

Extended Material Safety Data Sheet – Potassium Carbonate

1. EXPOSURE ASSESSMENT

The exposure assessment is organised in several scenarios:

- ES1: Manufacturing, formulation and industrial use of potassium carbonate (industrial setting)
- ES2: Industrial and professional end use of solid and liquid products containing potassium carbonate
- ES3: Consumer use of potassium carbonate in solid or liquid preparations and articles (private/domestic use)

The following table gives a descriptive overview on these scenarios :

Table 1: Overview on exposure scenarios and coverage of substance life cycle

ES number	Manufacture	Identified uses				Resulting life cycle stage		Sector of Use (SU)	Product Category (PC)	Process category (PROC)	Article category (AC)
		Formulation	End use (industrial application)	End use (public domain)	Consumer use	Service life (for articles)	Waste stage				
ES 1	X	X	X					3, 8, 9, 10	N/A	1-5, 7-10, 13-15, 19, 21-24	N/A
ES 2			X	X				1, 2, 4, 5, 7, 13, 19, 22	N/A	1-11, 13-16, 19, 21-24	N/A
ES 3					X			21	4, 8, 9a, 12, 18, 27, 30, 35	N/A	4, 7, 8, 10, 11, 13 (formerly AC 12-1, AC 12-2)

1.1. Exposure Scenario 1: Manufacturing, formulation and industrial use of potassium carbonate (industrial setting)

1.1.1. Exposure scenario

1.1.1.1. Generic description of the exposure scenario

This exposure scenario covers uses of potassium carbonate as such or in preparations at industrial sites, manufacture of bulk, large scale chemicals (including petroleum products), fine chemicals as well as formulation (mixing) of preparations containing or involving the use of potassium carbonate. Potassium carbonate is manufactured in the following settings: closed process with no likelihood of exposure, closed, continuous process with occasional controlled exposure, closed batch process (synthesis or formulation), batch and other process (synthesis) where opportunity for exposure arises as well as mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact). Activities involve industrial spraying, transfer of potassium carbonate or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities, transfer of potassium carbonate or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities, transfer of potassium carbonate or preparation into small containers (dedicated filling line, including weighing), roller application or brushing, treatment of articles by dipping and pouring, production of preparations or articles by tableting, compression, extrusion, pelletisation, use as laboratory reagent, hand-mixing with intimate contact and only PPE available, low energy manipulation of potassium carbonate bound in materials and/or articles, potentially closed processing operations with potassium carbonate at elevated temperature, open processing and transfer operations with potassium carbonate at elevated temperature, high (mechanical) energy work-up of potassium carbonate bound in materials and/or articles. Exposure to workers by PC and AC are not applicable for this ES.

1.1.1.2. 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 220 days/year.

1.1.1.3. Risk management measures

1.1.1.3.1. Risk management measures related to workers

General risk management measures related to workers handling potassium carbonate are summarized in Table 2. A distinction is made between measures that are required or compulsory and measures that indicate good practice. Specific requirements apply to PROCs 7 and 21-24. These requirements are stated in Table 3 by indication of risk management target factors, which need at least to be met unless results of work-place measurements allow less stringent measures.

Because potassium carbonate is irritating to skin and the respiratory system, and can produce severe effects on the eye, the risk management measures for human health should focus on the prevention of exposure e.g. by dust or aerosol formation of the substance. For this reason automated and closed systems should preferably be used. Due to the irritating properties especially to eyes, appropriate skin and eye protection is required during any handling of this substance. Respiratory protection is needed when dust or aerosols of potassium carbonate can be formed.

