



# POTASSIUM HYDROXIDE SOLUTION

Revision: 1  
Date of Issue.: 26.11.2010

## SAFETY DATA SHEET

ACCORDING TO EC-REGULATIONS 1907/2006 (REACH), 1272/2008 (CLP/GHS) & 453/2010

### 1. SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

<b>1.1</b>	<b>Product identifier</b>	
	Product Name	Potassium Hydroxide Solution
	Chemical Name	Potassium Hydroxide
	Trade name	Potassium Hydroxide 44 – 52 % solution
	Alternative names	Caustic lye, Caustic potash, Caustic potash lye, Caustic potash solution, KOH-solution, Potassium hydrate, Potash lye, Potassium lye
	Formula	KOH
	EC No.	215-181-3
	REACH Registration No.	01-2119487136-33-0003
	CAS No.	1310-58-3
<b>1.2</b>	<b>Relevant identified uses of the substance or mixture and uses advised against</b>	
	Identified use(s)	PROC 1 Use in closed process, no likelihood of exposure PROC 2 Use in closed, continuous process with occasional controlled exposure (e.g. sampling) PROC 3 Use in closed batch process (synthesis or formulation) PROC 4 Use in batch and other process (synthesis) where opportunity for exposure arises
	Uses advised against	None
<b>1.3</b>	<b>Details of the supplier of the Safety Data Sheet</b>	
<b>1.3.1</b>	<b>Manufacturer</b>	KCKK Polymer Plant LLC Bld. 17A, Zavodskaya street, Polymer Plant Territory, 613040, Kirovo-Chepetsk, Kirov Region, The Russian Federation.
	Telephone	+7-83361-9-3594
	Fax	+7-83361-9-4281
	Website	www.halopolymer.ru
	E-mail	office@polymerplant.ru
<b>1.3.2</b>	<b>Only representative of a non-Community manufacturer</b>	URALCHEM Assist GmbH Johannssenstrasse 10 30159, Hannover, Germany
	Telephone	+7 495 721 89 89
	Fax	+7 495 721 85 85
	E-mail	Vladimir.onischenko@uralchem.com
<b>1.4</b>	<b>Emergency telephone number</b>	
	Emergency Phone No.	+7-83361-4-1250 [24hour(s).]

### 2. SECTION 2: HAZARDS IDENTIFICATION

Classification and labelling have been performed according to EU directives 1999/45/EC and 67/548/EEC as amended and adapted and to Regulation (EC) No 1272/2008 [CLP/GHS]

<b>2.1</b>	<b>Classification of the substance</b>	
<b>2.1.1</b>	<b>Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]</b>	<b>Hazard class and category:</b> Acute Tox; category 4 * Skin corrosive; category 1A Corrosive to metals; category 1 <b>Hazard statement:</b> H290: May be corrosive to metals H302 : Harmful if swallowed H314: Causes severe skin burns and eye damage
<b>2.1.2</b>	<b>Classification according to Directive 67/548/EEC</b>	C; R35 Xn; R22
<b>2.1.3</b>	<b>Additional information</b>	See Section 16 for full text of R-phrases and EC hazards
<b>2.2</b>	<b>Label elements</b>	
	Labelling according to Regulation (EC) No 1272/2008 [CLP/GHS]	



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Hazard Pictogram:



GHS05,



GHS07

Signal word:

Dgr : Danger

Hazard statements:

H290: May be corrosive to metals  
H302 : Harmful if swallowed  
H314: Causes severe skin burns and eye damage

Precautionary Statements:

P260: Do not breathe dust/fume/gas/mist/vapours/spray.  
P280: Wear protective gloves/protective clothing/eye protection/face protection.  
P303 + P361 + P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.  
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.

## 2.3 Other hazards Health hazard:

Causes burns to the respiratory track, skin, eyes and gastrointestinal tract.  
Medical conditions aggravated by exposure: asthma, respiratory disorders.

Physical hazards:

Mixing with water, acid or incompatible materials may cause splattering and release of heat.

Potential health hazards:

Target organs affected: respiratory system, skin. Eyes

Environmental effects:

Avoid ingress into water-supply sources and sewerage. The substance has alkaline character and can raise pH of surface water.

## 2.4 Additional Information

See Section 11

## 3. SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Product identifier type in accordance with Article 18(2) of Regulation (EC) No 1272/2008	Identifier number	Identification name	Weight % content (or range)		EC Number
Index number in CLP Annex VI	019-002-00-8	Potassium hydroxide	44-52	48	215-181-3
CAS number	7732-18-5	Water	48-56	52	231-91-2
Index number in CLP Annex VI	011-002-00-6	sodium hydroxide	Max 1.0		215-185-5
CAS number	584-08-7	dipotassium carbonate	Max 0.20		209-529-3

### 3.2 Mixtures Not applicable.

### 3.3 Additional Information None.



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## 4. SECTION 4: FIRST AID MEASURES



### 4.1 Description of first aid measures

Inhalation	Consult a doctor/medical service if breathing problems develop. Remove the victim into fresh air. Unconscious: maintain adequate airway and respiration.
Skin Contact	Consult a doctor/medical service. Rinse immediately with plenty of water for 15 minutes. Do not apply neutralizing agents.
Eye Contact	Consult a doctor/medical service. Wash immediately with lots of water and soap for 15 minutes. Remove clothing while washing.
Ingestion	Consult a doctor/medical service if you feel unwell. Immediately give lots of water to drink. Never give water to an unconscious person . Do not induce vomiting.

### 4.2 Most important symptoms and effects, both acute and delayed

<b>Inhalation:</b>	Exposure may cause coughing. Inhalation of mist or spray may injure the entire respiratory tract with painful and corrosive action on tissue. Irritancy expected to become noticeable at 2 mg/m <sup>3</sup> in air. Concentrations of 200 mg/m <sup>3</sup> are immediately dangerous - pulmonary edema (fatal at higher levels may occur).
<b>Eyes contact :</b>	Contact with solution rapidly causes severe damage. Permanent corneal damage almost inevitably results. Mist from solutions is extremely corrosive.
<b>Skin contact:</b>	May cause irritation (possibly severe) and chemical burns. Blistering may occur. Extent of damage depends on duration of contact.
<b>Ingestion:</b>	Severe and rapid corrosive burns of the mouth, gullet and gastrointestinal tract will result, if swallowed. Effects include severe pain, difficulty in breathing, vomiting, diarrhea and collapse. Some effects may be delayed. Estimated average fatal dose is 10g or 6,7 ml (human, adult).

### 4.3 Indication of immediate medical attention and special treatment needed

No specific requirements

## 5. SECTION 5: FIRE-FIGHTING MEASURES

### 5.1 Extinguishing Media

Suitable Extinguishing Media	The product is non-combustible. Use fire-extinguishing media appropriate for surrounding materials.
Unsuitable Extinguishing Media	Water may be ineffective.

### 5.2 Special hazards arising from the substance or mixture

Corrosive liquid.- Not combustible.  
Gives off hydrogen by reaction with metals.

### 5.3 Advice for fire-fighters

Use fire fighting water moderately and contain it.  
Use water spray to cool tanks/containers exposed to heat / remove them into safety.  
Wear self contained breathing apparatus in case of fire.  
Wear corrosion proof suit.



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## 6. SECTION 6: ACCIDENTAL RELEASE MEASURES

<b>6.1</b>	<b>Personal precautions, protective equipment and emergency procedures</b>	Isolate the area. Evacuate personnel to safe areas. Approach from upwind. Ventilate the area. Keep away from incompatible products (see Section 10).  Wear chemical resistant personal protective equipment. Prevent further leakage or spillage if safe to do so. Abundant running water should be available for emergency use. Refer to protective measures listed in sections 7 and 8.
<b>6.2</b>	<b>Environmental precautions</b>	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. Dam up the liquid spill. Contain leaking substance, pump over in suitable containers. Notify environmental personnel.
<b>6.3</b>	<b>Methods and material for containment and cleaning up</b>	Take up liquid spill with inert absorbent material. Scoop absorbed substance into closing containers. Carefully collect spill / leftovers. Equipment must be corrosion resistant. Flush contaminated areas with large amounts of water and direct rinsings to chemical sewer or collect for treatment.
<b>6.4</b>	<b>Reference to other sections</b>	See Sections 8 and 13
<b>6.5</b>	<b>Additional Information</b>	None

## 7. SECTION 7: HANDLING AND STORAGE

<b>7.1</b>	<b>Precautions for safe handling</b>	Observe strict hygiene - avoid eye and skin contact. Avoid splashing of material. Safety showers should be readily available in handling and storage areas. Eye wash fountains should be located in the work areas and should be immediately accessible for emergency use. Remove contaminated clothing immediately. When diluting, always add the product to water. Never add water to the product. Keep away from incompatible products (see Section 10).
<b>7.2</b>	<b>Conditions for safe storage, including any incompatibilities</b>	Store in a well-ventilated area. Store at ambient temperature. Keep container tightly closed. Keep away from : heat sources, highly flammable materials, incompatible products. Packaging material Suitable: stainless steel, synthetic material / polyethylene, glass To avoid: lead, aluminum, copper, tin, zinc, bronze
<b>7.3</b>	<b>Specific end use(s)</b>	KOH has mainly industrial uses. On a global level the main uses are : production of potassium carbonate (26 %), chemical manufacturing (16 %), production of potassium chemicals (12 %), production of fertilizers (11 %), production of phosphates (9 %), production of detergents (8 %), production of agricultural chemicals (7 %), production of alkaline batteries (6 %), all other (5 %)



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## 8. SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters 8.1.1 Occupational Exposure Limits

Substance	Potassium hydroxide			
CAS No.	1310-58-3			
	Limit value - Eight hours		Limit value - Short term*	
Country	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
Austria	-	2 inhalable aerosol	-	-
Belgium	-	-	-	2
Canada - Québec	-	-	-	2 (1)
Denmark	-	2	-	2
France	-	-	-	2
Hungary	-	2	-	2
Poland	-	0,5	-	1
Spain	-	2	-	-
Sweden	-	1	-	(2)
Switzerland	-	2 inhalable aerosol	-	-
USA - NIOSH	-	-	-	2 (1)
United Kingdom	-	-	-	2

#### Remarks

Canada - Québec

(1) Ceiling value

USA - NIOSH

(1) ceiling limit value

### 8.1.2 PNECs and DNELs PNECs:

Based on the facts that KOH dissociates completely in water to K<sup>+</sup> and OH<sup>-</sup>, possesses high water solubility and low vapor pressure, PNEC derivation for soil and sediments, as well as PNEC oral for potassium hydroxide is not considered useful because potassium hydroxide will be found predominantly in aquatic environment. Based on the available data it is not considered useful to derive a PNEC for potassium hydroxide in fresh water because the natural pH can vary significantly between several aquatic ecosystems and also the sensitivity to a change of the pH can vary significantly between aquatic ecosystems.

#### DNELs:

##### Acute - short-term exposure - local effects (dermal):

According to the CLP Regulation No 1272/2008 Annex VI Table 3.1, the concentration limit for corrosivity of KOH is considered to be 2%.

##### Long-term exposure - local effects (dermal DNEL in mg/kg bw):

No DNEL long-term exposure - local effects could be derived as no reliable dose descriptors were available for that route of exposure.

##### Long-term exposure - local effects (inhalation DNEL in mg/m<sup>3</sup>):

the DNEL for potassium hydroxide for long-term inhalation for workers is 1.0 mg/m<sup>3</sup>.

the DNEL for long-term inhalation, general population = 1.0 mg/m<sup>3</sup>.

### 8.2 Exposure controls 8.2.1 Appropriate engineering controls

Ensure adequate ventilation

Apply technical measures to comply with the occupational exposure limits

### 8.2.2 Personal protection equipment Eye/face protection

Wear chemical resistant goggles

Face shield if risk on splashes





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Skin protection



Impervious gloves- Suitable material: PVC, Neoprene, Natural rubber, Butyl rubber  
Unsuitable material: Leather

Respiratory protection



In the case of dust or aerosol formation use respirator with an approved filter  
Recommended Filter type: P2

Hygiene measures

Eye wash bottles or eye wash stations in compliance with applicable standards  
Take off contaminated clothing and shoes immediately  
Handle in accordance with good industrial hygiene and safety practice

## 8.2.3 Environmental Exposure Controls

Dispose of rinse water in accordance with local and national regulations.

