicals Notification and Assessment Scheme (NICNAS), the human health hazards for each chemical are characterised by analysing the toxicokinetics (the absorption, distribution, metabolism and excretion of the chemical in humans or laboratory animals), acute toxicity, irritation and corrosivity, repeat dose toxicity, genotoxicity, carcinogenicity, reproductive toxicity, and other health effects. The environmental hazards for each chemical are characterised by analysing the environmental fate properties (such as mobility, persistence, bioavailability and bioaccumulation), acute toxicity and chronic toxicity. In support of the hazard assessment, a risk assessment dossier is prepared for each of the chemicals included in the assessment.

Potentially complete exposure pathways (in that a source, a migration pathway, a mechanism for exposure, and a potential receptor are present) are assessed herein to determine the potential for risk. An incomplete pathway precludes an exposure occurring and an associated potential risk. In this context, site setting and management protocols associated with the action are evaluated. Key controls limiting the potential for exposure include:

- Engineering controls (including fencing and secondary containment);
- Storage (drums, totes and storage tanks) constructed in accordance with Australian standards and managed and monitored in accordance with regulatory requirements;
- Maintenance of access control restrictions during site activities that will preclude access by the public, livestock and large native fauna; and,
- Safe Work Australia and Santos Occupational Safety Guidance used to minimise human health exposure.

This qualitative assessment provides information to be used as a complement to the risk assessment dossier to provide a summary of human and ecological hazards that may occur from exposure to the chemical. Where a potential hazard exists, additional information is provided in the risk assessment dossiers and safety data sheets (SDSs) and are available to emergency responders, health and safety managers, and environmental hazard clean-up teams.

As a result, the assessment for this Tier 2 chemical includes the following components: completing the screening; developing a risk assessment dossier and Predicted No Effect Concentrations (PNECs) for water and soil; and, providing a qualitative discussion of risk. Each of these components is detailed within this memorandum.

## Background

Santos has been releasing treated water to the Dawson River since 2015. The Dawson River Release Scheme[1] is located in the southeast region of the Fairview Arcadia Project Area (FAPA) (within the hub compressor station four (HCS4) gathering network). Coal seam water produced in the HCS4 gathering network is collected and is treated at Reverse Osmosis Plant 2 (ROP2) with the treated permeate stored within a permeate pond prior to release to the Dawson River. The outfall location is located within a tributary gully of the Dawson River, which joins the Dawson River midway between "Dawson's Bend" and Yebna Crossing.

The permeate pond is connected to the outfall location by a 5.3 kilometre (km) pipeline constructed across farmland with the released water flowing down a 2.9 km tributary gully before discharging to the Waterbody (nominal capacity 500 megalitre [ML]) and then flowing 1.8 km before joining the Dawson River at its downstream confluence.

ROP 2 at FAPA is a reverse osmosis plant with a specification designed to produce high quality water for the intended release of treated coal seam water to the Dawson River. The process removes the suspended and dissolved solids through a set of six processes to produce high quality treated water. These include coagulation/clarification, oxidation, filtration, softening, reverse osmosis, and finally adjustment of sodium adsorption ratio (SAR).

Cationic polymers are a component in a Water Management Facility (WMF) product used as a coagulant during oily water treatment. Process and usage information for this chemical is included in **Attachment 1** and summarised in **Table 1**.

**Table 1 Water Management Facility Chemicals**

| Chemical Name | CAS No. | Use | Approximate Quantity Stored On-Site (plant available storage) |
|---|---|---|---|
| Adipic Acid<br>Cationic acrylamide copolymer | 124-04-9<br>69418-26-4 | Sludge polymer | 1000 kg |

CAS No = Chemical Abstracts Service Number
kg = kilogram

The identity of the cationic polymer in the vendor product is acrylamide-acroloyloxyethyltrimethyl ammonium chloride (also known as polyquaternium-33) (CAS RN 69418-26-4)[2]. Information compiled for polyquaternium-33 is provided in the risk assessment dossier included as **Attachment 2**. Results of the screening assessment are included in the dossier.