Table 2: General risk management measures related to workers handling potassium carbonate

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 dust, mists, sprayings and subsequent potential splashes:</p> <ul style="list-style-type: none"> • Use closed systems or covering of open containers (e.g. screens) (<u>good practice</u>) • Transport over pipes, technical barrel filling/emptying of barrel with automatic systems (suction pumps etc.) (<u>good practice</u>) • 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>) 	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 tract 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 tract irritation in working areas.
Personal protection equipment (PPE) required under regular working conditions	<ul style="list-style-type: none"> • Respiratory protection: In case of dust or aerosol formation: use respiratory protection with approved filter (P2) (<u>required</u>) • Hand protection: impervious chemical resistant protective gloves (<u>required</u>): <ul style="list-style-type: none"> ○ material: butyl-rubber, PVC, polychloroprene with natural latex liner, material thickness: 0.5 mm, breakthrough time: > 480 min ○ material: nitrile-rubber, fluorinated rubber, material thickness: 0.35-0.4 mm, breakthrough time: > 480 min • Eye protection: chemical resistant goggles must be worn. If splashes are likely to occur, wear tightly fitting safety goggles, face –shield (<u>required</u>) • 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>) 	
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"> • workers in the risky process/areas identified should be trained a) to avoid to work without respiratory protection and b) to understand the irritating properties and, especially, the respiratory inhalation effects of potassium carbonate and c) to follow the safer procedures instructed by the 	Partly based on the EU RRS (2008) for NaOH

Information type	Data field	Explanation
	employer <ul style="list-style-type: none"> the employer has also to ascertain that the required PPE is available and used according to instructions 	

Specific requirements for PROCs 7 and 21-24

Based on results of the ECETOC TRA exposure estimation, PROCs 7 and 21-24 require specific risk management measures during handling of potassium carbonate. The following table shows applicable risk management target factors which need at least to be met by implementation of one or combination of two or more risk management measures (examples for calculation are given further down). Please note that general risk management measures given in Table 2 still apply to these PROCs. In case of the given target factors have already been met by implementation of general risk management measures stated above, no further RMM are needed for the respective PROC(s).

Table 3 Risk management target factors

Process Category	Target factor – liquid K ₂ CO ₃ (solid K ₂ CO ₃ , low dustiness)
PROC 7	0.0017 (0.99)
PROC 21	N/A (0.99)
PROC22-24 (worst case)	N/A (0.1)

Table 4 Risk reduction factors¹

Risk management measure	Data field	Risk reduction factor
Working restrictions	1-4 hours	0.6
	0.25-1 hours	0.2
	< 0.25 hours	0.1
Concentration (mixtures only)	5-25%	0.6
	1-5%	0.2
	<1	0.1
Local exhaust ventilation (LEV)	Effectiveness (usually between 80 and 95%)	Examples: 0.2 (Effectiveness = 80%) 0.1 (Effectiveness = 90%) 0.05 (Effectiveness = 95%)
Respiratory protective equipment	Effectiveness (usually between 90 and 95%)	Examples: 0.1 (Effectiveness = 90%) 0.05 (Effectiveness = 95%)

Example for calculation of total risk reduction factor to verify if given RMM target factor is met:

Given risk management target factor: 0.005

RMM aimed to be applied:

Working restriction: reduction of total duration of activity per 8 h shift to < 0.25 h (risk reduction factor: **0.1**)

Use of respiratory protective equipment with effectiveness of 95% (risk reduction factor: **0.05**)

Calculation of total risk reduction factor: **0.1** (working restriction) x **0.05** (RPE) = **0.005**

The total risk reduction factor of 0.005 does not exceed the given risk management target factor of 0.005 and thus, the applied risk management measures meet the requirements for safe handling.

¹ Based on ECETOC default values

Note that a combination of e.g. concentration range 1-5% (risk reduction factor 0.2) and use of local exhaust ventilation with an effectiveness of 95% (risk reduction factor 0.05) will not be sufficient to assure a safe handling since 0.2×0.05 equals 0.01 and thus exceeds the given risk management target factor of this example.