## 9. SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

Physical state at 20°C and 101.3 kPa	solid
Colour	white
Odour	Odorless
pH (Value)	13.5 @ 25°C
Melting Point (°C) / Freezing Point (°C)	406
Boiling point	1327 @ 1013 hPa
Flash Point (°C)	Not applicable
Flammability (solid, gas)	Not applicable
Explosive limit ranges.	Not applicable
Vapour Pressure (mm Hg)	Not applicable
Surface tension	Not applicable
Relative density (g/ml) @ 20°C	2.044
Solubility (Water)	121g/100g water at 25°C
Stability in organic solvents and identity of relevant degradation products	Not applicable
Partition Coefficient (n-Octanol/water)	Not applicable
Self-ignition temperature (°C)	Not applicable
Viscosity (mPa.s)	Not applicable
Explosive properties	Not applicable
Oxidising properties	Not applicable

### 9.2 Other information

## 10. SECTION 10: STABILITY AND REACTIVITY

10.1	<b>Reactivity</b>	Potential for exothermic hazard. May be corrosive to metals.
10.2	<b>Chemical stability</b>	Stable under recommended storage conditions
10.3	<b>Possibility of hazardous reactions</b>	Gives off hydrogen by reaction with metals. Exothermic reaction with strong acids. Reacts violently with water.
10.4	<b>Conditions to avoid</b>	Unstable on exposure to air. Freezing.
10.5	<b>Incompatible materials</b>	Keep away from: heat sources, oxidizing agents, acids, highly flammable materials, halogens, organic materials. Keep away from: lead, aluminium, copper, tin, zinc, bronze.
10.6	<b>Hazardous Decomposition Product(s)</b>	Absorbs the atmospheric CO <sub>2</sub> . Hydrogen : reacts with (some) metals and their compounds: release of highly flammable gas.



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## 11. SECTION 11: TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### 11.1.1 Acute toxicity

Ingestion

LD<sub>50</sub> (oral): 333 mg/kg bw

KOH ingestion can cause gastrointestinal burns. The mechanism of injury is one of liquefactive necrosis. Thrombosis of local blood vessels contributes to tissue damage.

Inhalation / Skin Contact / Eye Contact

According to the REACH Regulation, acute toxicity testing does not generally need to be conducted if the substance is classified as corrosive to the skin (column 2 adaptation, Annex VIII). Potassium hydroxide is a corrosive substance at concentrations of about 2% and higher.

**Skin corrosion/irritation**

Potassium hydroxide is a corrosive substance at concentrations of about 2% and higher.

Skin irritation / corrosion: corrosive

**Serious eye damage/irritation**

KOH (1%) is irritating to the eyes (5 min exposure). KOH (5%) is extremely irritating and corrosive for the eyes (5 min exposure).

Eye irritation / corrosion: corrosive

**Respiratory or skin sensitization**

Not classified

**Mutagenicity**

Negative mutagenicity tests support no classification

**Carcinogenicity**

Lack of positive in vitro and in vivo mutagenicity data support no classification for carcinogenicity and support no additional animal testing to assess carcinogenicity.

**Reproductive toxicity**

Potassium hydroxide is not classified since it is not expected to be systemically available in the body under normal handling and use conditions. For this reason it can be stated that the substance will neither reach the foetus nor male and female reproductive organs in effective toxic concentrations (OECD SIAR, 2002).

**STOT - single exposure**

The only real effects of KOH ingestion are gastrointestinal burns. The mechanism of injury is one of liquefactive necrosis. Thrombosis of local blood vessels contributes to tissue damage. Tran mural necrosis can occur with frightening rapidity and injury often extrudes through the oesophagus to involve adjacent mediastinal and peritoneal structures. When alkali enters the stomach, there may be some neutralization by gastric acid, which can limit the injury to this organ. Perforation of the stomach can occur with peritonitis and caustic injury to the contiguous organs including the colon, pancreas, liver and spleen. If sufficient quantities of alkali pass through the pylorus, there may be substantial duodenal damage including perforation. Lye constitutes a greater danger than solid granules, which tend to adhere on contact to mucous membranes without travelling further. The severity of damage depends on concentration of the agent, but also on the quantity swallowed. Aspiration of the alkali into the airway can result in live-threatening injuries to the larynx, the tracheobronchial passages, and the lungs.

**STOT - repeated exposure**

KOH in aqueous solutions is completely dissociated into K<sup>+</sup> and OH<sup>-</sup> ions. Due to the neutralization of OH<sup>-</sup> by gastric HCl and the quick and efficient blood pH regulation mechanisms (buffer capacity of extra cellular body fluids, respiratory and renal compensation mechanisms), an alkalosis due to the OH<sup>-</sup> ions after KOH oral dosage in non-irritating conditions is prevented.

Therefore, a possible systemic toxicity of KOH would be related to the K<sup>+</sup> ion and studies with potassium salts in which the anion does not contribute significantly to toxicity could be used for KOH as well.

**Aspiration hazard**

Not classified

#### 11.2 Other information

None



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## 12. SECTION 12: ECOLOGICAL INFORMATION

<b>12.1 Toxicity</b>	The effects of KOH on the aquatic compartment are expected to be comparable to the effects of NaOH. Available data on NaOH indicate that concentrations of 20-40 mg/L may be acutely toxic to fish and invertebrates (single species tests). Data on pH increases due to the addition of these amounts of NaOH in the used test waters are lacking. In waters with a relatively low buffering capacity, NaOH concentrations of 20-40 mg/L may result in a pH increase with one to several pH units
<b>12.2 Persistence and degradability</b>	Potassium hydroxide is a strong alkaline substance that dissociates completely in water to K <sup>+</sup> and OH <sup>-</sup> . Considering its high water solubility, potassium hydroxide is not expected to bioconcentrate in organisms. Log Pow is not applicable for an inorganic compound that dissociates.
<b>12.3 Bioaccumulative potential</b>	Considering its high water solubility, potassium hydroxide is not expected to bioconcentrate in organisms. Log Pow is not applicable for an inorganic compound which dissociates
<b>12.4 Mobility in soil</b>	Potassium hydroxide is a strong alkaline substance that dissociates completely in water to K <sup>+</sup> and OH <sup>-</sup> . High water solubility and low vapour pressure indicate that potassium hydroxide will be found predominantly in aqueous environments. KOH will not adsorb on particulate matter or surfaces and will not accumulate in living substances
<b>12.5 Results of PBT and VPVB assessment</b>	KOH does not fulfill the criteria for persistence, bioaccumulation and toxicity. Therefore, KOH is not considered a PBT or a vPvB substance
<b>12.6 Other adverse effects</b>	None anticipated

## 13. SECTION 13: DISPOSAL CONSIDERATIONS

<b>13.1 Waste treatment methods</b>	Dilute with plenty of water. Remove for physico-chemical treatment : neutralisation with pH control. In accordance with local and national regulations.
<b>13.2 Additional Information</b>	
<b>13.2.1 Waste code</b>	Waste material code (91/689/EEC, Council Decision 2001/118/EC, O.J. L47 of 16/2/2001): 06 02 04 (sodium and potassium hydroxide). Waste material code (Flanders): 302. Hazardous waste (91/689/EEC).
<b>13.2.2 Contaminated packaging:</b>	Where possible recycling is preferred to disposal or incineration. Clean container with water. In accordance with local and national regulations.
<b>13.2.3 Packaging/Container</b>	Waste material code packaging (91/689/EEC, Council Decision 2001/118/EC, O.J. L47 of 16/2/2001): 15 01 10 (packaging containing residues of or contaminated by dangerous substances).

## 14. SECTION 14: TRANSPORT INFORMATION

<b>14.1 Land transport (ADR/RID):</b>	
UN-No.:	1814
Proper shipping name	POTASSIUM HYDROXIDE, LIQUID
Class	8
Packing group:	II
Hazard label(s):	DANGER LABEL TANKS : 8 DANGER LABEL PACKAGES : 8
<b>14.2 Inland water ways transport (ADN):</b>	
UN-No.:	1814
Proper Shipping Name:	POTASSIUM HYDROXIDE, LIQUID
Class:	8
Packing group:	II



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Hazard Label(s):	DANGER LABEL TANKS : 8 DANGER LABEL PACKAGES : 8
<b>14.3 Marine transport (IMDG)</b>	
UN-No.:	1814
Proper Shipping Name:	POTASSIUM HYDROXIDE, LIQUID
Class(es):	8
Packing group:	II
EmS number	8-06
Labels	8 CORROSIVE EMS: F-A, S-B
Marine Pollutant:	no
<b>14.4 Air transport (ICAO-TI/IATA-DGR):</b>	
UN-No.:	1814
Proper Shipping Name:	POTASSIUM HYDROXIDE, LIQUID
Class(es)	2
Packing group:	II
Labels	CORROSIVE
Special provisions	PACKING INSTRUCTIONS PASSENGER AIRCRAFT : 809/Y809 PACKING INSTRUCTIONS CARGO AIRCRAFT : 813
<b>14.5 Additional information:</b>	Limited quantities (LQ) : When substances and their packaging meet the conditions established by ADR/RID/ADNR in chapter 3.4, only the following prescriptions shall be complied with: each package shall display a diamond-shaped figure with the following inscription: - 'UN 1814' or, in the case of different goods with different identification numbers within a single package: - the letters 'LQ'

## 15. SECTION 15: REGULATORY INFORMATION

<b>15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture</b>	
<b>15.1.1 EU regulations</b>	Potassium hydroxide is a food additive, listed as E525 in Annex 1 of Directive 95/2/EU. This means that KOH is a general food additive to be used following the "quantum satis" principle: as much as necessary according to GMP. The concentration of potassium is limited under the EU Directive on Drinking Water Quality 80/778/EEC. The potassium guide level is 10 mg/l and the maximum allowable concentration is 12 mg/l
Authorisations and/or restrictions on use	Not applicable
<b>15.1.2 National regulations</b>	Hazard classification - In accordance with: State Standard of Russian Federation (GOST 12.1.007). Label elements - In accordance with: State Standard of Russian Federation (GOST 31340-07).
<b>15.2 Chemical Safety Assessment</b>	Chemical Safety Report is available

## 16. SECTION 16: OTHER INFORMATION

<b>16.1 Classification of the substance</b>	
<b>16.1.1 Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]</b>	<b>Hazard class and category:</b> Acute Tox; category 4 * Skin corrosive; category 1A Corrosive to metals; category 1 <b>Hazard statement:</b> H290: May be corrosive to metals H302 : Harmful if swallowed H314: Causes severe skin burns and eye damage



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## Label elements

Hazard Pictogram:



GHS05,



GHS07

Signal word:

Dgr : Danger

Hazard statements:

H290: May be corrosive to metals  
H302 : Harmful if swallowed  
H314: Causes severe skin burns and eye damage

Precautionary Statements

P260: Do not breathe dust/fume/gas/mist/vapours/spray.  
P280: Wear protective gloves/protective clothing/eye protection/face protection.  
P303 + P361 + P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.  
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.

## 16.1.2 Classification according to Directive 67/548/EEC

Indication of danger: Xn – harmful, C – corrosive  
R-phrase: R22 - Harmful if swallowed  
R35 - Causes severe burns

## Label elements

Indication of danger:



C – ( агрессивное вещество)

R-phrases:

R22 - Harmful if swallowed  
R35 - Causes severe burns

S-phrases:

(S1/2 - keep locked up and out of reach of children)  
S26 - in case of contact with eyes, rinse immediately with plenty of water and seek medical advice  
S36/37/39 - Wear suitable protective clothing, gloves and eye/face protection.  
S45 - in case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

## 16.2 LEGEND

STOT  
DNEL  
PNEL  
PBT

Specific Target Organ Toxicity  
Derived No Effect Level  
Predicted No Effect Concentration  
PBT: Persistent, Bioaccumulative and Toxic

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## **Annexes to the extended Safety Data Sheet (eSDS)**

Annex 1 Description of the main identified uses

Annex 2 Exposure assessment

Annex 3 Risk characterization



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## Annex 1 to the extended Safety Data Sheet (eSDS)

### Description of the main identified uses

Identified Uses KOH Consortium				use descriptors					Life Cycle Stage(s)					
ES №	IU №	Short title	Short description of process or activity including examples	Sector of use(SU)	Process Category (PROC)	Environmental Release Category (ERC)	Product category (PC)	Article Category (AC)	end use					
									Manufacture	Formulation	Industrial	Professional	Consumer	Service Life
1	Manufacture liquid KOH	Manufacture of KOH in aq solution (Manufacture of the substance including storage, maintenance, sampling and associated laboratory activities)	NA	1,2,3,4,8a,8b,9	1	NA	NA	X						
2	Manufacture solid KOH	Manufacture of KOH in solid form (Manufacture of the substance including storage, maintenance, sampling and associated laboratory activities)	NA	1,2,3,4,8a,8b,9	1	NA	NA	X						
3	Distribution	Distribution of the substance (Industrial) Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance)	3	1,2,3,8a,8b,9	1	NA	NA	X						
4	Formulation	Formulation & (re)packing of substances and mixtures (Industrial) (washing and cleaning products, fragrances )	3,10	1,2,3,5,8a,8b,9,19	2	NA	NA		X	X	X			
5	Intermediate	Manufacture of bulk large scale chemicals, fine chemicals, inorganic and organic chemicals e.g. potassium salts, fertilisers, de-icers, pesticides, pigments, detergents, pharmaceuticals, food products, additives, cosmetics, etc.	3,8,9	1,2,3,4,8a,8b	6a	19	NA				X			
<b>Use of KOH &amp; formulations by Industry</b>														
6	Transfer of substance	Transfer of KOH in industrial settings	3	8a,8b,9	4,5,6a,6b,7	all	NA			X				
7	Reactive processing aid - Industrial	Use as pH-regulator, flocculant, precipitant, neutralization agent ( industrial) - in the production of chemicals and articles, base and precious metals... - pulp & paper production - food manufacturing - fertiliser formulation - regeneration of ion-exchange resins. - in formulations like washing & cleaning products, metal working fluids, developers for photography etc. - waste treatment, water treatment.	3 all	1,2,3,4	6b	20	NA				X			
8	Extraction	Use in extracting agents (industrial)	3,9	3,4	6b	40	NA			X				
9	Metal manufacturing	Use in metal treatment products	3,14	4,23,24	4	NA	NA			X				
10	Laboratory	Use as laboratory chemical (industrial)	3	15	4	21	NA			X				
11	Water treatment	Use in water treatment (industrial)	3	1,2,3,4,11,13,19	4,6b	37	NA							
12	Cleaning	Use in detergents in industrial settings	3,9	1,4,7,10,13	4,6b	35	NA							
<b>Use of KOH &amp; formulations by Professionals and Consumers</b>														
13	Transfer of substance	Transfer of KOH by professionals	22	8a,8b,9	8a,8b,8c,8d,8e,8f	all	NA				X			
14	Formulation	Formulation - detergents. - drain cleaners. - fertilisers - paint strippers. - cosmetics - fragrances	10	1,2,3,4,5,14,19	2	NA	NA		X					
15	Detergents	Wide dispersive indoor & outdoor use of detergents by professionals	22	1,2,3,4,7,10,11,13,14,19	8a,8b,8d,8e	35	NA				X			
16	Detergents	Wide dispersive indoor & outdoor use of detergents by consumers	21	NA	8a,8b,8d,8e	35	NA					X		



