POTASSIUM HYDROXIDE

This dossier on potassium hydroxide presents the most critical studies pertinent to the risk assessment of potassium hydroxide in its use in drilling muds and water treatment systems. It does not represent an exhaustive or critical review of all available data. The information presented in this dossier was obtained from the OECD-SIDS documents on potassium hydroxide (OECD, 2002) and 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 – Potassium hydroxide is classified as a **tier 1** chemical and requires a hazard assessment only.

1 BACKGROUND

Potassium hydroxide (KOH) is a strong alkaline substance that dissociates completely in water to potassium (K+) and hydroxyl (OH-) ions. Both ions are ubiquitous in the environment. K+ and OH- ions will not adsorb on the particulate matter or surfaces and will not accumulate in living tissues. Potassium is an essential nutrient involved in fluid and electrolyte balance and is required for normal cellular function. The hazard of KOH for aquatic organisms is caused by the hydroxyl ion (OH-) which has the potential to increase the pH of the aquatic environment, depending on the buffering capacity of the water.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): Potassium hydroxide

CAS RN: 1310-58-3

Molecular formula: KOH

Molecular weight: 56.1 g/mol

Synonyms: Potassium hydroxide; caustic potash; potash lye; potassium hydrate

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 Potassium Hydroxide

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	White, crystalline solid	2	ECHA
Melting Point	406°C (pressure not provided) 250°C	2	ECHA
Boiling Point	1,327°C @ 1013 hPa	2	ECHA

Property	Value	Klimisch score	Reference
Density	2044 kg/m^3 @ 20°C	2	ECHA
Partition Coefficient (log K_{ow})	Not applicable	-	-
Water Solubility	Very soluble	2	ECHA

Potassium hydroxide (KOH) is a strong alkaline substance that dissociates completely in water to potassium (K^+) and hydroxyl (OH^-) ions.

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 potassium hydroxide.

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

Due to its high water solubility and low vapour pressure, potassium hydroxide will be found predominantly in the aquatic environment where it dissociates completely to potassium (K^+) and hydroxyl (OH^-) ions. Both ions are ubiquitous in the environment (UNEP, 1995).

The addition of potassium hydroxide to an aquatic ecosystem may increase the pH depending on the buffer capacity of the receiving water. In general, the buffer capacity is regulated by the equilibria between CO_2, HCO_3^- and CO_3^{2-}:

$CO_2 + H_2O \leftrightarrow HCO_3^- + H^+$ ($pKa_1 = 6.35$)
$HCO_3^- \leftrightarrow CO_3^{2-} + H^+$ ($pKa_2 = 10.33$)

A release of potassium hydroxide into the aquatic environment from the use of KOH could potentially increase the potassium concentration and the pH in the aquatic environment. Table 3 shows the concentration of potassium hydroxide needed to increase the pH to values of 9.0, 10.0, 11.0 and 12.0.

Table 3 Potassium Hydroxide Concentration (mg/L) Needed to Increase pH to a Value of 9 (OECD, 2002)

Buffer capacity	Concentration of KOH (mg/L)
0 mg/L HCO_3 (distilled water)	0.56
20 mg/L HCO_3 (10^{th} percentile of 77 rivers)	0.86
106 mg/L HCO_3^- (mean value of 77 rivers)	4.51
195 mg/L HCO_3^- (90^{th} percentile of 77 rivers)	8.30

K^+ and OH^- ions will not adsorb on the particulate matter or surfaces and will not accumulate in living tissues (OECD, 2002).

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Aquatic Toxicity

As noted in(OECD, 2002) toxicity tests with KOH depend on the buffer capacity of the test medium. Thus, the pH change could influence the speciation of other chemicals and therefore increase and/or decrease the toxicity.

There are no guideline studies on potassium hydroxide; the studies summarised below have Klimisch scores of 3 or 4. Studies on sodium hydroxide (NaOH) have also been included, given its similarity to KOH.

Acute Fish

KOH: The 96-hour LC_{50} to *Gambusia affinis* (mosquito fish) is 80 mg/L. At 56 mg/L, no mortality was observed.

NaOH: The 24-hour LC_{50} to *Carassius auratus* (goldfish) is 160 mg/L. At 100 mg/L, which was equivalent to a pH of 9.8, no mortality was observed. The 48-hour LC_{50} to *Leuciscus idus melanotus*, is 189 mg/L. The 96-hour LC_{50} of *Gambusia affinis* (mosquitofish) is 125 mg/L. At 84 mg/L, no effects on the fish were observed. The pH was 9 at 100 mg/L.

Acute Invertebrate

KOH: No studies are available.

NaOH: The 48-hour LC_{50} is 40 mg/L for *Ceriodaphnia cf. dubia*. The toxicity threshold concentration of NaOH for *Daphnia magna* was reported to range from 40 to 240 mg/L.

Acute Algae

No studies are available.

B. Terrestrial Toxicity

No studies are available.

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).

Potassium hydroxide is an inorganic salt that dissociates completely to potassium and hydroxide ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both potassium and hydroxide 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.

Potassium and hydroxide ions are essential to all living organisms, and their intracellular and extracellular concentrations are actively regulated. Thus, potassium hydroxide is not expected to bioaccumulate.

No chronic toxicity data exist on potassium hydroxide; however, the acute EC_{50} values are >1 mg/L in fish, invertebrates and algae. Thus, potassium hydroxide does not meet the screening criteria for toxicity.

The overall conclusion is that potassium hydroxide is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for potassium hydroxide.

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]	
Potassium Hydroxide	1310-58-3	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

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.

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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
ECHA	European Chemicals Agency
EU	European Union
g/L	grams per litre
hPa	hectopascal
IUPAC	International Union of Pure and Applied Chemistry
kg/m^3	kilograms per cubic metre
kPa	kilopascal
LC	lethal concentration
mg/L	milligrams per litre
OECD	Organisation for Economic Co-operation and Development
Pa	pascal

PBT	Persistent, Bioaccumulative and Toxic
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SGG	Synthetic Greenhouse Gases
SIDS	Screening Information Data Set