1.1.1.3.2. Risk management measures related to environment

Risk management measures related to the environment aim to avoid discharging potassium carbonate 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 6.5-8.5. This is also reflected in the description of standard OECD tests with aquatic organisms. In exceptional cases, local conditions may sometimes require specific measures, usually in agreement with local authorities. Indirect discharge, i.e. discharge to municipal sewer systems generally require wastewater to be in the range of pH 6.5-9.5.

1.1.1.4. Waste related measures

Liquid potassium carbonate waste should be re-used or discharged to the industrial wastewater and further neutralized if needed (cfr. RMM related to environment).

1.1.2. Exposure estimation

1.1.2.1. Workers exposure

Potassium carbonate is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of potassium carbonate after dermal or inhalation exposure are not expected to occur and a quantitative assessment is not performed for systemic toxicity.

Furthermore, absence of intrinsic systemic toxicity of potassium carbonate is generally taken for granted, which is proved by its long-standing safe use in food and pharmaceuticals and its GRAS (generally recognized as safe) status in the USA. In accordance with the European Parliament and Council Directive No 95/2/EC, potassium carbonate (E 501 i) may be added to almost all foodstuffs - including foodstuffs for infants and children - following the quantum satis principle. This means that no maximum level is specified. However, potassium carbonate shall be used in accordance with good manufacturing practice, at a level not higher than is necessary to achieve the intended purpose. Also according to JECFA (Joint FAO/WHO Expert Committee on Food Additives) Potassium carbonate (501(i)) has the ADI evaluation "not limited" and may therefore be used in food stuffs with no limitations other than current good manufacturing practice (Codex Alimentarius specification INS number 501 (i), <http://www.fao.org/ag/agn/jecfa-additives/specs/Monograph1/Additive-333.pdf>) and FAO/WHO Codex Alimentarius GSFA (General Standard for Food Additives) online, <http://www.codexalimentarius.net/gsaonline/additives/details.html?id=199>).

Local irritation is the only activity of potassium carbonate relevant to human health. This activity becomes effective once the substance is present in dissociated state. Potassium carbonate has an ionic structure and dissociates in an aqueous milieu including biological fluids like gastric juice or lacrimal fluid to yield carbonate ions (CO_3^{2-}) and potassium ions (K^+). Due to its alkalinity, the resulting solution may potentially cause local irritating effects.

No irritation was induced by undiluted potassium carbonate applied to the skin and moistened with saline in tests performed for twenty four hours under occlusive conditions with rabbits. Slight irritating effects observed in humans after accidental exposure were fully reversible. Based upon these considerations, no DNEL for local dermal effects in workers is derived.

A quantitative assessment is performed for long-term exposure - local effects inhalation.

The substance KOH is comparable to potassium carbonate regarding hygroscopic properties. For KOH an OECD SIDS assessment was made. The KOH OECD SIDS on Human Exposure – makes a statement on inhalation that is assigned to potassium carbonate in the following paragraph, as both substances are comparable re-

garding risk from inhalation:

Furthermore, due to a negligible vapour pressure and highly hygroscopic properties of potassium carbonate, dust and vapour exposure are not expected. For production and major uses of potassium carbonate, aerosols/mists do normally not occur. In any case, it should be realised that aerosols of potassium carbonate are not stable. They are rapidly transformed due to an uptake of carbon dioxide from the atmosphere resulting in the formation of potassium bicarbonate.

Analytical measurements, to determine potassium carbonate concentrations in the air of working places during production and use, seem to be unavailable.

International occupational exposure limits for potassium carbonate are not known.

Due to the low vapour pressure of potassium carbonate, the atmospheric concentration of this substance based on vaporisation from the liquid will be very low. There are no measured inhalation data available for potassium carbonate. However, measured data from the analogous substance NaOH can be used by read across as a worst case approach for potassium carbonate. An overview of the estimated and measured exposure concentrations can be found in the following table.

Table 5: NaOH Exposure concentrations to workers

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

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.

In the absence of exposure data for potash as read across data of NaOH have been used.