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17	Paint strippers Drain deblockers	Wide dispersive indoor & outdoor use of paint strippers and drain deblockers by professionals	22	10,11,13	8a,8b,8d,8e	9a,35	NA				X	
18	Paint strippers Drain deblockers	Wide dispersive indoor & outdoor use of paint strippers and drain deblockers by consumers	21	NA	8a,8b,8d,8e	9a,35	NA					X
19	Cosmetics, personal care, fragrances	Wide dispersive indoor use of cosmetics, fragrances by professionals	22	10,11,13,19	8a,8b	28,39	NA				X	
20	Cosmetics, personal care, fragrances	Wide dispersive indoor use of cosmetics, fragrances by consumers	21	NA	8a,8b	28,39	NA					X
21	Laboratory, processing aid	Use as laboratory chemical, pH-regulator, neutralising agent. ... (professional)	22	15,19	8a,8b,8d,8e	20,21	NA				X	
<b>Use of KOH &amp; formulations in articles</b>												
X	Batteries	Production and maintenance of batteries	3,22	2,3,4,8a,8b,9	2,7	20	3					X X
X	Batteries	Prof & consum end-use	21,22	NA	9a,9b	20	3					
<b>DRAFT Exposure Scenarios</b>												
1		Manufacturing of liquid KOH	NA	1,2,3,4,8a,8b,9	1	NA	NA					
2		Manufacturing of solid KOH	NA	1,2,3,4,8a,8b,9	1	NA	NA					
3		Industrial and Professional use	3,22	1,2,3,4,5,7,8a,8b,9,10,11,13,14,15,19,23,24,26	2,4,5,6a,6b,7,8a,8b,8c,8d,8e,8f	9a,12,19,20,35,37,39,40	NA					
4		Consumer use of KOH	21	NA	8a,8b,8d,8e	9a,12,35,39	NA					
5		Use of KOH in batteries	3,21,22	2,3,4,8a,8b,9	2,7,9a,9b	20	3					

## Remarks regarding the choice of process categories

Potassium hydroxide could be used according to the following process categories (PROC):

- PROC 1 Use in closed process, no likelihood of exposure
- PROC 2 Use in closed, continuous process with occasional controlled exposure (e.g. sampling)
- PROC 3 Use in closed batch process (synthesis or formulation)
- PROC 4 Use in batch and other process (synthesis) where opportunity for exposure arises
- PROC 5 Mixing or blending in batch processes for formulation of preparations and articles
- PROC 7 Spraying in industrial settings and applications
- PROC 8a/b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at (non) dedicated facilities
- PROC 9 Transfer of substance or preparation into small containers (dedicated filling line, incl. weighing)
- PROC 10 Roller application or brushing of adhesive and other coating
- PROC 11 Spraying outside industrial settings or applications
- PROC 13 Treatment of articles by dipping and pouring
- PROC 14 Production of preparations or articles by tableting, compression, extrusion, pelettisation
- PROC 15 Use a laboratory reagent
- PROC 19 Hand-mixing with intimate contact and only PPE available
- PROC 23 Open processing and transfer operations (with minerals) at elevated temperature
- PROC 24 High (mechanical) energy work-up of substances bound in materials and/or articles
- PROC 26 Handling of solid inorganic substances at ambient temperature

The process categories mentioned above are assumed to be the most important ones but other process categories could also be possible (PROC 1 – 27).

## Remarks regarding the choice of product categories

Potassium hydroxide can be used in many different chemical product categories (PC).

- PC 9a/b/c Coatings and Paints, Fillers, Putties, Thinners
- PC 12 Fertilizers
- PC 19 Intermediate
- PC 20 Products such as pH-regulators, flocculants, precipitants, neutralization agents, other
- PC 28 Perfumes, fragrances
- PC 35 Washing and Cleaning Products (including solvent based products)
- PC 37 Water treatment chemicals
- PC 39 Cosmetics



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PC40 Extraction agents  
However, it could potentially also be used in other chemical product categories (PC 0 – 40).

Potential human exposure to KOH is thus for less than 5% of its total production. Without taking into account recycling of the alkaline batteries (these represent 6 % of the total production), which is normally done in many countries, the exposure to the environment is for less than 11% of the total production. Losses through production, through processes that use the compound and through disposal of the compound are minimized. The pH of effluents is controlled and these must be neutralized, this being normally linked to the agreement given to the plant by the authorities.

## Remarks regarding the choice of sector of use

Potassium hydroxide has many uses and can potentially be used in all sectors of use (SU) it can be described by the use descriptor system (SU 1-23). KOH is used for different purposes in a variety of industrial sectors.

## Remarks regarding the choice of article category

Although potassium hydroxide can be used during the manufacturing process of articles, the substance is not expected to be widely present in articles. Following article codes are relevant for KOH:

AC 3: Electrical batteries and accumulators

## Remarks regarding the choice of environmental release category

To assess the environmental exposure of substances environmental release categories (ERC) have been developed for REACH. For potassium hydroxide the following environmental release categories are considered applicable:

ERC1	Production of chemicals
ERC2	Formulation of preparations
ERC4	Industrial use of processing aids
ERC5	Industrial use resulting in inclusion into or onto a matrix
ERC6A	Industrial use of intermediates
ERC6B	Industrial use of reactive processing aids
ERC 7	Industrial use of substances in closed systems
ERC8A	Wide dispersive indoor use of processing aids in open systems
ERC8B	Wide dispersive indoor use of reactive substances in open systems
ERC8C	Wide dispersive indoor use resulting in inclusion into or onto a matrix
ERC8D	Wide dispersive outdoor use of processing aids in open systems
ERC8E	Wide dispersive outdoor use of reactive substances in open systems
ERC8F	Wide dispersive outdoor use resulting in inclusion into or onto a matrix
ERC9A	Wide dispersive indoor use of substances in closed systems
ERC9B	Wide dispersive outdoor use of substances in closed systems

The environmental release categories mentioned above are assumed to be the most important ones but other environmental release categories could also be feasible (ERC 1 – 11b).

Some identified uses were merged because many uses lead to similar exposure under the same operational conditions and risk management measures. Table 1 gives an overview of the identified exposure scenarios.

**Table 1: Description of identified exposure scenarios**

Exposure Scenario	Process category (PROC)	Preparation Category (PC)	Sector of Use (SU)	Article category (AC)	Environmental Release Category (ERC)
All	PROC 1-27	PC 0-40	SU 1-23	Not applicable	ERC 1 – 11b
ES 1: Manufacturing of liquid KOH	PROC 1,2	Not applicable	SU 3, SU 8	Not applicable	ERC 1
ES 2: Manufacturing of solid KOH	PROC 1, 2	Not applicable	SU 3, SU 8	Not applicable	ERC 1



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ES 3: Industrial and professional use of KOH	PROC 1-27	PC 0-40	SU 1-24 except SU 21	Not applicable	ERC 2-12
ES 4: Consumer use of KOH	Not applicable	PC 4, 9a, 12, 28, 35, 39	SU 21	Not applicable	ERC 8-11
ES 5: Consumer use, service life and waste stage of KOH in alkaline batteries	Not applicable	PC 20	SU 21	AC 3	ERC 9a, 9b



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## Annex 2 to the extended Safety Data Sheet (eSDS)

### Exposure assessment

The exposure assessment is organised in several scenarios:

- ES1: Manufacturing of liquid KOH
- ES2: Manufacturing of solid KOH
- ES3: Industrial and professional use of KOH
- ES4: Consumer use of KOH in preparations (excl. batteries)
- ES5: Use of KOH in batteries

A separate scenario was developed for use of KOH in batteries because this is the only scenario characterized by an article category with a specific service life and waste stage. The industrial uses (production of alkaline batteries and recovery processes) are covered under the exposure scenario 3 (Industrial and Professional use of KOH). The overview of exposure scenarios and coverage of substance life cycle can be found in Table1.

The exposure assessment is based on measured data and analogous data from the exposure assessment of the EU RAR for NaOH (2007). KOH and NaOH have an analogous hazardous profile and similar exposure characteristics and comparable activities.

**Table1: Overview on exposure scenarios and coverage of substance life cycle**

Number and title	Manu- facture	Prepa- ration making	Industrial and/or wide dispersive use	Consumer use	Article service life	Waste stage
ES1: Manufacturing of liquid KOH	X					
ES2: Manufacturing of solid KOH	X					
ES3: Industrial and professional use of KOH		X	X			
ES4: Consumer use of KOH in preparations (excl. batteries)				X		
ES5: Use of KOH in batteries				X	X	X

#### 1. Exposure Scenario 1: Manufacturing of liquid KOH

##### 1.1. Exposure scenario

###### 1.1.1. Short title of the exposure scenario

PROC 1, 2, 3, 4, 8a, 8b, 9: use in (closed) continuous or batch process with no likelihood of exposure or where opportunity for exposure arises (industrial setting), including charging, discharging, sampling and maintenance

PC and AC not applicable for this ES

###### 1.1.2. Description of activities and processes covered in the exposure scenario

KOH is produced commercially by an electrolytic process. Brine, prepared from potassium chloride, is electrolyzed in either a mercury cell or membrane cell. The coproducts are chlorine and hydrogen. In the mercury cell process, a potassium-mercury amalgam is formed in the cell. The amalgam is sent to a decomposer where it is reacted with water to form liquid KOH, hydrogen and free mercury. The free mercury is returned to the electrolytic cell. The resulting KOH solution is then stored in storage tanks as a 50% solution. The solution is shipped in tank trucks, tank cars or barges. In the membrane process, a solution of approximately 30% in strength is formed in the cell. The solution is then sent to evaporators, which concentrate it to a strength of 50% by removing the appropriate amount of water. The resulting KOH solution is stored in storage tanks prior to shipment. Solid KOH is obtained through further concentration of 50% KOH.

###### 1.1.3. Operational conditions

The amount used per worker varies from activity to activity. The maximum duration considered for this exposure scenario is a full working shift (8h/day) and 200 days/year. Production sites usually manufacture liquid KOH with a concentration of about 50%. Some sites have also other liquid products (between 10 and 75%).

###### 1.1.4. Risk management measures

###### 1.1.4.1. Risk management measures related to workers

The risk management measures related to workers are summarized in



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Table. A distinction is made between measures that are required or compulsory and measures that indicate good practice. Because potassium hydroxide is corrosive, the risk management measures for human health should focus on the prevention of direct contact with the substance. For this reason automated and closed systems should preferably be used for manufacturing of potassium hydroxide. Respiratory protection is needed when aerosols of potassium hydroxide can be formed. Due to the corrosive properties appropriate skin and eye protection is required.