The assessment of toxicity of this chemical was used to develop initial screening criteria for human health exposure scenarios and is presented in **Attachment 2**. As detailed in the attachment and

[1] Santos obtained an amendment to the Fairview Arcadia Project Area (FAPA) Environmental Authority (EA) (EPPG00928713) on 31st May 2013 to authorise the release of desalinated produced water from the Fairview reverse osmosis plant (ROP) 2 to the Dawson River – the Dawson River Release Scheme (DRRS).

[2] CAS RN - Chemical Abstracts Service Registry Number

presented in **Table 2**, no data are available to derive toxicological reference and drinking water guidance values for polyquaternium-33.

**Table 2 Oral Reference Doses and Derived Drinking Water Guidelines**

| Constituent (CAS No.) | Study | Critical Effect/ Target Organ(s) | NOAEL (mg/kg-day) | Uncertainty Factors | Oral Reference Dose (mg/kg-day) | Drinking Water Guideline (mg/L) |
|---|---|---|---|---|---|---|
| Polyquaternium-33 (69418-26-4) | - [a] | - | - | - | - | - |

[a] – No data available.
CAS = Chemical Abstracts Service
mg/kg-day = milligrams per kilogram-day
mg/L = milligrams per litre
NOAEL = No observed adverse effect level
Refer to **Attachment 2** for information on the key studies selected for oral reference dose and drinking water level development.

For ecological receptors, the assessment utilises the information presented in the dossiers on the relative toxicity of the aquatic and terrestrial flora and fauna to the chemical. This assessment focuses on the aquatic invertebrate and fish species within the surface water resources and the soil flora and fauna associated with releases to the soil.

The determination of toxicological reference values (TRVs) was conducted according to the PNEC guidance in the *Environmental Risk Assessment Guidance Manual for Industrial Chemicals* prepared by the Australian Environmental Agency (AEA, 2009). PNECs for freshwater and sediment were developed to assess aquatic receptors, and PNECs for soil were developed for terrestrial receptors.

**Table 3** presents the chemical, endpoint, no observable effects concentration (NOEC) (milligrams per litre [mg/L]), assessment factor, and the aquatic PNEC (mg/L). A PNEC for soil was not calculated for the chemical. Refer to the dossier provided in **Attachment 2** for the development of PNECs, or the rational for PNECs that do not have a calculated PNEC.

**Table 3 PNECs Water**

| Constituents | Endpoint | $EC_{50}$ or NOEC (mg/L) | Assessment Factor | $PNEC_{water}$ (mg/L) |
|---|---|---|---|---|
| Polyquaternium-33 (69418-26-4) | Acute fish | 1-10 | 1,000 | 0.001-0.01 |

$EC_{50}$ = effects concentration – 50%
mg/L = milligrams per litre
NOEC = no observable effects concentration
PNEC = predicted no effect concentration
Refer to **Attachment 2** for information on the development of PNECs listed above.

A detailed assessment of the potential risks posed by this Tier 2 chemical is provided in the following sections.

## General Overview

Polyquaternium-33 is a copolymer of trimethylaminoethylacetate salt and acrylamide. It is a highly charged cationic homopolymer with high molecular weights. While specific information is not available, typical flocculants that are cationic polyacrylamide-based copolymers have molecular weights that can range from 1 million to >50 million (Lyons and Vasconcellos, 1997). The molecular structure of polyquaternium-33 is presented in **Figure 1**.

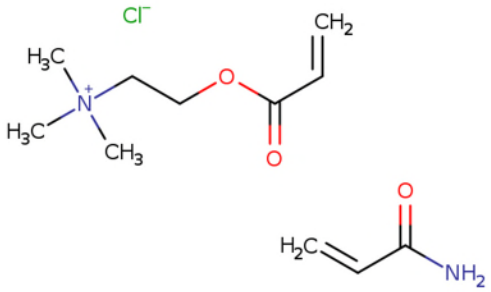


**Figure 1 Molecular Structure of Polyquaternium-33**[3]

Synthetic polymers are persistent in the environment. They are expected to be poorly biodegraded, and adsorption would be expected to be the primary process that determines its ecological concentrations and mobility (Lyons and Vasconcellos, 1997). As a cationic polymer, polyquaternium-33 will rapidly react with many kinds of naturally occurring substances, such as humic acids, lignins, silts and clays (Lyons and Vasconcellos, 1997). Due to its physical properties (i.e., molecular size), polyquaternium-33 is not expected to bioaccumulate.