Modelled data

Worst case inhalation exposure to vapour or aerosols (PROC 7) is estimated by ECETOC TRA to be 100 ppm (575.8 mg/m³), assuming liquid potassium carbonate with very low vapour pressure, exposure duration of more than 4 hours/day and no local exhaust ventilation or respiratory equipment. The same process (PROC7) is estimated by ECETOC to be 0.17 ppm (1 mg/m³) for solid potassium carbonate (e.g. use of powders) and therefore is quite below the inhalative DNEL of 10 mg/m³.

The following table gives an overview of the modelled worst case exposure estimates according to ECETOC TRA:

Table 6: Exposure estimates for workers (worst case scenarios)

Routes of exposure	Estimated Exposure Concentrations		Measured exposure concentrations		Explanation / source of measured data
	value (value liquid solid, low dustiness)	unit	Value	unit	
Inhalation exposure	0.058 (0.01)	mg/m ³	---	---	Default value PROC 1 (ECETOC)
	0.58 (0.01)	mg/m ³	---	---	Default value PROC 2 (ECETOC)
	0.58 (0.1)	mg/m ³	---	---	Default value PROC 3 (ECETOC)
	0.58 (0.5)	mg/m ³	---	---	Default value PROC 4 (ECETOC)
	0.58 (0.5)	mg/m ³	---	---	Default value PROC 5 (ECETOC)
	575.8 (1)	mg/m ³	---	---	Default value PROC 7 (ECETOC)
	0.58 (0.5)	mg/m ³	---	---	Default value – worst case PROC 8a-8b (ECETOC)
	0.58 (0.1)	mg/m ³	---	---	Default value PROC 9 (ECETOC)
	57.58 ² (0.5)	mg/m ³	---	---	Default value PROC 10 (ECETOC)
	0.58 (0.1)	mg/m ³	---	---	Default value PROC 13 (ECETOC)
	0.58 (0.1)	mg/m ³	---	---	Default value PROC 14 (ECETOC)
	0.58 (0.1)	mg/m ³	---	---	Default value PROC 15 (ECETOC)
	57.58 ³ (0.5)	mg/m ³	---	---	Default value PROC 19 (ECETOC)

² This value is considered to be overestimated by ECETOC which does not take into account the absence of volatility-aspects of liquid potassium carbonate. Hence, no RMM target factor is calculated for this process category (exposure estimation considered to be max. 0.5 mg/m³).

³ This value is considered to be overestimated by ECETOC which does not take into account the absence of volatility-aspects of liquid potassium carbonate. Hence, no RMM target factor is calculated for this process category (exposure estimation considered to be max. 0.5 mg/m³).

Routes of exposure	Estimated Exposure Concentrations		Measured exposure concentrations		Explanation / source of measured data
	value (value low dustiness)	liquid solid, unit	Value	unit	
	N/A (1)	mg/m ³	---	---	Default value PROC 21 (ECETOC)
	N/A (10)	mg/m ³	---	---	Default value – worst case PROC 22 (ECETOC)
	N/A (10)	mg/m ³	---	---	Default value – worst case PROC 23 (ECETOC)
	N/A (10)	mg/m ³	---	---	Default value – worst case PROC 24 (ECETOC)

1.1.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for potassium carbonate. Any potential for exposure to potassium carbonate due to environmental releases will only have relevance at the local scale. Any potential pH effect of local releases will be neutralised by the natural buffer capacity of the receiving water. Therefore, *indirect* exposure of humans via the environment (oral) is not relevant in the case of potassium carbonate.