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**Table 2: Risk management measures related to workers**

Information type	Data field	Explanation
Containment plus good work practice required	<p><u>Good practice</u>: replacing, where appropriate, manual processes by automated and/or closed processes. This would avoid irritating mists, sprayings and subsequent potential splashes:</p> <ul style="list-style-type: none"> <li>Use closed systems or covering of open containers (e.g. screens) (<u>good practice</u>)</li> <li>Transport over pipes, technical barrel filling/emptying of barrel with automatic systems (suction pumps etc.) (<u>good practice</u>)</li> <li>Use of pliers, grip arms with long handles with manual use "to avoid direct contact and exposure by splashes (no working over one's head)" (<u>good practice</u>)</li> </ul>	Partly based on the EU RRS (2008) for NaOH
Local exhaust ventilation required plus good work practise	Local exhaust ventilation is not required but <u>good practice</u> .	To improve air quality and avoid potential respiratory track irritation in working areas
General ventilation	General ventilation is <u>good practice</u> unless local exhaust ventilation is present	To improve air quality and avoid potential respiratory track irritation in working areas.
Personal protection equipment (PPE) required under regular working conditions	<ul style="list-style-type: none"> <li>Respiratory protection: In case of dust or aerosol formation: use respiratory protection with approved filter (P2) (<u>required</u>)</li> <li>Hand protection: impervious chemical resistant protective gloves (<u>required</u>): <ul style="list-style-type: none"> <li>material: butyl-rubber, PVC, polychloroprene with natural latex liner, material thickness: 0.5 mm, breakthrough time: &gt; 480 min</li> <li>material: nitrile-rubber, fluorinated rubber, material thickness: 0.35-0.4 mm, breakthrough time: &gt; 480 min</li> </ul> </li> <li>Eye protection: chemical resistant goggles must be worn. If splashes are likely to occur, wear tightly fitting safety goggles, face –shield (<u>required</u>)</li> <li>Wear suitable protective clothing, aprons, shield, protective helmet and suits, if splashes are likely to occur, wear: rubber or plastic boots, rubber or plastic boots (<u>required</u>)</li> </ul>	
Other risk management measures related to workers. For example: Particular training systems, monitoring/reporting or auditing systems, specific control guidance.	<p>Next measures are <u>required</u> (from EU RRS, 2008):</p> <ul style="list-style-type: none"> <li>workers in the risky process/areas identified should be trained a) to avoid to work without respiratory protection and b) to understand the corrosive properties and, especially, the respiratory inhalation effects of potassium hydroxide and c) to follow the safer procedures instructed by the employer</li> <li>the employer has also to ascertain that the required PPE is available and used according to instructions</li> </ul>	Partly based on the EU RRS (2008) for NaOH

#### 1.1.4.2. Risk management measures related to environment

Risk management measures related to the environment aim to avoid discharging KOH solutions into municipal wastewater or to surface water, in case such discharges are expected to cause significant and undesired pH changes. Adequate control of the pH value during introduction into open waters is required. In general, discharges should be carried out such that pH changes in receiving surface waters are minimised. Most aquatic organisms can tolerate pH values in the range of 6-9, this is also reflected in the description of standard OECD tests with aquatic organisms.

#### 1.1.5. Waste related measures

Liquid KOH waste should be reused or discharged to the industrial wastewater and further neutralized if needed (cfr. RMM related to environment).

## 1.2. Exposure estimation

### 1.2.1. Workers exposure

KOH is a corrosive substance. For the handling of corrosive substances and formulations, immediate dermal contacts occur only occasionally and it is assumed that repeated daily dermal exposure can be neglected. Therefore according to the NaOH EU RAR (2007), dermal exposure to >2% KOH formulations is not quantitatively assessed. Ocular exposure is possible due to hand-eye contact but this is not quantified.

KOH is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of KOH after dermal or inhalation exposure are not expected to occur.

Furthermore KOH has a negligible vapour pressure and is rapidly neutralized in air by carbon dioxide and therefore dust and vapour exposure are not expected. For production and major uses of KOH, aerosols/mists do normally not occur. Different to NaOH,



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specific uses with a possibility of formation of aerosols are not known for KOH applications. In every case, it should be realised that aerosols of KOH are not stable. They are rapidly transformed due to an uptake of carbon dioxide from the atmosphere resulting in the formation of potassium bicarbonate and potassium carbonate. Cooper et al. (1979) reported that the transformation of respirable NaOH aerosols into carbonate aerosols could occur in seconds. Analytical measurements, to determine KOH concentrations in the air of working places during production and use, seem to be unavailable (OECD SIAR, 2002). There are no measured inhalation data available for KOH. However, measured data from the analogous NaOH can be used as a surrogate for KOH. An overview of the estimated and measured exposure concentrations can be found in Table 1.

**Table 1: Surrogate measured NaOH and predicted KOH exposure concentrations to workers**

Routes of exposure	Estimated Exposure Concentrations		Measured exposure concentrations		Explanation / source of measured data
	Value	unit	Value	unit	
<b>Dermal exposure</b>	Not available		Not available		
<b>Inhalation exposure</b>			AM: 0.14	mg/m <sup>3</sup>	<b>From EU RAR (2007)</b> NaOH, Range: 0.02 – 0.5 mg/m <sup>3</sup> Truck loading of liquid STAT measurement, N=17, 2002; 2003
			AM: 0.33	mg/m <sup>3</sup>	<b>From EU RAR (2007)</b> NaOH, Range: 0.29 – 0.37 mg/m <sup>3</sup> Liquid, other task Spot measurement, N=5, 2003
			AM: <0.26	mg/m <sup>3</sup>	<b>From EU RAR (2007)</b> NaOH, Liquid, other task STAT measurement, N=20, 2002
			AM: 0.01*	mg/m <sup>3</sup>	<b>From EU RAR (2007)</b> NaOH, Range: 0.05 – 0.18 mg/m <sup>3</sup> * Liquid, pearls, close to installation STAT measurement, N=109, 2002
	0.17	mg/m <sup>3</sup>			ECETOC TRA predictions

STAT Stationary Air Sample  
Spot Short term stationary sample  
N Amount of measurements  
AM Arithmetic mean  
\* These values are considered not to be correct. A mean value can't be lower than the range.

## Measured data

In the EU RAR (2007) for NaOH, atmospheric exposure measurements are available for 6 production sites from 4 different countries (Czech Republic, Poland, Spain and United Kingdom). In all cases the concentrations were lower than 2 mg/m<sup>3</sup> (see Table 1). The data of the production site in Spain are based on measurements of the sodium content, which were performed according to a norm of the National Institute for Worker Safety and Hygiene (NTP-63 of 1983). For this production site the sampling duration was 6-8 hours. Other sites reported that the measurements were based on a Polish standard method, a colorimetric method or on atomic absorption spectroscopy. The sampling duration was unknown for these sites.

## Modelled data

Inhalation exposure to vapour or aerosols due to all PROCs is estimated in the ECETOC TRA and the inhalation exposure is 0.1 ppm (0.17 mg/m<sup>3</sup>), assuming very low vapour pressure, exposure duration of more than 4 hours/day and no local exhaust ventilation or respiratory equipment.

## Summary of the exposure values

Only one single value will be used for risk characterisation. A summary of exposure concentration for workers is given in Table 2.

**Table 2: Summary of exposure concentration for workers**

Routes of exposure	Concentrations	Justification
<b>Dermal exposure (in mg/cm<sup>2</sup>)</b>	negligible	KOH products with a concentration > 2% are corrosive, therefore effective control measures are in place to prevent dermal exposure. Furthermore protective clothing and gloves are considered to be used consistently when handling corrosive substances. Production companies report the use of protective gloves, suits and boots while handling pure KOH. Repeated daily dermal exposure to commercial product is therefore considered negligible. Dilutions of KOH containing < 2% are not produced at the production sites.
<b>Inhalation exposure (in mg/m<sup>3</sup>)</b>	0.33	For drumming liquid KOH the modelled data are underestimated by ECETOC TRA in comparison with the measured surrogate data of NaOH. Because there is a relatively large number of measured surrogate data, these will be used for risk characterisation. The value 0.33 mg/m <sup>3</sup> is taken as reasonable worst case level and 0.14 mg/m <sup>3</sup> is taken as typical exposure level.

## 1.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure



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to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

### 1.2.3. Environmental exposure

Similar to what is stated in the EU RAR on NaOH (2007), the risk assessment for the environment is only relevant for the aquatic environment, when applicable including STPs/WWTPs, as emissions of NaOH in the different life-cycle stages (production and use) mainly apply to (waste) water. The aquatic effect and risk assessment only deal with the effect on organisms/ecosystems due to possible pH changes related to OH<sup>-</sup> discharges, as the toxicity of the Na<sup>+</sup> ion is expected to be insignificant compared to the (potential) pH effect. The same approach is valid for KOH. The main effect to organisms/ecosystems will be due to possible pH changes related to the OH<sup>-</sup> discharges as the K<sup>+</sup> ion is expected to be insignificant compared to the (potential) pH effect. Therefore, only the local scale will be addressed, including sewage treatment plants (STPs) or waste water treatment plants (WWTPs) when applicable, both for production and industrial use. Any effects that might occur would be expected to take place on a local scale. Therefore it was decided not meaningful to include the regional and continental scale in this safety assessment. Furthermore, the high water solubility and very low vapour pressure indicate that KOH will be found predominantly in water. Significant emissions or exposure to air are not expected due to the very low vapour pressure of KOH. Significant emissions or exposure to the terrestrial environment are not expected either. The sludge application route is not relevant for the emission to agricultural soil, as sorption of KOH to particulate matter will not occur in STPs/WWTPs.

In the EU RAR on NaOH (2007), a survey was conducted on environmental impact of NaOH at producer and downstream user level. The main outcome was that local procedures are usually in place to prevent discharges outside the pH range required by authorities, such as recycling, mixing with other streams for neutralisation or discharge to a WWTP when that is considered favourable. This outcome is also valid for KOH and will be used in this dossier.

#### 1.2.3.1. Environmental releases

The production of KOH can potentially result in an aquatic emission and locally increase the potassium concentration and pH in the aquatic environment. When the pH is not neutralised, the discharge of effluent from KOH production sites may cause an increase in pH in the receiving water. The pH of effluents is normally measured very frequently and can be neutralised easily. Therefore a significant increase of the pH of the receiving water is not expected. Generally the change in pH of the receiving water should stay within a tolerated range of the pH at the effluent site, and for these reason adverse effects on the aquatic environment are not expected due to production or use of KOH, if emissions of waste water are controlled by appropriate pH limits and/or dilutions in relation to the natural pH and buffering capacity of the receiving water.

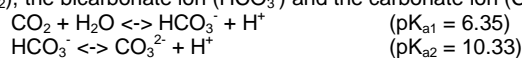
Specific measured data or other reliable data about the use of KOH and the related emissions of potassium are not available. However, it should be realised that emissions originating from the use of KOH are probably small compared to other sources of potassium. With a global potash production of 29 million tons K<sub>2</sub>O, or 24 million tons K in 1989, and an estimated KOH production not exceeding 0.800 million tons, or 0.560 million tons K (Ullmann, 1998), and taking into account that no more than 11% of the K from KOH could be discharged to the environment, not more than 0.060 million tons K coming directly from KOH reaches the environment, equivalent to 0.25% of the total anthropogenic potassium (OECD SIAR potassium hydroxide, 2002).

#### 1.2.3.2. Exposure concentration in waste water treatment plants (WWTP)

Waste water from KOH production sites is coming from the salt electrolyses and is an inorganic wastewater stream. For this reason it is not feasible to treat it biologically. Therefore wastewater streams from KOH production sites will normally not be treated in biological waste water treatment plants (WWTPs). KOH may be used on purpose, however, for pH control of acid wastewater streams that are treated in biological WWTPs.

#### 1.2.3.3. Exposure concentration in aquatic pelagic compartment

If emitted to surface water, sorption to particulate matter and sediment will be negligible. An addition of KOH to surface water may increase the pH, depending on the buffer capacity of the water. The higher the buffer capacity of the water, the lower the effect on pH will be. In general the buffer capacity preventing shifts in acidity or alkalinity in natural waters is regulated by the equilibrium between carbon dioxide (CO<sub>2</sub>), the bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) and the carbonate ion (CO<sub>3</sub><sup>2-</sup>):



If the pH is < 6, un-ionised CO<sub>2</sub> is the predominant species and the first equilibrium reaction is most important for the buffer capacity. At pH values of 6-10 the bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) is the predominant species and at pH values > 10 the carbonate ion (CO<sub>3</sub><sup>2-</sup>) is the predominant species. In the majority of natural waters the pH values are between 6 and 10, thus the bicarbonate concentration and the second equilibrium reaction are most important for the buffer capacity (Rand, 1995; De Groot and Van Dijk, 2002; OECD, 2002). UNEP (1995) reported the bicarbonate concentration for a total number of 77 rivers in North-America, South-America, Asia, Africa, Europe and Oceania. The 10th-percentile, mean and 90th-percentile concentrations were 20, 106 and 195 mg/l, respectively (OECD, 2002). To underline the importance of the buffer capacity, Table 3 is included with the concentration of KOH needed to increase the pH to a value of 9.0 at different bicarbonate concentrations. It should be realised that the final pH could be slightly lower than 9.0 because at initial pH values below 8 there is some CO<sub>2</sub> available to buffer the pH (OECD SIAR potassium hydroxide, 2002).