The PBT assessment for polyquaternium-33 is included in the dossier provided in **Attachment 2**. Based on physico-chemical properties and screening data detailed below, the overall conclusion was that polyquaternium-33 is not a PBT substance.

## Human Health Hazards

There is a low concern for human health hazards. Polyquaternium-33 is not acutely toxic to humans by the oral route ($LD_{50}$ > 5,000 mg/kg bw)[4]. Likewise, it is non-irritating to the skin and is not a skin sensitiser.

No data are available to derive toxicological reference and drinking water guideline values for polyquaternium-33. Additional discussion is included in the dossier provided in **Attachment 2**.

Managed release of treated water to the Dawson River would have the potential to affect surface water within the river. As the Dawson River meanders through large areas that are uncontrolled, exposures could potentially occur to downstream agricultural workers and residents. Based on the treatment process described in **Attachment 1**, the cationic polymers would be bound to the solids

[3] Source https://chem.nlm.nih.gov/chemidplus/rn/69418-26-4

[4] LD50 = lethal dose of 50 percent of population; mg/kg bw – milligrams per kilogram body weight

present in the oily water and removed during clarification. As a result, this chemical would not be present in permeate or brine. Therefore, exposure pathways associated with Dawson River discharge would be incomplete.

## Environmental Hazards

In standard acute aquatic toxicity tests, polyquaternium-33, as a highly charged cationic polymer, has a moderate acute toxicity concern to aquatic organisms. However, under environmental conditions, the toxicity of these polymers is mitigated by the presence of dissolved organic carbon (DOC) and suspended solids. Cationic polymers react with DOC in environmental waters to form insoluble complexes, which settle out of water and therefore are not bioavailable to cause toxic effects. It has previously been established that a reduction in likely toxicity by a factor of 110 is appropriate to apply to laboratory test results for cationic polymers with a high charge density to account for the mitigating effects of DOC on toxicity in natural environmental waters (Boethling and Nabholz, 1997).

As described in the previous section (Human Health Hazards), managed release of treated water to the Dawson River would have the potential to affect surface water within the river. As released treated water would become part of the regional surface water resource (i.e., Dawson River water quality and flow), ecological resources (livestock and native flora and fauna) are potential receptors. Specifically, potential receptors include:

- Aquatic ecological receptors within Dawson River downstream of the release point
- Livestock and wildlife that may access Dawson River surface water

However, as discussed earlier, exposure pathways associated with Dawson River discharge would be incomplete, including those associated with the following Matters of National Environmental Significance [MNES] receptors:

- White-throated Snapping Turtle (*Elseya albagula*) – Critically endangered; and
- Fitzroy River Turtle (*Rheodytes leukops*) – Vulnerable.

These findings are consistent with an assessment completed by NICNAS in 2017 for a similar cationic polymer (polyDADMAC). Based on an assessment of environmental hazards, NICNAS identified polyDADMAC as a chemical of low concern to the environment (DoEE, 2017). Chemicals of low concern are unlikely to have adverse environmental effects if they are released to the environment from coal seam gas operations.

## References

Australian Environmental Agency (AEA). (2009). Environmental Risk Assessment Guidance Manual for Industrial Chemicals, Commonwealth of Australia. Available: http://www.nepc.gov.au/resource/chemical-risk-assessment-guidance-manuals

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# Attachment 1 Vendor WMF Chemicals and Exposure Point Concentration

**Attachment 1**
**Summary of Exposure Point Concentration Development**
**(Water Treatment Chemicals)**

| Product Name | Chemical Name | CAS Number | % | Proper Shipping Name | Supplier | Area | Transport | | Onsite Storage | | Operation | | Annual Usage (ROP volumes based on peak rate of 10ML/d) | Purpose / Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mass/volume | concentration | mass/volume | concentration | mass/volume | concentration | | |
| Hydrex 6926 (Sludge Polymer) | Adipic Acid<br>Cationic acrylamide copolymer | 124-04-9<br>69418-26-4 | 1-5%<br>80-90% | Hydrex 6926 | Veolia Water Solutions | Reverse Osmosis Plant | 25kg bags | 100% | 1000kg | 100% | 2mg/L (AVG) | 100% | 7300L | sludge polymer |