1.1.2.3. Environmental exposure

Regarding acid/base properties, potassium carbonate is acting with water analogous to the reaction of sodium hydroxide (NaOH) with water. In water potassium carbonate, as NaOH, sets OH⁻ ions free. And analogous to what is stated in the EU RAR on NaOH (2007), the risk assessment of potassium carbonate 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 dealt with the effect on organisms/ecosystems due to possible pH changes related to OH⁻ discharges, as the toxicity of the Na⁺ ion is expected to be insignificant compared to the (potential) pH effect. The same approach is valid for potassium carbonate. The main effect to organisms/ecosystems will be due to possible pH changes related to the OH⁻ discharges as the K⁺ 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 potassium carbonate will be found predominantly in water. Significant emissions or exposure to air are not expected due to the very low vapour pressure of potassium carbonate. Significant emissions or exposure to the terrestrial environment via WWTPs are not expected either. The sludge application route is not relevant for the emission to agricultural soil, as sorption of potassium carbonate 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 potassium carbonate and will be used in this dossier.

1.1.2.3.1. Environmental releases

The production of potassium carbonate 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 potassium carbonate 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 potassium carbonate and the related emissions of potassium are not available. The global production of potassium in the form of various potassium salts is 24 million tons K in 1989 (Ullmann, 1998). Potassium salts (KCl, K₂SO₄) are one of three main components in fertilizers which are applied to promote plant growth.

1.1.2.3.2. Exposure concentration in waste water treatment plants (WWTP)

Waste water from potassium carbonate production sites is an inorganic wastewater stream. For this reason it is not feasible to treat it biologically. Therefore, wastewater streams from potassium carbonate production sites will normally not be treated in biological waste water treatment plants (WWTPs).

1.1.2.3.3. Exposure concentration in aquatic pelagic compartment

If emitted to surface water, sorption to particulate matter and sediment will be negligible. An addition of potassium carbonate 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 (CO₂), the bicarbonate ion (HCO₃⁻) and the carbonate ion (CO₃²⁻):



If the pH is < 6, un-ionised CO₂ 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 (HCO₃⁻) is the predominant species and at pH values > 10 the carbonate ion (CO₃²⁻) 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 7 is included with the concentration of potassium carbonated needed to increase the pH to a value of 9.0/10/11 at different bicarbonate concentrations. It should be realised that the final pH could be slightly lower because at initial pH values below 8 there is some CO₂ available to buffer the pH (OECD SIDS 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 (HCO₃⁻), carbonate (CO₃²⁻) and hydroxide (OH⁻) (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 7 are useful to estimate pH increases in natural waters (most of them having a pH value of 7-8), if data on potassium carbonate additions and bicarbonate concentrations are available.

Table 7: Concentrations of potassium carbonate (mg/l) needed to increase the pH of natural river water to values of 9.0, 10.0 and 11.0

(recalculated for potassium carbonate from De Groot et al., 2002 as cited in OECD SIDS potassium hydroxide, 2002)

mg HCO ₃ ⁻ in natural water ^A	mg K ₂ CO ₃ for reaching the final final pH =		
	9.0	10.0	11.0
0 mg HCO ₃ ⁻ /l (distilled water)	1.4	21	786
20 mg HCO ₃ ⁻ /l (10 th percentile of 77 rivers)	3.5	42	999
106 mg HCO ₃ ⁻ /l (mean value of 77 rivers)	12.6	133	1913
200 mg HCO ₃ ⁻ /l (90 th percentile of 77 rivers)	22	228	2858

^A The initial pH of a hydrogen carbonate solution with a concentration of 20 – 195 mg/l is 8.3 (calculated).

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.

1.1.2.3.4. Exposure concentration in sediments

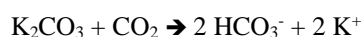
The sediment compartment is not included in this CSA, because it is not considered relevant for potassium carbonate. If emitted to the aquatic compartment, due to the ionic and polar nature of the inorganic salt, sorption to sediment particles will be negligible.

1.1.2.3.5. Exposure concentrations in soil and groundwater

The terrestrial compartment is not included in this CSA, because it is not considered relevant for potassium carbonate. With respect to the fate of potassium carbonate 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⁻ (built from CO₃²⁻ + water) will be neutralised according to the buffer capacity of the soil pore water.