The alkalinity, defined as the acid-neutralising (i.e. proton accepting) capacity of the water, thus the quality and quantity of constituents in water that result in a shift in the pH toward the alkaline site of neutrality, is determined for > 99% by the concentrations of bicarbonate (HCO<sub>3</sub><sup>-</sup>), carbonate (CO<sub>3</sub><sup>2-</sup>) and hydroxide (OH<sup>-</sup>) (Rand, 1995), with bicarbonate being the predominant species at pH values in the range of 6-10 (see also above). Hydroxide is only relevant in alkaline waters. Thus, the data in **Table 3** are useful to estimate pH increases in natural waters (most of them having a pH value of 7-8), if data on KOH additions and bicarbonate concentrations are available. The alkalinity is determined from acid/base titration or can be calculated from the calcium concentration, as follows (De Schampelaere et al., 2003; Heijerick et al., 2003):

$$\text{Log (alkalinity in eq/l)} = - 0.2877 + 0.8038 \text{ Log (Ca in eq/l)}$$



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**Table 3: Concentration of KOH needed to increase pH to a value of 9 (OECD SIAR potassium hydroxide, 2002)**

Buffer capacity	Concentration KOH (mg/l)	Concentration K (mg/l)	Concentration KOH (mM)
0 mg/l HCO <sub>3</sub> <sup>-</sup> (distilled water)	0.56	0.39	0.010
20 mg/l HCO <sub>3</sub> <sup>-</sup> (10 <sup>th</sup> percentile 77 rivers)	0.86	0.60	0.015
106 mg/l HCO <sub>3</sub> <sup>-</sup> (mean value of 77 rivers)	4.51	3.14	0.080
195 mg/l HCO <sub>3</sub> <sup>-</sup> (90 <sup>th</sup> percentile 77 rivers)	8.30	5.78	0.148

Based on the neutralized environmental releases and the fate in the aquatic compartment described above, there is no environmental impact on the receiving surface water.

#### 1.2.3.4. Exposure concentration in sediments

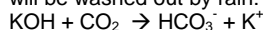
The sediment compartment is not included in this CSA, because it is not considered relevant for KOH. If emitted to the aquatic compartment, sorption to sediment particles will be negligible.

#### 1.2.3.5. Exposure concentrations in soil and groundwater

The terrestrial compartment is not included in this CSA, because it is not considered relevant for KOH. With respect to the fate of KOH in soil the following information is available. If emitted to soil, sorption to soil particles will be negligible. Depending on the buffer capacity of the soil, OH<sup>-</sup> will be neutralised in the soil pore water or the pH may increase.

#### 1.2.3.6. Atmospheric compartment

The air compartment is not included in this CSA because it is considered not relevant for KOH. With respect to the fate of NaOH in air the following information is available from EU RAR (2007). If emitted to air as an aerosol in water, NaOH will be rapidly neutralised as a result of its reaction with CO<sub>2</sub> (or other acids) and the same will apply to KOH as stated in the KOH SIAR. The salts will be washed out by rain:



#### 1.2.3.7. Exposure concentration relevant for the food chain (Secondary poisoning)

Bioaccumulation in organisms is not relevant for KOH. Therefore, there is no need to perform a risk assessment for secondary poisoning

## 2. Exposure Scenario 2: Manufacturing of solid KOH

### 2.1. Exposure scenario

#### 2.1.1. Short title of the exposure scenario

PROC 1, 2, 3, 4, 8a, 8b, 9: use in (closed) continuous or batch process with no likelihood of exposure or where opportunity for exposure arises (industrial setting), including charging, discharging, sampling and maintenance  
PC and AC not applicable for this ES

#### 2.1.2. Description of activities, processes and operational conditions covered in the exposure scenario

The processes and activities for solid KOH include the processes and activities for liquid KOH. Solid KOH results when molten KOH, from which most of the water has been evaporated (commercial solid KOH typically contains ca.10 % of water), is allowed to cool and solidify. Flake KOH is made by passing molten KOH over cooled flaking rolls to form flakes of uniform thickness.

Flakes can be packed in bags (25 kg), bulk bags (500 or 1,000 kg) or in metallic drums (e.g. 400 kg). However, it should be realised that other packaging forms could exist. The shifts can be 8 hrs/day (40 hours/week).

#### 2.1.3. Risk management measures

##### 2.1.3.1. Risk management measures related to workers

Relevant risk management measures related to workers are described in ES1.

##### 2.1.3.2. Risk management measures related to environment

Relevant risk management measures related to environment are described in Section 1.1.4.2.

##### 2.1.4. Waste related measures

There is no solid waste of KOH. Liquid KOH waste should be reused or discharged to the industrial wastewater and further neutralized if needed (see risk management measures related to environment).

### 2.2. Exposure estimation

#### 2.2.1. Workers exposure

KOH is a corrosive substance. For the handling of corrosive substances and formulations, immediate dermal contacts occur only occasionally and it is assumed that repeated daily dermal exposure is negligible. Therefore according to the NaOH EU RAR (2007), dermal exposure to >2% KOH will not be quantitatively assessed. KOH is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of KOH after dermal or inhalation exposure are not expected to occur.

Dust formation is unlikely because of the hygroscopic properties. Furthermore KOH has a negligible vapour pressure and is rapidly neutralized in air by carbon dioxide and therefore dust and vapour exposure are not expected. For production and major uses of KOH, aerosols/mists do normally not occur. Different to NaOH, specific uses with a possibility of formation of aerosols are not known for KOH applications. In every case, it should be realised that aerosols of KOH are not stable. They are rapidly transformed due to an uptake of carbon dioxide from the atmosphere resulting in the formation of potassium bicarbonate and potassium carbonate. Cooper et al. (1979) reported that the transformation of respirable NaOH aerosols into carbonate aerosols could occur in seconds. Analytical measurements, to determine KOH concentrations in the air of working places during production and use, seem to be unavailable (OECD SIAR, 2002).

Inhalation of KOH dust does normally not occur. Most of the production of KOH is in the liquid form (mostly 50% solution). Potential dust formation during drying, pellets production and packing occurs normally in closed systems, which is essential for the product quality, to avoid moisture and carbon dioxide absorption. Moreover, as KOH is a deliquescent solid, the potential for dust formation is low (OECD SIAR, 2002).

An overview of the estimated and available measured exposure concentrations for inhalation can be found in



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Table 4.

**Table 4: KOH exposure concentrations to workers**

Routes of exposure	Estimated Exposure Concentrations		Measured exposure concentrations		Explanation / source of measured data
	Value	unit	Value	unit	
Inhalation exposure			50P: 0.12 90P: 0.2	mg/m <sup>3</sup>	Pelletization belt: 0.12 mg/m <sup>3</sup> Filling: Range: 0.05 – 0.27 mg/m <sup>3</sup> Personal Air Sample, More details, see text
	0.5	mg/m <sup>3</sup>			Maximum ECETOC TRA simulations

#### Measured data

A data set is gathered from an open system with local exhaust ventilation. The pelletization belt and filling are the most critical processes. Other steps in the process are more contained. Sampling was done with air pump, flow was going through the filter. KOH is dissolved with water and in excess of HCl. The remaining of HCl is titrated with KOH. The indicator used is methylred. This analytical method is compliant with NIOSH 7401. The exposure time was 340 or 505 minutes. These relate to an 8 and 12 hour shift respectively. The exposure was zero during the remaining time of the shift. Measurements were done during one shift. The number of workers is 3 per shift and the amount of substance handled: 7 ton per shift. The size of packing is 25-1000 kg. The process was an open system and had local ventilation installed (20 m<sup>3</sup>/hour). No respiratory protection was used. The ECHA guidance on information requirements R.14 suggests to take the 75<sup>th</sup> percentile for large databases and the 90<sup>th</sup> percentile for smaller databases. Therefore, the 90<sup>th</sup> percentile of 0.20 mg/m<sup>3</sup> was selected as a reasonable worst-case estimate. Also note that no respiratory tract effects were observed among the workers.

#### Modelled data

Considering low dustiness, no LEV and no respiratory protection, ECETOC TRA predicts inhalative exposure of 0.01 mg/m<sup>3</sup> for PROC 1 and PROC 2, 0.1 mg/m<sup>3</sup> for PROC 3 and PROC 9, 0.5 mg/m<sup>3</sup> for PROC 4 and PROC 8a.

#### Summary of the exposure values

The summary of exposure concentrations to workers, used for risk characterization is given in Table 5.

**Table 5: Summary of exposure concentration to workers**

Routes of exposure	Concentrations	Justification
Dermal exposure (in mg/cm <sup>2</sup> )	Negligible	KOH products with a concentration > 2% are corrosive, therefore effective control measures are in place to prevent dermal exposure. Furthermore protective clothing and gloves are considered to be used consistently when handling corrosive substances. Production companies report the use of protective gloves, suits and boots while handling pure KOH. Repeated daily dermal exposure to commercial product is therefore considered negligible. Dilutions of KOH containing < 2% are not possible for solid KOH.
Inhalation exposure (in mg/m <sup>3</sup> )	0.2	Highest exposures are measured at the drumming/bagging place and therefore these values are taken to the risk characterisation.

#### 2.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

#### 2.2.3. Environmental exposure

Potassium hydroxide will rapidly dissolve and dissociate in water when released to water. The environmental exposure assessment for solid potassium hydroxide is consequently the same as for liquid potassium hydroxide (see Section 1.2.3).

### 3. Exposure Scenario 3: Industrial and professional use of solid and liquid KOH

#### 3.1. Exposure scenario

##### 3.1.1. Short title of the exposure scenario

The OECD SIAR report (last update Feb 2002) gives an overview of the uses for KOH.

KOH has mainly industrial uses. On a global level the main uses are: production of potassium carbonate (26 %), chemical manufacturing (16 %), production of potassium chemicals (12 %), production of fertilizers (11 %), production of phosphates (9 %), production of detergents (8 %), production of agricultural chemicals (7 %), production of alkaline batteries (6 %), all other (5 %) (OECD SIAR, 2002).

So, more than 95% of the KOH production is for non dispersive use, and is consumed by the industry, mainly by large enterprises. KOH is used in these applications as an intermediate or as a reactive processing aid and does not leave the plant where it is used. In these applications, KOH is consumed in a reaction and is no more present in the product that goes to the market.

KOH is still present in the alkaline batteries, but here this substance is strictly confined in the battery screening and does not come in contact with the consumer.

Less than 5% of the KOH production is for wide dispersive use and enters in the composition of products for professional use or consumer products (eventually to be consumed in small enterprises like garages or farms): paint and varnish removers, drain



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cleaners (Howell, 1991; Leape et al., 1971), degreasing agents (Swanson et al., 1995) and dairy pipeline cleaners (Edmonson, 1987).

Potassium hydroxide could be used according to the following process categories (PROC):

PROC1	Use in closed process, no likelihood of exposure
PROC2	Use in closed, continuous process with occasional controlled exposure (e.g. sampling)
PROC3	Use in closed batch process (synthesis or formulation)
PROC4	Use in batch and other process (synthesis) where opportunity for exposure arises
PROC5	Mixing or blending in batch processes for formulation of preparations and articles
PROC7	Spraying in industrial settings and applications
PROC8a/b	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers
PROC9	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
PROC10	Roller application or brushing of adhesive and other coating
PROC11	Spraying outside industrial settings or applications
PROC13	Treatment of articles by dipping and pouring
PROC14	Production of preparations or articles by tableting, compression, extrusion, pelettisation
PROC15	Use a laboratory reagent
PROC19	Hand-mixing with intimate contact and only PPE available
PROC23	Open processing and transfer operations (with minerals) at elevated temperature
PROC24	High (mechanical) energy work-up of substances bound in materials and/or articles
PROC26	Handling of solid inorganic substances at ambient temperature

The process categories mentioned above are assumed to be the most important ones but other process categories could also be possible (PROC 1 – 27).

Potassium hydroxide can be used in many different chemical product categories (PC): Coatings and Paints, Fillers, Putties, Thinners (PC 9), Fertilizers (PC12), Intermediate (PC19), Products such as pH-regulators, flocculants, precipitants, neutralization agents (PC20), Washing and Cleaning Products (PC35), Water treatment chemicals (PC37), Cosmetics (PC39), Extraction agents (PC40). However, it could potentially also be used in other chemical product categories (PC 0 – 40).

Because potassium hydroxide has so many uses and is used so widely it can potentially be used in all sectors of use (SU) described by the use descriptor system (SU 1-23).

The article categories (AC) are not applicable for potassium hydroxide in this exposure scenario.

To assess the environmental exposure of substances environmental release categories (ERC) have been developed for REACH.

For potassium hydroxide the following environmental release categories could be applicable:

ERC2	Formulation of preparations
ERC4	Industrial use of processing aids
ERC5	Industrial use resulting in inclusion into or onto a matrix
ERC6	Industrial use of intermediates and reactive processing aids
ERC7	Industrial use of substances in closed systems
ERC8	Wide dispersive indoor and outdoor use of reactive substances, processing aids in open systems

The environmental release categories mentioned above are assumed to be the most important ones but other environmental release categories could also be possible (ERC 1 – 11b).

### 3.1.2. Description of activities, processes and operational conditions covered in the exposure scenario

Potential human exposure to KOH is thus for less than 5% of its total production. Without taking into account recycling of the alkaline batteries (these represent 6 % of the total production), which is normally done in many countries, the potential exposure to the environment is less than 11% of the total production. Losses through production, through processes that use the compound and through disposal of the compound are minimized. The pH of effluents of production sites is controlled and these must be neutralized, this being normally regulated according to local requirements.