AVG = average
CAS = Chemical Abstracts Service
COPC = constituent of potential concern
L = litres
kg = kilograms
mg/kg = milligrams per kilogram
mg/L = milligrams per litre
ML/d = millilitre per day
NA = not applicable
ROP = reverse osmosis process

**Attachment 1**
**Summary of Exposure Point Concentration Development**
**(Water Treatment Chemicals)**

| Product Name | Chemical Name | CAS Number | Fate | Permeate Concentration | | COPC concentration in soil from release of permeate | COPC concentration in soil from 20 years of irrigation | Brine Concentration |
|---|---|---|---|---|---|---|---|---|
| | | | | (mg/L) | Permeate notes | (mg/kg) | (mg/kg) | (mg/L) |
| Hydrex 6926 (Sludge Polymer) | Adipic Acid | 124-04-9 | Removed with Actiflo sludge (solid waste) | NA | This product is not directed to the permeate stream. | NA | NA | NA |
| | Cationic acrylamide copolymer | 69418-26-4 | | NA | This product is not directed to the permeate stream. | NA | NA | NA |

AVG = average
CAS = Chemical Abstracts Service
COPC = constituent of potential concern
L = litres
kg = kilograms
mg/kg = milligrams per kilogram
mg/L = milligrams per litre
ML/d = millilitre per day
NA = not applicable
ROP = reverse osmosis process

**Attachment 1**
**Summary of Exposure Point Concentration Development**
**(Water Treatment Chemicals)**

| Product Name | Chemical Name | CAS Number | Brine Notes |
|---|---|---|---|
| Hydrex 6926 (Sludge Polymer) | Adipic Acid | 124-04-9 | This product not directed to brine dams. |
| | Cationic acrylamide copolymer | 69418-26-4 | This product not directed to brine dams. |

AVG = average
CAS = Chemical Abstracts Service
COPC = constituent of potential concern
L = litres
kg = kilograms
mg/kg = milligrams per kilogram
mg/L = milligrams per litre
ML/d = millilitre per day
NA = not applicable
ROP = reverse osmosis process

# Attachment 2 Risk Assessment Dossier

**ACRYLAMIDE, (2-ACRYLOYLOXYETHYLTRIMETHYLAMMONIUM CHLORIDE)**

This dossier on acrylamide, (2-acryloyloxyethyltrimethylammonium chloride) (also known as polyquaternium-33) presents the most critical studies pertinent to the risk assessment of polyquaternium-33 in its use in coal seam gas extraction activities. It does not represent an exhaustive or critical review of all available data. Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch *et al.*, 1997).

Screening Assessment Conclusion – Polyquaternium-33 was not identified in chemical databases used by NICNAS as an indicator that the chemical is of concern and is not a PBT substance. Polyquaternium-33 was assessed as a tier 2 chemical for acute toxicity and as a tier 2 chemical for chronic toxicity. Therefore, polyquaternium-33 is classified overall as a **tier 2** chemical and requires a hazard assessment and qualitative assessment of risk.

## 1 BACKGROUND

Polyquaternium-33 is a copolymer of trimethylaminoethylacetate salt and acrylamide. Polyquaternium-33 is a highly charged cationic polymer with high molecular weights. It is used as flocculent, retention and drainage aid in the manufacture of food contact paper and paper board (FDA, 2013).

It is expected to be poorly biodegraded and adsorption would be expected to be the primary process that determines its ecological concentrations and mobility. As a cationic polymer, polyquaternium-33 will rapidly react with many kinds of naturally occurring substances, such as humic acids, lignins, silts and clays. Due to its physical properties (i.e. molecular size), polyquaternium-33 is not expected to bioaccumulate. The acute toxicity of polyquaternium-33 is very low by the oral route. It is non-irritating to the skin and is not a skin sensitiser. No other data are available regarding the human health hazard of polyquaternium-33. Polyquaternium-33 is a moderate acute toxicity concern to aquatic organisms.

## 2 CHEMICAL NAME AND IDENTIFICATION

**Chemical Name (IUPAC):** prop-2-enamide;trimethyl(2-prop-2-enoyloxyethyl)azanium; chloride
**CAS RN:** 69418-26-4
**Molecular formula:** $(C_8H_{16}ClNO_2)x.(C_3H_5NO)_x$
**Molecular weight:** No information is available. It is expected to be a high molecular weight polymer.

