CALCIUM OXIDE
CALCIUM HYDROXIDE

This dossier on calcium oxide and calcium hydroxide presents the most critical studies pertinent to the risk assessment of these substances in their use in drilling muds. It does not represent an exhaustive or critical review of all available data. The information presented in this dossier was obtained primarily 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 – Calcium oxide and calcium hydroxide are classified as a **tier 1** chemicals and requires a hazard assessment only.

1 BACKGROUND

Calcium oxide and calcium hydroxide are inorganic compounds. They are partially soluble in water, dissociating into calcium (Ca^{2+}) and hydroxyl (OH^-) ions; both are ubiquitous in the environment. The ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues. The substances are of low toxicity concern to aquatic and terrestrial organisms.

For the purposes of this dossier, information will be focused on calcium oxide as both the oxides and hydroxides of calcium have the same environmental fate and toxicity profiles.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): Calcium oxide

CAS RN: 1305-78-8

Molecular formula: CaO

Molecular weight: 56.08 g/mol

Synonyms: Lime; Quicklime; Burnt lime; Calcia; Calxyl; Gebrannter kalk; Unslaked lime; Calcium monoxide

Chemical Name (IUPAC): Calcium dihydroxide

CAS RN: 1305-62-0

Molecular formula: CaH_2O_2

Molecular weight: 74.09 g/mol

Synonyms: calcium hydroxide; slaked lime; hydrated lime; calcium hydroxide, hydrated

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 Calcium Oxide

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	Solid powder - Beige	1	ECHA
Melting Point	> 450°C (pressure not provided)	1	ECHA
Boiling Point	2,850°C @ 101.3 kPa	1	ECHA
Density	3310 kg/m^3 @ 22°C	1	ECHA
Vapour Pressure	-	-	-
Partition Coefficient (log K_{ow})	-	-	-
Water Solubility	1.338 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 calcium oxide.

Based on an assessment of environmental hazards, NICNAS identified calcium oxide as a chemical of low concern to the environment (NICNAS, 2017). Chemicals of low concern are unlikely to have adverse environmental effects 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

As an inorganic substance, calcium 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, calcium oxide will react and release calcium ions and hydroxyl ions. Therefore, relevant information on adsorption/desorption of calcium oxide can be broadened to data on adsorption/desorption of calcium and 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 CO_2, biological processes, etc.) and as such, partition coefficients are not relevant for the fate and behaviour of OH- in soils or sediment.

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Calcium oxide is of low toxicity concern to aquatic and terrestrial organisms.

B. Aquatic Toxicity

Acute Studies

Table 3 lists the results of acute aquatic toxicity studies conducted on calcium oxide.

Table 3 Acute Aquatic Toxicity Studies on Calcium Oxide

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
Oncorhynchus mykiss	96-hour LC_{50}	50.6 mg/L	1	ECHA
Daphnia magna	48-hour EC_{50}	49.1 mg/L	1	ECHA
Pseudokirchneriella subcapitata	72 hour EC_{10}	79.22 mg/L	1	ECHA

Chronic Studies

A 42-day *Oncorhynchus mykiss* test showed that enhanced Ca^{2+} diets (60 mg Ca^{2+}) had no effects on survival. Mean fish weights remained constant across all treatments (ECHA) [Kl Score = 4]. A 14-day *Crangon septemspinosa* test showed an EC_{10} of 32 mg/L (ECHA) [Kl Score = 2].

C. Terrestrial Toxicity

Table 4 lists the results of terrestrial toxicity studies conducted on calcium oxide.

Table 4 Terrestrial Toxicity Studies on Calcium Oxide

Test Species	Endpoint	Results (mg/kg soil dw)	Klimisch score	Reference
Eisenia foetida	14-day LC_{50} NOEC	> 5 000	1	ECHA

Studies on other terrestrial organisms are available and these either do not show effects, or do show effects but at levels which are significantly higher than the PEC values in the chemical safety report. Since the CSA shows that there is no risk for the soil compartment, there is no indication for this test to be conducted. This is in accordance with column 2 of REACH Annex VII.

Calcium and hydroxyl ions are ubiquitous in the environment and are found naturally in soil, water and sediment. Calcium is an important constituent of most soils and the minerals found in soil are mostly compounds of calcium with other substances. Therefore, the performance of long term toxicity tests on terrestrial arthropods is scientifically unjustified.

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).

Calcium oxide is an organic salt that dissociates to calcium and hydroxyl ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both calcium and hydroxyl ions are also ubiquitous and are present in most water, soil and sediment. For the purposes of this PBT assessment, the persistent criteria are not considered applicable to this inorganic salt.

Both chronic and acute aquatic toxicity data are >1 mg/L. Thus, calcium oxide does not meet the screening criteria for toxicity.

The overall conclusion is that calcium oxide is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for calcium oxide.

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]	
Calcium oxide	1305-78-8	Not a PBT	No	No	NA	No	No	No	1	1	1
Calcium hydroxide	1305-62-0	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

Department of the Environment, Water, Heritage and the Arts (DEWHA). (2009). Environmental risk assessment guidance manual for industrial chemicals, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia.

ECHA. ECHA REACH database: https://echa.europa.eu/information-on-chemicals/registered-substances

European Chemicals Agency (ECHA). (2008). Guidance on Information Requirements and Chemical Safety Assessment, Chapter R11: PBT Assessment, European Chemicals Agency, Helsinki, Finland.

Klimisch, H.J., Andreae, M., and Tillmann, U. (1997). A systematic approach for evaluating the quality of experimental and toxicological and ecotoxicological data. Regul. Toxicol, Pharmacol. 25:1-5.

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
dw	dry weight
EC	effective concentration
ECHA	European Chemicals Agency
EU	European Union
g/L	grams per litre
IUPAC	International Union of Pure and Applied Chemistry
kg/m^3	kilogram per cubic metre
kPa	kilopascal
LC	lethal concentration
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
NOEC	no observed effective concentration
PBT	Persistent, Bioaccumulative and Toxic
PEC	Predicted exposure concentrations
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals

SGG	Synthetic Greenhouse Gases