#### 3.1.2.1. Use of KOH and formulations by industry

KOH is mainly used as intermediate for the production of organic and inorganic chemicals which end up in a broad variety of end products. At the production sites of organic and inorganic chemicals, KOH is used as pH stabiliser or as reactant for synthesis of other chemicals. In all cases KOH must be added to a reaction vessel and will react after which no KOH is left. In some plants KOH is recycled to the process.

KOH is also used in alkaline batteries. KOH is still present in the alkaline batteries, but here this substance is strictly confined in the battery screening and does not come in contact with the worker/professional/consumer. Recovery of KOH from alkaline batteries includes emptying the electrolyte, collection and neutralization with sulphuric acid and carbon dioxide, optionally including sedimentation step to remove Ni and Cd ions.

#### 3.1.2.2. Use of KOH and formulations by professionals

KOH also has professional uses. This includes following processes/activities: transfer of KOH by professionals and wide dispersive indoor and outdoor use of KOH-containing formulations: detergents, fertilizers, drain cleaners, paint strippers, cosmetics/personal care, etc...

In fertilizers, KOH usually interacts with other ingredients in acid-base reactions and thus practically no free KOH is left in the final product. In some cases, up to 20% of free KOH can still be present in the fertilizer. In that case, the fertilizer also has an intended pH-correction function.

KOH is used during the production phase of various cleaning products although in most case the amounts in the end products are limited. The KOH will be diluted and will interact with other ingredients in acid-base reactions and thus practically no free KOH is left in the final product. Product categorization for professional cleaning products with remaining free KOH after formulation can be found in the table below.



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Table 6: Product categorization for professional cleaning products with remaining free KOH after formulation

Product type	'free KOH' content	pH range	Remarks concerning RMM/OC
Floor strippers	<10%	>13	
Oven cleaners	5-20%	>13	
Floor degreasers	<5%	>12.5	
Drain openers	<30%	>13	
Dish washing products	5-30%	>13	(concentrated product)
interior heavy duty cleaners	<5%	>12.5	

### Professional oven cleaners

Oven cleaners are strong degreasers and they are suitable for cleaning ovens, grills, etc. Oven cleaners contain strong alkaline ingredients. Strong alkali is effective in removing burned-on contamination. There are trigger sprays and spray cans. When using a spray can, foam is formed on the target area. After spraying, the oven door is closed and the foam has to soak 30 minutes. Then the oven is wiped clean with a wet cloth or sponge and one has to rinse frequently. The maximum content of potassium hydroxide in a spray can is 10%. The product is either a gel, which leads to large droplets upon spraying (100% >10 µm), or a liquid which is applied as a foam with a special trigger also leading to less aerosol.

The frequency of application is 1 event per day and the duration is 10 minutes per event. Spraying should be done into cold oven. There is potential exposure to hands and arms. One can spray up to 1g product per second, by hand-held ready-to-use trigger spray or foam sprayer.

### Professional floor strippers

Floor strippers in I&I applications are not used. The highly alkaline products are dosed 15-20% and per 10 m<sup>2</sup> 1-2 L stripper solution is applied to the floor with a single disc machine. Usually 10-15 min acting time are necessary between applying and scrubbing the floor. Afterwards the stripper/polish mixture is removed by a vacuum cleaner.

### Drain cleaners

Drain openers open slow running and obstructed drains by dissolving and by loosening grease and organic waste. Liquid drain openers have a maximum KOH content of 30%. The use of liquid drain openers is comparable with the dosing of liquid cleaners. The drain opener must be dosed slowly down the drain. Pellets, which can also be used for opening the drain, have contents up to 90%. The drain opener must be dosed slowly down the drain. One has to wait at least 15 minutes so that the drain opener can clear the blockage.

## 3.1.3. Risk management measures

### 3.1.3.1. Risk management measures related to workers

The risk management measures related to workers can be found in Table 7. This table applies to both liquid and solid KOH containing products at concentration >2%. Because potassium hydroxide is corrosive, the risk management measures for human health aim to avoid direct contact with the substance. For this reason automated and closed systems should preferably be used for industrial and professional uses of potassium hydroxide. Respiratory protection is needed when aerosols of potassium hydroxide can be formed. Due to the corrosive properties appropriate skin and eye protection is required.

Table 7: Risk management measures related to worker

Information type	Data field	Explanation
Containment plus good work practice required	<p><u>Good practice</u>: replacing, where appropriate, manual processes by automated and/or closed processes. This would avoid irritating mists, sprays and subsequent potential splashes:</p> <ul style="list-style-type: none"> <li>Use closed systems or cover open containers (e.g. screens) (<u>good practice</u>)</li> <li>Transport through pipes, technical barrel filling/emptying of barrel with automatic systems (suction pumps etc.) (<u>good practice</u>)</li> <li>Use of pliers, grip arms with long handles with manual use "to avoid direct contact and exposure by splashes (no working over one's head)" (<u>good practice</u>)</li> </ul>	Partly based on the EU RRS (2008) for NaOH
Local exhaust ventilation required plus good work practise	Local exhaust ventilation is not required but good practice.	To improve air quality and avoid potential respiratory track irritation in working areas.
General ventilation	General ventilation is <u>good practice</u> unless local exhaust ventilation is present	To improve air quality and avoid potential respiratory track irritation in working areas.
Personal protection equipment (PPE) required under regular working conditions	<ul style="list-style-type: none"> <li>Respiratory protection: In case of dust or aerosol formation (e.g. spraying): use respiratory protection with approved filter (P2) (<u>required</u>)</li> <li>Hand protection: impervious chemical resistant protective gloves (<u>required</u>) <ul style="list-style-type: none"> <li>material: butyl-rubber, PVC, polychloroprene with natural latex liner, material thickness: 0.5 mm, breakthrough time: &gt; 480 min</li> <li>material: nitrile-rubber, fluorinated rubber, material thickness: 0.35-0.4 mm, breakthrough time: &gt; 480 min</li> </ul> </li> <li>Eye protection: chemical resistant goggles must be worn. If</li> </ul>	To avoid direct contact with the substance



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Information type	Data field	Explanation
	splashes are likely to occur, wear tightly fitting safety goggles, face –shield <u>(required)</u> <ul style="list-style-type: none"> <li>Wear suitable protective clothing, aprons, shield, protective helmet and suits, if splashes are likely to occur, wear: rubber or plastic boots<u>(required)</u>.</li> </ul>	
Other risk management measures related to workers. For example: Particular training systems, monitoring/reporting or auditing systems, specific control guidance.	Next measures are <u>required</u> : <ul style="list-style-type: none"> <li>workers in the risky process/areas identified should be trained a) to avoid to work without respiratory protection and b) to understand the corrosive properties and, especially, the respiratory inhalation effects of potassium hydroxide and c) to follow the safer procedures instructed by the employer (EU RRS, 2008).</li> <li>the employer should ascertain that the required PPE is available and used according to instructions</li> </ul>	Partly based on the EU RRS (2008) for NaOH
Measures related to the design of product (other than concentration) related to workers	<ul style="list-style-type: none"> <li>High viscosity adjustment with aids (good practice)</li> <li>Delivery only as barrel commodity and/or in tank car (good practice)</li> </ul>	to avoid splashes

### 3.1.3.2. Risk management measures related to professionals

Because potassium hydroxide is corrosive, the risk management measures for human health should focus on the prevention of direct contact with the substance. For this reason automated and closed systems should preferably be used for professional uses of potassium hydroxide. When automated, closed systems and local exhaust ventilation is less feasible to implement, product related design measures preventing direct eye/skin contact with KOH and preventing formation of aerosols and splashes are more important in addition to the personal protective equipment measures.

Product related design measures are required. These include specific dispensers and pumps etc specifically designed to prevent splashes/spills/exposure to occur.

Table 8 gives an overview of the personal protective equipment recommendations. Based on the KOH concentration in the preparation, a different degree of restriction is proposed.

**Table 8: Personal protective equipment related to professional use**

	KOH concentration in product > 2%	KOH concentration in product between 0.5% and 2%	KOH concentration in product < 0.5%
Respiratory protection: In case of dust or aerosol formation (e.g. spraying): use respiratory protection with approved filter (P2)	compulsory	good practice	Not needed
Hand protection: In case of potential dermal contact: use impervious chemical resistant protective gloves	compulsory	good practice	Not needed
Protective clothing: If splashes are likely to occur, wear suitable protective clothing, aprons, shield and suits, rubber or plastic boots	compulsory	good practice	Not needed
Eye protection: If splashes are likely to occur, wear tightly fitting chemical resistant safety goggles, face –shield	compulsory	good practice	Not needed

### 3.1.3.3. Risk management measures related to environment

Relevant risk management measures related to environment are described in Section 1.1.4.2. There are additionally some specific environmental risk management measures related to fertilizers containing up to 20% of KOH in the end product. Direct releases to adjacent surface waters should be avoided. Drift should be minimized. And in line with the requirements for good agricultural practice, agricultural soil should be analysed prior to application of the fertiliser and the application rate should be adjusted according to the results of the analysis.

### 3.1.4. Waste related measures

Liquid KOH waste should be reused or discharged to industrial wastewater and further neutralized if needed (cfr. RMM related to environment).

## 3.2. Exposure estimation

### 3.2.1. Workers exposure

KOH is a corrosive substance at concentrations >2%. For the handling of corrosive substances and formulations, immediate dermal contacts occur only occasionally and it is assumed that repeated daily dermal exposure is negligible. Therefore according to the NaOH EU RAR (2007), dermal exposure to >2% KOH will not be quantitatively assessed. Repeated dermal exposure is negligible for <2% formulations.

KOH is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of KOH after dermal or inhalation exposure are not expected to occur.

#### Measured exposure concentrations

One measured exposure concentration of KOH was available from the textile industry. Even though the use of closed systems for KOH is wide-spread in the majority of the textile industry, an open use measurement for KOH (during cleaning of the machinery)



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showed less than 0.06 mg/m<sup>3</sup>.

The amount of alkali dust was measured in three sampling locations of a downstream user. The three sampling locations are packaging (filter placed where belt from container and elevator belt meet), personal sampler by operator and placed close to the filling operations. These are the most critical steps for occupational exposure to KOH. The exposure time was respectively 260, 270 and 263 minutes. The inhalable dust fraction was respectively 0.8, 1 and 0.3 mg/m<sup>3</sup>. These measurements are an overestimation because all dust is assumed to originate from alkali. These measurements are therefore not suitable for risk characterization of KOH.

## Estimated exposure concentrations

The estimated inhalation exposure concentrations to workers are summarized in Table 9. The ECETOC TRA was used to estimate the concentrations. It was assumed that there is no local exhaust ventilation and no respiratory protection unless specified otherwise. The duration of exposure was set at more than 4 hours per day as a worst-case assumption. Professional use was specified where relevant as a worst-case assumption. For the solid, the low dustiness class was selected because KOH is very hygroscopic. Only the most relevant PROCs were considered in the assessment.

There is no need to quantitatively derive dermal exposure estimations because a DNEL for dermal exposure is not applicable.

**Table 9: Long-term inhalation exposure concentrations to workers (estimated exposure concentrations)**

PROC	PROC description	Liquid (mg/m <sup>3</sup> )	Solid (mg/m <sup>3</sup> )
PROC 1	Use in closed process, no likelihood of exposure	0.23	0.01
PROC 2	Use in closed, continuous process with occasional controlled exposure (e.g. sampling)	0.23	0.01
PROC 3	Use in closed batch process (synthesis or formulation)	0.23	0.1
PROC 4	Use in batch and other process (synthesis) where opportunity for exposure arises	0.23	0.2 (with LEV)
PROC 5	Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)	0.23	0.2 (with LEV)
PROC 7	Spraying in industrial settings and applications	0.23	Not applicable
PROC 8a/b	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non dedicated or dedicated facilities	0.23	0.5
PROC 9	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	0.23	0.5
PROC10	Roller application or brushing of adhesive and other coating	0.23	0.5
PROC11	Spraying outside industrial settings or applications	0.23	0.2 (with LEV)
PROC13	Treatment of articles by dipping and pouring	0.23	0.5
PROC14	Production of preparations or articles by tableting, compression, extrusion, pelettisation	0.23	0.2 (with LEV)
PROC15	Use a laboratory reagent	0.23	0.1
PROC19	Hand-mixing with intimate contact and only PPE available.	0.23	0.5
PROC23	Open processing and transfer operations (with minerals) at elevated temperature	0.23	0.4 (with LEV and RPE(90%))
PROC24	High (mechanical) energy work-up of substances bound in materials and/or articles	0.23	0.5 (with LEV and RPE(90%))

PROC 26 was considered to mainly applicable to metals industry. Handling of inorganic substances is assumed to be included in the existing PROCs assessed.

## Summary of the exposure values

The summary of exposure concentrations to workers, taken forward to risk characterization, is given in Table 10.

**Table 10: Summary of exposure concentration to workers**

Routes of exposure	Concentrations	Justification
Dermal exposure (in mg/cm <sup>2</sup> )	Qualitative	KOH products with a concentration > 2% are corrosive, therefore effective control measures are expected to be in place to prevent dermal exposure. Furthermore protective clothing and gloves are considered to be used consistently when handling corrosive substances. Repeated daily dermal exposure to the pure substance is therefore considered negligible. Dilutions of NaOH containing less than 2% of the substance do not have corrosive properties. For this concentration a qualitative risk characterization is proposed.
Inhalation exposure (in mg/m <sup>3</sup> )	0.5	The estimated inhalation concentrations are larger than the measured value available. These will be used for risk characterisation. The maximum estimated inhalation concentration is 0.23 mg/m <sup>3</sup> for liquid and 0.5 mg/m <sup>3</sup> for solid.