1.1.2.3.6. Atmospheric compartment

The air compartment is not included in this CSA because it is considered not relevant for potassium carbonate. If emitted to air as an aerosol in water, potassium carbonate will be rapidly neutralised as a result of its reaction with CO₂ (or other acids):



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

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

1.2. Exposure Scenario 2: Industrial and professional end use of solid and liquid products containing potassium carbonate

1.2.1. Exposure scenario

1.2.1.1. Generic description of the exposure scenario

This exposure scenario covers the use of liquid or solid potassium carbonate in the following sectors: agriculture, forestry, fishery, mining, offshore industries, manufacture of food products, textiles, leather, fur and other non-metallic mineral products, printing and reproduction of recorded media, building and construction work as well as professional uses in the public domain (administration, education, entertainment, services, craftsmen). The use of potassium carbonate is carried out in the following settings: use in closed process with no likelihood of exposure, closed, continuous processes with occasional controlled exposure, closed batch processes (synthesis or formulation), batch and other processes (synthesis) where opportunity for exposure arises, mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact), calendaring operations as well as industrial and non-industrial spraying. Activities involve: transfer of potassium carbonate or its preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities, transfer of potassium carbonate or its preparation (charging/discharging) from/to vessels/large containers at dedicated facilities, transfer of potassium carbonate or its preparation into small containers (dedicated filling line, including weighing), roller application or brushing, treatment of articles by dipping and pouring, production of preparations or articles by tableting, compression, extrusion, pelletisation, use of potassium carbonate as laboratory reagent, using potassium carbonate-containing material as fuel sources (limited exposure to unburned product to be expected), hand-mixing with intimate contact and only PPE available, low energy manipulation of potassium carbonate bound in materials and/or articles, potentially closed processing operations with minerals/metals at elevated temperature in an industrial setting, open processing and transfer operations with minerals/metals at elevated temperature as well as high (mechanical) energy work-up of potassium carbonates bound in materials and/or articles. Exposure to workers by PC and AC are not applicable for this ES.

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

Main activities included in this scenario are the use of solid or liquid products or articles containing potassium carbonate for the purpose of fertilization of amenity (parks, public lawns, sport fields, golf courses), for greenhouse applications (including leaf spray, surface spreading, irrigation), leaf spraying at open field, sowing of seeds coated in fertilizer (including surface coating of seeds), for alkalisng purposes in the cacao-industry, pH-regulation for the production of yeast, manufacture of solid mineral fertilizers, for the use in building and construction preparations, during glass processes (including batch transportation to furnace, raw material transport, dosing weighing, mixing and batch filling to tank as well as fumes treatment), for the use of or in detergents, paint strippers, chemical peeling, pickling, for titration and extraction purposes and use as pH regulator, neutralizing and/or water treatment agent, for application, receipt and storage of imaging and printing chemicals as well as for the use as anti-freeze and de-icing product in the form of granules or powder.

1.2.1.4. Risk management measures

1.2.1.4.1. Risk management measures related to industrial and professional workers

General risk management measures related to workers handling potassium carbonate are summarized in Table 8. A distinction is made between measures that are required or compulsory and measures that indicate good practice. Specific requirements apply to industrial processes described by PROCs 7 and 21-24 as well as to professional processes described by PROCs 4-6, 11, 14, 16, 21 and 23-24. These requirements are stated in Table 9 by indication of risk management target factors, which need at least to be met unless results of work-place measurements allow less stringent measures.

Because potassium carbonate is irritating to skin, eyes and the respiratory system, the risk management measures for human health should focus on the prevention of exposure e.g. by dust or aerosol formation of the substance. For this reason automated and closed systems should preferably be used. Due to the skin irritating properties and the seriously irritating eye nature, appropriate skin and eye protection is required during any handling of this substance. Respiratory protection is needed when dust or aerosols of potassium carbonate can be formed.