**Synonyms:** Acrylamide, (2-acryloyloxyethyl)trimethylammonium chloride polymer; ethanaminium, N,N,N,trimethyl-2-[1-oxo-2-propenyl)oxy]-, chloride, polymer with 2-propenamide; polyquaternium-33

## 3 PHYSICO-CHEMICAL PROPERTIES

The commercial polymer is a white to off-white powder. It is soluble in water, forming a viscous solution (BASF, 2010; WaterSolve, 2013).

While specific information is not available, typical flocculants that are cationic polyacrylamide-based copolymers have molecular weights that can range from 1 million to >50 million g/mol (Lyons and Vasconcellos, 1997).

## 4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 1). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No specific environmental regulatory controls or concerns were identified within Australia and internationally for acrylamide, (2-acryloyloxyethyltrimethylammonium chloride).

**Table 1 Existing International Controls**

| Convention, Protocol or other international control | Listed Yes or No? |
|---|---|
| Montreal Protocol | No |
| Synthetic Greenhouse Gases (SGG) | No |
| Rotterdam Convention | No |
| Stockholm Convention | No |
| REACH (Substances of Very High Concern) | No |
| United States Endocrine Disrupter Screening Program | No |
| European Commission Endocrine Disruptors Strategy | No |

## 5 ENVIRONMENTAL FATE SUMMARY

Polyquaternium-33 is a highly charged cationic polymer with high molecular weights. It is expected to be poorly biodegraded and adsorption would be expected to be the primary process that determines its ecological concentrations and mobility (Lyons and Vasconcellos, 1997). As a cationic polymer, polyquaternium-33 will rapidly react with many kinds of naturally occurring substances, such as humic acids, lignins, silts and clays (Lyons and Vasconcellos, 1997).

Due to its physical properties (i.e. molecular size), polyquaternium-33 is not expected to bioaccumulate.

## 6 HUMAN HEALTH HAZARD ASSESSMENT

### A. Summary

The acute toxicity of polyquaternium-33 is very low by the oral route. It is non-irritating to the skin and is not a skin sensitiser. No other data are available regarding the human health hazard of polyquaternium-33.

### B. Acute Toxicity

The oral $LD_{50}$ in rats is >5,000 mg/kg (BASF, 2010; WaterSolve, 2013). [Kl. score = 4]

## C. Irritation

Polyquaternium-33 is non-irritating to the skin of rabbits (BASF, 2010; WaterSolve, 2013). [Kl. score = 4]

No eye irritation studies are available. Polyquaternium-33 is expected to be a non-irritant to the eyes of rabbits (BASF, 2010; WaterSolve, 2013).

## D. Sensitisation

Polyquaternium-33 is not a skin sensitiser to guinea pigs (WaterSolve, 2013).

## E. Repeated Dose Toxicity

No studies are available.

## F. Genotoxicity

No studies are available.

## G. Carcinogenicity

No studies are available.

## H. Reproductive Toxicity

No studies are available.

## I. Developmental Toxicity

No studies are available.

## J. Derivation Of Toxicological Reference And Drinking Water Guidance Values

No data are available to derive toxicological reference and drinking water guidance values for polyquaternium-33.

## K. HUMAN HEALTH HAZARD ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES

Polyquaternium-33 does not exhibit the following physico-chemical properties:

- Explosivity
- Flammability
- Oxidising potential

## 7 ENVIRONMENTAL EFFECTS SUMMARY

### A. Summary

Polyquaternium-33 has a moderate acute toxicity concern to aquatic organisms.

### B. Aquatic Toxicity

The 96-hour $LC_{50}$ to fish was reported to be 1 – 10 mg/L (BASF, 2010; WaterSolve, 2013). [Kl. score = 4]

The 48-hour $EC_{50}$ to *Daphnia magna* was approximately 35 mg/L (WaterSolve, 2013). [Kl. score = 4]

Chronic Studies

No studies are available.

### C. Terrestrial Toxicity

No studies are available.