### 3.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be



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expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

### 3.2.3. Environmental exposure

Analogously as argued in the EU RAR on NaOH (2007), the risk assessment for the environment will focus solely on the aquatic environment, when applicable including STPs/WWTPs, as the emissions of KOH in the different life-cycle stages (production and use) mainly apply to (waste) water. The aquatic effect and risk assessment will only deal with the effect on organisms/ecosystems due to possible pH changes related to OH<sup>-</sup> discharges, as the toxicity of the K<sup>+</sup> ion is expected to be insignificant compared to the (potential) pH effect. Only the local scale will be addressed, including sewage treatment plants (STPs) or waste water treatment plants (WWTPs) when applicable, both for production and industrial use. Any effects that might occur would be expected to take place on a local scale and therefore it was decided as not meaningful to include the regional or continental scale in this risk assessment. Furthermore, the high water solubility and very low vapour pressure indicate that KOH will be found predominantly in water. Significant emissions to air are not expected due to the very low vapour pressure of KOH. Significant emissions to the terrestrial environment are not expected either. The sludge application route is not relevant for the emission to agricultural soil, as no sorption of KOH to particulate matter will occur in STPs/WWTPs.

The exposure assessment for the aquatic environment will only deal with the possible pH changes in STP effluent and surface water related to the OH<sup>-</sup> discharges at the local scale.

#### 3.2.3.1. Environmental releases

It is envisaged that the pH of discharges would also be strictly controlled by the industry involved, often in response to local requirements. Usually, the pH of waste water discharges is controlled and normally proper regulations are in place. Therefore a significant increase of the pH of the receiving water is not expected. Generally the change in pH of the receiving water should stay within a tolerated range of the pH at the effluent site, and for this reason adverse effects on the aquatic environment are not expected due to production or use of KOH, if emissions of waste water are controlled by appropriate pH limits and/or dilutions in relation to the natural pH and buffering capacity of the receiving water (OECD SIAR, 2002).

#### 3.2.3.2. Exposure concentration in waste water treatment plants (WWTP)

Referring to the RMMs related to the environment, aiming to avoid discharging KOH solutions into municipal wastewater unless, the influent of municipal waste water treatment plants are normally circum-neutral and strongly buffered and therefore no effect on the biological activity is expected.

#### 3.2.3.3. Exposure concentration in aquatic pelagic compartment

The exposure concentration in aquatic pelagic compartment is similar to the assessment done in Section 1.2.3.3.

#### 3.2.3.4. Exposure concentration in sediments

The exposure concentration in sediment compartment is similar to the assessment done in Section 1.2.3.4.

#### 3.2.3.5. Exposure concentrations in soil and groundwater

The exposure concentration in soil and groundwater compartment is similar to the assessment done in ES 1 (Section 1.2.3). An additional consideration should be made related to the use of fertilizers containing up to 20% of KOH in the end product. In that case, the fertilizer has an intended pH-correction impact on the soil and following the risk management measures on good agricultural practice, agricultural soil should be analysed prior to application of the fertiliser and the application rate should be adjusted according to the results of the analysis. This way, the impact to terrestrial organisms should be beneficial rather than adverse.

#### 3.2.3.6. Atmospheric compartment

The exposure concentration in atmospheric compartment is similar to the assessment done in Section 1.2.3.6.

#### 3.2.3.7. Exposure concentration relevant for the food chain (Secondary poisoning)

The exposure concentration relevant for the food chain is similar to those presented in the assessment done in Section 1.2.3.7.

## 4. Exposure Scenario 4: Consumer use of solid and liquid KOH (excl. batteries)

### 4.1. Exposure scenario

#### 4.1.1. Short title of the exposure scenario

SU21: private households

PROC not applicable for this ES

PC 9 Coatings and Paints, Fillers, Putties, Thinners

PC12 Fertilizers

PC20 Products such as pH-regulators, flocculants, precipitants, neutralization agents, other

PC28 Perfumes, fragrances

PC35 Washing and Cleaning Products (including solvent based products)

PC39 Cosmetics

However, it could potentially also be used in other chemical product categories (PC 0 – 40).

AC not applicable for this ES

#### 4.1.2. Description of activities, processes and operational conditions covered in the exposure scenario

Less than 5% of the KOH production is applied in wide dispersive uses and enters in consumer products paint and varnish removers, drain cleaners (Howell, 1991; Leape et al., 1971), degreasing agents (Swanson et al., 1995) and dairy pipeline cleaners (Edmonson, 1987).

The amounts used will interact with other ingredients in acid-base reactions and thus practically no KOH is left in the final consumer product. However, some cleaning products may contain 0.25-0.45% of KOH in the final formulation. Some toilet cleaners may contain up to 1.1% and certain soaps contain up to 0.5% of KOH in the final formulation.

#### 4.1.3. Risk management measures

##### 4.1.3.1. Risk management measures related to consumers

The risk management measures related to consumers are mainly related to prevent accidents.

##### Measured related to the design of the product

- It is required to use resistant labelling-package to avoid its auto-damage and loss of the label integrity, under normal use



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and storage of the product. The lack of quality of the package provokes the physical loss of information on hazards and use instructions.

- It is required that household chemicals, containing potassium hydroxide for more than 2%, which may be accessible to children should be provided with a child-resistant fastening (currently applied) and a tactile warning of danger (Adaptation to Technical Progress of the Directive 1999/45/EC, annex IV, Part A and Article 15(2) of Directive 67/548 in the case of, respectively, dangerous preparations and substances intended for domestic use). This would prevent accidents by children and other sensitive groups of society.
- It is required that appropriate use instructions, and product information should always be provided to consumers. This clearly can reduce the risk of misuse. For reducing the number of accidents, it is advisable to use these products in the absence of children or other sensitive groups. To prevent improper use of potassium hydroxide, instructions for use should contain a warning against dangerous mixtures
- It is advisable to deliver only in very viscous preparations
- It is advisable to deliver only in small amounts

#### Instructions addressed to consumers

- Keep out of reach of children.
- Do not apply product into ventilator openings or slots.

#### PPE required under regular conditions of consumer use

	KOH concentration in product > 2%	KOH concentration in product between 0.5% and 2%	KOH concentration in product < 0.5%
Respiratory protection: In case of dust or aerosol formation (e.g. spraying): use respiratory protection with approved filter (P2)	required	good practice	Not needed
Hand protection: In case of potential dermal contact: use impervious chemical resistant protective gloves	required	good practice	Not needed
Eye protection: If splashes are likely to occur, wear tightly fitting goggles, face –shield	required	good practice	Not needed

#### **4.1.3.2. Risk management measures related to environment**

There are no specific risk management measures related to environment.

#### **4.1.4. Waste related measures**

Wasted material and its containers must be disposed of in a safe way (e.g. by returning to a public recycling facility). If container is empty, trash as regular municipal waste.

## **4.2. Exposure estimation**

### **4.2.1. Consumer exposure**

For consumer exposure it is important to stress that potassium hydroxide exposure is an external exposure. Contact with tissue and water will give potassium and hydroxide ions which are abundantly present in the body.

If the recommended RMMS are respected, local exposure through inhalation will not be higher compared to inhalation exposures in ES3 (Section 3.2.1). Therefore, the consumer exposure through inhalation is not further quantitatively assessed.

Potassium hydroxide is a food additive, listed as E525 in Annex 1 of Directive 95/2/EU. This means that KOH is a general food additive to be used following the “quantum satis” principle: as much as necessary according to GMP (European Union, 1995).

The concentration of potassium is limited under the EU Directive on Drinking Water Quality 80/778/EEC. The potassium guide level is 10 mg/l and the maximum allowable concentration is 12 mg/l (European Economic Community, 1980). The taste threshold of KOH in water is reported to be 1 to 50 mg/l (Mc Kee et al., 1963).

The normal daily dietary intake of potassium in humans is approximately 2 - 4 g (FASEB, 1979), typically 2 – 6 g in the US diet (Saxena, 1989). The daily dietary intake of K is recommended to be approximately 2.4 g or more because this is associated with a reduced risk of stroke-related mortality (Burgess et al., 1999). In line with the conclusion for NaOH (EU RAR, 2007), it was concluded that the potassium uptake due to the use of KOH containing products is negligible compared to the daily dietary intake of potassium ions. The effect of potassium intake is not further considered in this dossier.

Since accidental exposure is normally excluded from an EU chemical safety assessment and accidental exposure is considered in the OECD SIAR of KOH (2002, Section 2.2, page 5), accidental exposure will not be further assessed in this dossier.

### **4.2.2. Indirect exposure of humans via the environment (oral)**

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

### **4.2.3. Environmental exposure**

Consumer uses relate to already diluted products which will be quickly further neutralized in the sewer and therefore will not reach a WWTP or surface water.

## **5. Exposure Scenario 5: Consumer use, service life and waste stage of KOH in batteries**

### **5.1. Exposure scenario**

#### **5.1.1. Short title of the exposure scenario**

SU21: private households



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PROC not applicable for this ES  
PC not applicable for this ES  
AC 3: Electrical batteries and accumulators

## 5.1.2. Description of activities, processes and operational conditions covered in the exposure scenario

Aqueous potassium hydroxide is employed as electrolyte in alkaline batteries based on nickel-cadmium and manganese dioxide-zinc. Potassium hydroxide is preferred over sodium hydroxide because its solutions are more conductive. KOH is still present in alkaline batteries, but the substance is strictly confined in the battery containers and is not in direct contact with consumers.

The industrial and professional uses of KOH in batteries (incl. recycling operations) are covered under ES 3 (Section 3). This ES focuses on the consumer use, the service life and the end-of-life stage of KOH in batteries. Batteries are sealed articles and during normal use its contents, including KOH, will not be directly released and emission from KOH in these life-cycle stages should be minimal.

## 5.1.3. Risk management measures

### 5.1.3.1. Risk management measures related to consumers

Measures related to the design of the product: It is required to use completely sealed articles with a long service life maintenance.

### 5.1.3.2. Risk management measures related to environment

Due to the negligible exposure of KOH during normal battery use and disposal, there are no specific risk management measures related to environment.

### 5.1.4. Waste related measures

Batteries should be recycled as much as possible (e.g. by returning to a public recycling facility). Recovery of KOH from alkaline batteries includes removing the electrolyte, collection and neutralization with sulphuric acid and carbon dioxide. The occupational exposure related to these steps are considered in the exposure scenario on industrial and professional use of KOH.

## 5.2. Exposure estimation

### 5.2.1. Consumer exposure

Consumer exposure is negligible because batteries are sealed articles with a long service life maintenance.

### 5.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

### 5.2.3. Environmental exposure

The environmental release from the consumer use during service life is negligible because batteries are sealed articles with a long service life. After use, batteries normally are recycled and even in case it is disposed as municipal waste, KOH is not expected to cause a significant (pH) effect to the environment when incinerated or landfilled.

## 6. Regional exposure concentrations

Any effects of KOH that might occur would be expected to take place on a local scale and therefore it was decided as not meaningful to include the regional or continental scale in this risk assessment (cfr. EU RAR for NaOH, 2007). Predicted environmental concentrations (PECs) of KOH cannot be calculated, only a summary of measured levels is provided.

The emissions of KOH during production and use mainly apply to the aquatic environment. In water (including pore water of sediment and soil), KOH dissociates into the potassium ion (K<sup>+</sup>) and hydroxyl ion (OH<sup>-</sup>), both are ubiquitous in nature.

### 6.1. Freshwater (surface waters)

The concentration of hydroxyl ions (OH<sup>-</sup>) in the environment has been determined very extensively via pH measurements. Geochemical, hydrological and/or biological processes mainly determine the pH of an aquatic ecosystem. The pH is an important parameter of aquatic ecosystems and it is a standard parameter of water quality monitoring programs. The most important freshwater aquatic ecosystems of the world revealed average annual pH values between 6.5 and 8.3 but lower and higher values have been measured in other aquatic ecosystems. In aquatic ecosystems with dissolved organic acids a pH of less than 4.0 has been measured, while in waters with a high chlorophyll content the bicarbonate assimilation can result in pH values of higher than 9.0 at midday (OECD, 2002, from UNEP 1995).

Also potassium has been measured extensively in aquatic ecosystems. For example, UNEP (1995) reported the concentration for a total number of 75 rivers in North America, South-America, Asia, Africa, Europe and Oceania. The 10<sup>th</sup> -percentile, mean and 90<sup>th</sup> -percentile were 0.8 , 3.2 and 6.0 mg/l, respectively. The potassium concentration of topsoils is 0.2-3.3%, and that of seawater is 380 mg/l (Tait, 1980).