Table 8: General risk management measures related to workers handling potassium carbonate

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 dust, mists, sprayings and subsequent potential splashes:</p> <ul style="list-style-type: none"> • Use closed systems or covering of open containers (e.g. screens) (<u>good practice</u>) • Transport over pipes, technical barrel filling/emptying of barrel with automatic systems (suction pumps etc.) (<u>good practice</u>) • 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>) 	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"> • Respiratory protection: In case of dust or aerosol formation: use respiratory protection with approved filter (P2) (<u>required</u>) • Hand protection: impervious chemical resistant protective gloves (<u>required</u>): <ul style="list-style-type: none"> ○ material: butyl-rubber, PVC, polychloroprene with natural latex liner, material thickness: 0.5 mm, breakthrough time: > 480 min ○ material: nitrile-rubber, fluorinated rubber, material thickness: 0.35-0.4 mm, breakthrough time: > 480 min • Eye protection: chemical resistant goggles must be worn. If splashes are likely to occur, wear tightly fitting safety goggles, face –shield (<u>required</u>) • 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>) 	
Other risk management measures related to work-	Next measures are <u>required</u> (from EU RAR, 2008):	Partly based on the EU

Information type	Data field	Explanation
ers. For example: Particular training systems, monitoring/reporting or auditing systems, specific control guidance.	<ul style="list-style-type: none"> workers in the risky process/areas identified should be trained a) to avoid to work without respiratory protection and b) to understand the irritating properties and, especially, the respiratory inhalation effects of potassium carbonate and c) to follow the safer procedures instructed by the employer the employer has also to ascertain that the required PPE is available and used according to instructions 	RRS (2008) for NaOH

Specific requirements for PROCs 4-7, 11, 14, 16 and 21-24

Based on results of the ECETOC TRA exposure estimation, PROCs 4-7, 11, 14, 16 and 21-24 require specific risk management measures during handling of potassium carbonate. The following table shows applicable risk management target factors which need at least to be met by implementation of one or combination of two or more risk management measures (examples for calculation are given further down). Please note that general risk management measures given in Table 8 still apply to these PROCs. In case of the given target factors have already been met by implementation of general risk management measures stated above, no further RMM are needed for the respective PROC(s).

Table 9 Risk management target factors

Process Category	Target factor for industrial use – liquid K ₂ CO ₃ (solid K ₂ CO ₃ , low dustiness)	Target factor for professional use – liquid K ₂ CO ₃ (solid K ₂ CO ₃ , low dustiness)
PROC 4-6	---	N/A (0.99)
PROC 7	0.0017 (0.99)	N/A (N/A)
PROC11	N/A (N/A)	0.0017 (0.99)
PROC14	---	--- (0.99)
PROC16	---	--- (0.2)
PROC 21	N/A (0.99)	N/A (0.33)
PROC 22 (worst case)	N/A (0.1)	N/A (N/A)
PROC 23-24 (worst case)	N/A (0.1)	N/A (0.05)

Table 10 Risk reduction factors⁴

Risk management measure	Data field	Risk reduction factor
Working restrictions	1-4 hours	0.6
	0.25-1 hours	0.2
	< 0.25 hours	0.1
Concentration (mixtures only)	5-25%	0.6
	1-5%	0.2
	<1	0.1
Local exhaust ventilation (LEV)	Effectiveness (usually between 80 and 95%)	Examples: 0.2 (Effectiveness = 80%) 0.1 (Effectiveness = 90%) 0.05 (Effectiveness = 95%)
Respiratory protective equipment	Effectiveness (usually between 90 and 95%)	Examples: 0.1 (Effectiveness = 90%)

⁴ Based on ECETOC default values

Risk management measure	Data field	Risk reduction factor
Working restrictions	1-4 hours	0.6
	0.25-1 hours	0.2
	< 0.25 hours	0.1
Concentration (mixtures only)	5-25%	0.6
	1-5%	0.2
	<1	0.1
Local exhaust ventilation (LEV)	Effectiveness (usually between 80 and 95%)	Examples: 0.2 (Effectiveness = 80%) 0.1 (Effectiveness = 90%) 0.05 (Effectiveness = 95%)
		0.05 (Effectiveness = 95%)

