MAGNESIUM CHLORIDE

This dossier on magnesium chloride presents the most critical studies pertinent to the risk assessment of this substance in its use in hydraulic fracturing fluids. This dossier does not represent an exhaustive or critical review of all available data. The majority of information presented in this dossier was obtained from the ECHA database that provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch *et al.*, 1997).

Screening Assessment Conclusion – Magnesium chloride is classified as a **tier 1** chemical and requires a hazard assessment only.

1 BACKGROUND

Magnesium chloride dissociates completely in water to the Mg++ cation and the chloride anion (Cl-). Biodegradation is not applicable to magnesium chloride. Magnesium chloride and its dissociated ions are ubiquitous in the environment; they are not expected to adsorb to soil or sediment or to bioaccumulate. Magnesium chloride is of low toxicity concern to aquatic life.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): Magnesium (2+) dichloride

CAS RN: 7786-30-3

Molecular formula: Cl_2Mg

Molecular weight: 95.2 g/mol

Synonyms: Magnesium chloride; magnesium (2+) dichloride; magnesium chloride, anhydrous

3 PHYSICO-CHEMICAL PROPERTIES

Key physical and chemical properties for the substance are shown in Table 1.

Table 1: Overview of the Physico-chemical Properties of Magnesium Chloride

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	Colourless or white hexagonal crystals	2	ECHA
Melting point	712°C @ 101.3 kPa	2	ECHA
Boiling point	1412 °C (pressure not provided)_	-	ECHA
Density	2316 kg/m^3 @ 20°C	1	ECHA
Water Solubility	468.7 g/L @ 20°C	1	ECHA

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). 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 magnesium chloride.

NICNAS has assessed magnesium chloride in an IMAP Tier 1 assessment and concluded that it poses no unreasonable risk to the environment provided that ANZECC water quality guidelines for physical and chemical stressors are not exceeded[1]. In addition, based on an assessment of human health and environmental hazards, NICNAS also identified magnesium chloride as a chemical of low concern to the environment (NICNAS, 2017 and DoEE, 2017). Chemicals of low concern are unlikely to have adverse environmental effects or be a concern to human health if they are released to the environment from coal seam gas operations.

Table 2 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

Given its high solubility in water, magnesium chloride will dissociate and release magnesium (Mg^{2+}) and chloride (Cl^-) ions. The dissociated Mg^{2+} cation can then transform and form complexes with dissolved ligands present in natural waters. Magnesium is widespread in living cells and does not bioconcentrate in aquatic organisms. Environmental fate analysis based on log Kow and log Koc and typical fugacity modelling is not applicable to magnesium chloride as it is an inorganic compound. Photodegradation and biodegradation are also not applicable to inorganic metal salts such as magnesium chloride (OECD, 2011).

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Magnesium chloride is of low toxicity concern to aquatic life.

[1] https://www.industrialchemicals.gov.au/chemical-information/search-assessments?assessmentcasnumber=7786-30-3

B. Aquatic Toxicity

Acute Studies

Table 3 lists the results of acute aquatic toxicity studies conducted on magnesium chloride.

Table 3: Acute Aquatic Toxicity Studies on Magnesium Chloride

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
Pimephales promelas	96-hr LC_{50}	2,119	2	ECHA
Daphnia magna	48-hr LC_{50}	548	2	ECHA
Daphnia magna	48-hr LC_{50}	841	2	ECHA
Ceriodaphnia dubia	48-hr LC_{50}	1,328	2	ECHA
Desmodesmus subspicatus	72-hr EC_{50} NOEC	>100 100	1	ECHA

Chronic Studies

The 21-day EC_{10} of magnesium chloride in a Daphnia reproduction test is 321 mg/L (ECHA) [Kl. score = 2]

C. Terrestrial Toxicity

No studies are available.

Magnesium and chloride ions are ubiquitous in the environment and are found naturally in soil, water and sediment (Mg in soils/sediments are at a 50th percentile level in the range of 0.9-1.2 %). Magnesium will be assimilated by species residing in the soil and is necessary to maintain a good chemical balance in soils, water and sediment. The chloride will become part of the chloride cycle and/or be assimilated by microorganisms and other species that require chloride as an essential substance in their biological systems/ processes. Natural magnesium minerals are quite soluble, and so differences in bioavailability between natural magnesium sources and anthropogenic added magnesium are not expected. For these reasons, it is expected that magnesium chloride would not be toxic to soil organisms and hence, short-term and long-term toxicity tests to terrestrial organisms are scientifically unjustified (ECHA).

7 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 (DEWHA, 2009; ECHA, 2008).

Magnesium chloride is an inorganic salt that dissociates completely to magnesium and chloride ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions. For the purposes of this PBT assessment, the persistent criteria are not considered applicable to this inorganic salt.

Magnesium chloride is not expected to bioaccumulate; it will dissociate to ions that are ubiquitous in the environment. Thus, the substance does not meet the screening criteria for bioaccumulation.

The EC_{10} value from a chronic Daphnia reproduction study is >0.1mg/L. The acute EC_{50} values are >1 mg/L in fish, invertebrates and algae. Thus, magnesium chloride does not meet the screening criteria for toxicity.

The overall conclusion is that magnesium chloride is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for magnesium chloride.

8 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]	
Magnesium chloride	7786-30-3	Not a PBT	No	No	NA	No	No	No	1	1	1

Footnotes:

1 - PBT Assessment based on PBT Framework.

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

3 – Tier 1 – Hazard Assessment only.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

9 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

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B. Abbreviations and Acronyms

°C	degrees Celsius
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
g/cm^3	grams per cubic centimetre
g/L	grams per litre
IMAP	Inventory Multitiered Assessment and Prioritisation
IUPAC	International Union of Pure and Applied Chemistry
kPa	kilopascal
LC	lethal concentration
mg/L	milligrams per litre
NOEC	no observed effect concentration
PBT	Persistent Bioaccumulative Toxic
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SGG	Synthetic Greenhouse Gases