For European freshwaters, there are extensive databases on physico-chemical properties, including pH, hardness (calculated from the measured calcium and magnesium concentration), alkalinity (determined by acid/base titration or calculated from the calcium concentration, see further Section 3.1.3.2) and potassium concentration. In the framework of the EU Risk Assessment Report on Zn Metal (The Netherlands, 2004), data on physico-chemical properties of freshwaters in individual European countries and the combined data for freshwaters in European countries were collected and reported by De Schampelaere et al. (2003) and Heijerick et al. (2003). The combined European data for the above physico-chemical properties, all relevant for pH changes, are summarised in Table 11. The data in this table are based on 1991-1996 data for 411 European locations, extracted from the 'GEMS/Water database' (Global Environmental Monitoring System) that is mainly aimed on the large river systems. A correlation analysis on the data from all 411 locations indicate that all parameters listed in Table 11 are positively correlated, i.e. an increased pH is associated with increased concentrations of Ca, Mg and Na and increased hardness and alkalinity (De Schampelaere et al., 2003; Heijerick et al., 2003).

The variation in the above physico-chemical properties of the large river systems in different European countries is rather small, with exception of some areas in the Nordic countries (Denmark, Sweden, Norway and Finland) which are characterised by 'soft water' conditions, i.e. a hardness <24 mg CaCO<sub>3</sub>/l and low pH. For example, in Sweden the 50<sup>th</sup> percentile value for hardness is 15 mg CaCO<sub>3</sub>/l, which is 10-times lower than that for whole Europe. In Sweden the 50<sup>th</sup> percentile value for pH is just below 7, which is



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about 1 pH unit lower than that for whole Europe (De Schampelaere et al., 2003; Heijerick et al., 2003; The Netherlands, 2004).

**Table 11:** Distribution of European freshwaters (De Schampelaere et al., 2003; Heijerick et al., 2003)

Percentile value	pH	Hardness <sup>1</sup> (mg/l, as CaCO <sub>3</sub> )	Alkalinity (mg/l, as CaCO <sub>3</sub> )
5 <sup>th</sup> percentile	6.9	26	3
10 <sup>th</sup> percentile	7.0	41	6
20 <sup>th</sup> percentile	7.2	70	15
30 <sup>th</sup> percentile	7.5	97	31
40 <sup>th</sup> percentile	7.7	126	53
50 <sup>th</sup> percentile	7.8	153	82
60 <sup>th</sup> percentile	7.9	184	119
70 <sup>th</sup> percentile	7.9	216	165
80 <sup>th</sup> percentile	8.0	257	225
90 <sup>th</sup> percentile	8.1	308	306
95 <sup>th</sup> percentile	8.2	353	362

1) Hardness: total hardness, calculated from the Ca and Mg concentration

## 6.2. Seawater

In over 97% of the seawater in the world, the salinity (the amount of dissolved inorganic constituents), is 35‰ (promille, in g/kg). The major constituents of seawater at 35 ‰ are Cl<sup>-</sup> (19.35 g/kg), Na<sup>+</sup> (10.77 g/kg), SO<sub>4</sub><sup>2-</sup> (2.71 g/kg), Mg<sup>2+</sup> (1.29 g/kg), Ca<sup>2+</sup> (0.41 g/kg), K<sup>+</sup> (0.40 g/kg) and HCO<sub>3</sub><sup>-</sup> (0.142 g/kg, being the carbonate alkalinity expressed as though it were all HCO<sub>3</sub><sup>-</sup>, as this is the dominant species in seawater; the concentrations of CO<sub>2</sub> and CO<sub>3</sub><sup>2-</sup> in seawater are very low compared to that of HCO<sub>3</sub><sup>-</sup>) (Stumm and Morgan, 1981).

The pH of seawater (ocean water) is normally 8.0-8.3, which is very similar to the vast majority of European freshwaters (8.0-8.2, Table 11). The bicarbonate (HCO<sub>3</sub><sup>-</sup>) concentration in seawater (142 mg/kg, equivalent to 137 mg/l) is between the mean HCO<sub>3</sub><sup>-</sup> concentration (106 mg/l) and the 90th percentile HCO<sub>3</sub><sup>-</sup> concentration (195 mg/l) in European freshwaters, indicating a relatively high buffer capacity in seawater.

The observed pH values in European freshwater and seawater are within the tolerable ranges of the aquatic ecosystems.



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## Annex 3 to the extended Safety Data Sheet (eSDS)

### Risk characterisation

The potential for human health effects is the occurrence of local effects after acute and repeated exposure at those places where KOH is produced and/or used. This is because KOH is not expected to become systemically available in the body under normal handling and use conditions, i.e. neither the concentration of potassium in the blood nor the pH of the blood will be significantly affected.

Workers are protected from dermal exposure to avoid direct dermal contacts. Techniques and equipment (including PPE) are used providing a high level of protection from direct dermal contact. Dermal exposure to corrosive concentrations during normal handling and use of corrosive substances and formulations is therefore considered negligible and is not quantitatively assessed. Eye protection is obligatory for activities where direct handling of KOH may occur. However, dermal exposure to non-corrosive dilutions of KOH (concentrations < 2%) may occur. Dermal exposure to such non-corrosive dilutions of KOH are taken into account.

#### 1 Exposure Scenario 1: Manufacturing of liquid KOH

##### 1.1. Human health

##### 1.1.1. Workers

Table 1: Risk characterisation for workers

Route		ES 1- exposure concentrations (EC)	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/corrosion	<b>Qualitative:</b> KOH is considered to be a severe corrosive agent (concentrations $\geq 2\%$ ). Workers can be exposed to corrosive concentrations. However, dermal exposure to KOH is considered to occur only accidentally if the required protection is strictly adhered to. Therefore, a conclusion on adequately controlled risks is justifiable for scenarios in which corrosive concentrations of KOH are handled. KOH concentrations < 2% are not relevant for this ES.	
	Long term	Not relevant	Skin/eye irritation/corrosion		
Inhalation-local	Acute/ Long term	0.33 mg/m <sup>3</sup>	Respiratory tract irritation	1 mg/m <sup>3</sup>	0.33

Since the risk characterisation ratios are below one, it is demonstrated that the manufacturing of liquid KOH is adequately under control for workers.

##### 1.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

##### 1.2. Environment

##### 1.2.1. Aquatic compartment (including sediment and secondary poisoning)

Taking into account the recommended risk management measures for environment and the existing EU Directives for pH control for surface water and the data of many Member States on (additional) national regulations to control the pH of waste waters (STP influents) and surface waters it is concluded that STPs and surface waters are sufficiently protected with regard to pH changes (cfr. EU RAR for NaOH, 2007, section 3.3.1.1).

Therefore, the manufacturing of liquid KOH is adequately under control for environment.



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## 2. Exposure Scenario 2: Manufacturing of solid KOH

### 2.1. Human health

#### 2.1.1. Workers

Table 12: Risk characterisation for workers

Route		ES 2- exposure concentrations (EC)	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/corrosion	<b>Qualitative:</b> KOH is considered to be a severe corrosive agent (concentrations $\geq 2\%$ ). Workers can be exposed to corrosive concentrations. However, dermal exposure to KOH is considered to occur only accidentally if the required protection is strictly adhered to. Therefore, a conclusion on adequately controlled risks is justifiable for scenarios in which corrosive concentrations of KOH are handled. KOH concentrations $< 2\%$ are not relevant for this ES.	
	Long term	Not relevant	Skin/eye irritation/corrosion		
Inhalation-local	Acute/ Long term	0.2 mg/m <sup>3</sup>	Respiratory tract irritation	1 mg/m <sup>3</sup>	0.2

Since the risk characterisation ratios are below one, it is demonstrated that the manufacturing of solid KOH is adequately under control for workers.

#### 2.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

## 2.2. Environment

### 2.2.1. Aquatic compartment (including sediment and secondary poisoning)

Taking into account the recommended risk management measures for environment and the existing EU Directives for pH control for surface water and the data of many Member States on (additional) national regulations to control the pH of waste waters (STP influents) and surface waters it is concluded that STPs and surface waters are sufficiently protected with regard to pH changes (cfr. EU RAR for NaOH, 2007, section 3.3.1.1).

Therefore, the manufacturing of solid KOH is adequately under control for environment.



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## 3. Exposure Scenario 3: Industrial and professional use of KOH

### 3.1. Human health

#### 3.1.1. Workers

**Table 3: Risk characterisation for workers**

Route		ES 3- exposure concentrations (EC)	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/corrosion	<b>Qualitative (case KOH concentrations <math>\geq</math> 2%):</b> Workers can be exposed to corrosive concentrations. However, dermal exposure to KOH is considered to occur only accidentally if the required protection is strictly adhered to. Therefore, a conclusion on adequately controlled risks is justifiable for scenarios in which corrosive concentrations of KOH are handled. <b>Qualitative (case KOH concentrations &lt; 2% and &gt; 0.5%):</b> When existing controls and recommended RMMs are applied, safe use can be concluded. <b>Qualitative (case KOH concentrations &lt; 0.5%):</b> Safe use can be concluded because no health effects are observed.	
	Long term	Not relevant	Skin/eye irritation/corrosion		
Inhalation-local	Acute/Long term	0.5 mg/m <sup>3</sup>	Respiratory tract irritation	1 mg/m <sup>3</sup>	0.5

Since the risk characterisation ratios are below one, it is demonstrated that industrial and professional use of KOH is adequately under control for workers and professionals.

#### 3.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore indirect exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

### 3.2. Environment

#### 3.2.1. Aquatic compartment (including sediment and secondary poisoning)

Taking into account the recommended risk management measures for environment and the existing EU Directives for pH control for surface water and the data of many Member States on (additional) national regulations to control the pH of waste waters (STP influents) and surface waters it is concluded that STPs and surface waters are sufficiently protected with regard to pH changes (cf. EU RAR for NaOH, 2007, section 3.3.1.1).

It is noted that it cannot be excluded that there are (some) sites with KOH discharges to the aquatic environment, resulting in significant pH changes and effects on biological STPs/WWTPs or receiving surface waters. However, the available data clearly indicate that neutralisation of KOH containing waste waters and effluents is common practice, either from a legal point of view (legislation for surface waters) or from a practical point of view (protection of the functioning of biological STPs/WWTPs) (EU RAR, 2007, Section 3.3.1.2).

Therefore, the industrial and professional use of KOH is adequately under control for environment.



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## 4. Exposure Scenario 4: Consumer use of KOH

### 4.1. Human health

#### 4.1.1. Consumers

As potassium hydroxide is not expected to become systemically available in the body under normal handling and use conditions, the risk characterization for consumers will focus on possible risks from acute exposure (local effects).

**Table 4 Risk characterisation for consumers**

Route		ES 4- exposure concentrations (EC)	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/corrosion		<p><b>Qualitative (case KOH concentrations <math>\geq</math> 2%):</b> Consumers can be exposed to corrosive concentrations. However, dermal exposure to KOH is considered to occur only accidentally if the required protection is strictly adhered to. Therefore, a conclusion on adequately controlled risks is justifiable for scenarios in which corrosive and irritating concentrations of KOH are handled.</p> <p><b>Qualitative (case KOH concentrations &lt; 2% and &gt; 0.5%):</b> When existing controls and recommended RMMs are applied, safe use can be concluded.</p> <p><b>Qualitative (case KOH concentrations &lt; 0.5%):</b> Safe use can be concluded because no health effects are observed.</p>
	Long term	Not relevant	Skin/eye irritation/corrosion		
Inhalation-local	Acute	Not relevant	Respiratory tract irritation		<p><b>Qualitative:</b> KOH will be rapidly neutralised as a result of its reaction with CO<sub>2</sub> (or other acids). Since the KOH concentration and amount handled are smaller compared to professional use and since the DNEL and RMMs are similar, safe use can be concluded for consumer use.</p>
	Long term	Not relevant	Respiratory tract irritation		

Following the normal use of corrosive and irritating concentrations of potassium hydroxide it is concluded that the substance is of no risk for consumers if the required protection is used.

#### 4.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

#### 4.2. Environment

Consumer uses relate to already diluted products which will quickly be further neutralized in the sewer, well before reaching a WWTP or surface water. Therefore consumer use of KOH is adequately controlled for the environment.

## 5. Exposure Scenario 5: Consumer use, service life and waste stage of KOH in batteries

### 5.1. Human health

#### 5.1.1. Consumers

Consumer exposure is zero because batteries are sealed articles with a long service life maintenance. Therefore, consumer use of KOH in batteries is adequately under control.

#### 5.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for KOH. Any potential for exposure to KOH due to environmental releases will only have relevance at the local scale. Any pH effect of local releases will be neutralised by the buffer capacity of the receiving water and therefore no pH impacts at the regional scale related to KOH releases should be expected. Therefore *indirect* exposure of humans via the environment (oral) is not relevant in the case of KOH. This conclusion is similar to OECD SIAR (2002).

#### 5.2. Environment

The environmental release from the consumer use and the service life are negligible because batteries are sealed articles with a long service life. After use, batteries should be recycled as much as possible but in case of disposal as municipal waste, KOH is not expected to cause a significant (pH) effect to the environment when incinerated or landfilled. Therefore, the use of KOH in alkaline batteries is adequately under control for the environment



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