### D. Calculation of PNEC

The PNEC calculations for polyquaternium-33 follow the methodology discussed in DEWHA (2009).

PNEC water

Experimental results are available for two trophic levels. Acute $EC_{50}$ values are available for fish (1-10 mg/L) and invertebrates (35 mg/L). On the basis that the data consist of short-term results from two trophic levels, an assessment factor of 1,000 has been applied to the lowest $EC_{50}$ value of 1-10 mg/L for fish. The $PNEC_{water}$ is 0.001-0.01 mg/L.

PNEC sediment

There are no toxicity data for sediment-dwelling organisms. The $K_{ow}$ and $K_{oc}$ have not been experimentally derived for polyquaternium-33; these values cannot be estimated using QSAR models because of the high molecular weight of polyquaternium-33. Thus, the equilibrium partitioning method cannot be used to calculate the $PNEC_{sed}$.

PNEC soil

There are no toxicity data for soil-dwelling organisms. The $K_{ow}$ and $K_{oc}$ have not been experimentally derived for polyquaternium-33; these values cannot be estimated using QSAR models because of the high molecular weight of polyquaternium-33. Thus, the equilibrium partitioning method cannot be used to calculate the $PNEC_{soil}$.

## 8 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

### A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REACH Criteria methodology (IChEMS, 2022; ECHA, 2017).

Polyquaternium-33 is a large molecular weight, water-soluble polymer. It is not expected to be readily biodegradable; thus, it meets the screening criteria for persistence.

Polyquaternium-33 is not expected to be bioavailable to aquatic or terrestrial organisms because of its large molecular weight and size. Thus, it is not expected to meet the criteria for bioaccumulation.

There are no chronic aquatic toxicity studies on polyquaternium-33. The $EC_{50}$ values from the acute aquatic toxicity studies on polyquaternium-33 are >1 mg/L. Thus, it is does not meet the screening criteria for toxicity.

The overall conclusion is that polyquaternium-33 is not a PBT substance.

### B. Other Characteristics of Concern

No other characteristics of concern were identified for polyquaternium-33.

## 9 SCREENING ASSESSMENT

| Chemical Name | CAS No. | Overall PBT Assessment [1] | Chemical Databases of Concern Assessment Step | | Persistence Assessment Step | | Bioaccumulative Assessment Step | Toxicity Assessment Step | | | Risk Assessment Actions Required[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Listed as a COC on relevant databases? | Identified as Polymer of Low Concern | P criteria fulfilled? | Other P Concerns | B criteria fulfilled? | T criteria fulfilled? | Acute Toxicity [2] | Chronic Toxicity[2] | |
| Polyquaternium-33 | 69418-26-4 | Not a PBT | No | No | Yes[a] | No | No | No | 2 | 2 | 2 |

**Footnotes:**

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 - Tier 2 - Hazard Assessment and Qualitative Assessment Only. Develop toxicological profile and PNECs for water and soil and provide qualitative discussion of risk

**Notes:**

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

[a] – high molecular weight polymer

## 10 REFERENCES, ABBREVIATIONS AND ACRONYMS

### A. References


BASF. (2010). Safety Data Sheet for ZETAG 8185, revision date: 2010/07/22, version 1.0. Available at: http://www.kubwater.com/wp-content/uploads/2014/02/Zetag-8185-MSDS.pdf

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### B. Abbreviations and Acronyms

| | |
|---|---|
| AICS | Australian Inventory of Chemical Substances |
| COC | constituent of concern |
| DEWHA | Department of the Environment, Water, Heritage and the Arts |
| EC | effective concentration |
| ECHA | European Chemicals Agency |
| EU | European Union |

| | |
|---|---|
| IChEMS | Industrial Chemicals Environmental Management Standard |
| IUPAC | International Union of Pure and Applied Chemistry |
| KI | Klimisch scoring system |
| LC | lethal concentration |
| LD | lethal dose |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per litre |
| NICNAS | The National Industrial Chemicals Notification and Assessment Scheme |
| PBT | Persistent, Bioaccumulative and Toxic |
| PNEC | Predicted No Effect Concentration |
| QSAR | quantitative structure activity relationship |
| REACH | Registration, Evaluation, Authorisation and Restriction of Chemicals |
| SGG | Synthetic Greenhouse Gases |