Example for calculation of total risk reduction factor to verify if given RMM target factor is met:

Given risk management target factor: 0.005

RMM aimed to be applied:

Working restriction: reduction of total duration of activity per 8 h shift to < 0.25 h (risk reduction factor: **0.1**)

Use of respiratory protective equipment with effectiveness of 95% (risk reduction factor: **0.05**)

Calculation of total risk reduction factor: **0.1** (working restriction) x **0.05** (RPE) = **0.005**

The total risk reduction factor of 0.005 does not exceed the given risk management target factor of 0.005 and thus, the applied risk management measures meet the requirements for safe handling.

Note that a combination of e.g. concentration range 1-5% (risk reduction factor 0.2) and use of local exhaust ventilation with an effectiveness of 95% (risk reduction factor 0.05) will not be sufficient to assure a safe handling since 0.2×0.05 equals 0.01 and thus exceeds the given risk management target factor of this example.

1.2.1.4.2. Risk management measures related to environment

Risk management measures related to the environment aim to avoid discharging potassium carbonate 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 6.5-8.5. This is also reflected in the description of standard OECD tests with aquatic organisms. In exceptional cases, local conditions may sometimes require specific measures, usually in agreement with local authorities. Indirect discharge, i.e. discharge to municipal sewer systems generally require wastewater to be in the range of pH 6.5-9.5.

1.2.1.5. Waste related measures

Liquid potassium carbonate waste should be reused or discharged to the industrial wastewater and further neutralized if needed (cfr. RMM related to environment). Deposition or application of solid potassium carbonate should not alter prevalent pH-ranges in soil. Respective impact by releases to the environment by e.g. stormwater should also comply with local legal requirements and/or requirements stated in chapter 9.2.1.4.2

1.2.2. Exposure estimation

1.1.2.1. Workers exposure

Potassium carbonate is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of Potassium carbonate after dermal or inhalation exposure are not expected to occur and a quantitative assessment is not performed for systemic toxicity.

Furthermore, absence of intrinsic systemic toxicity of potassium carbonate is generally taken for granted, which is proved by its long-standing safe use in food and pharmaceuticals and its GRAS (generally recognized as safe) status in the USA. In accordance with the European Parliament and Council Directive No 95/2/EC, potassium carbonate (E 501 i) may be added to almost all foodstuffs - including foodstuffs for infants and children - following the quantum satis principle. This means that no maximum level is specified. However, potassium carbonate shall be used in accordance with good manufacturing practice, at a level not higher than is necessary to achieve the intended purpose. Also according to JECFA (Joint FAO/WHO Expert Committee on Food Addi-

tives) Potassium carbonate (501(i)) has the ADI evaluation "not limited" and may therefore be used in food stuffs with no limitations other than current good manufacturing practice (Codex Alimentarius specification INS number 501 (i), <http://www.fao.org/ag/agn/jecfa-additives/specs/Monograph1/Additive-333.pdf>) and FAO/WHO Codex Alimentarius GSFA (General Standard for Food Additives) online, <http://www.codexalimentarius.net/gsfonline/additives/details.html?id=199>).

Local irritation is the only activity of potassium carbonate relevant to human health. This activity becomes effective once the substance is present in dissociated state. Potassium carbonate has an ionic structure and dissociates in an aqueous milieu including biological fluids like gastric juice or lacrimal fluid to yield carbonate ions (CO₃²⁻) and potassium ions (K⁺). Due to its alkalinity, the resulting solution may potentially cause local irritating effects.

Potassium carbonate is classified as a irritating substance to eyes and skin. As reliable dose descriptors for local irritation could not be derived from the available data, no quantitative assessment was performed concerning skin and eye effects.

A quantitative assessment is performed for long-term exposure - local effects inhalation.

The substance KOH is comparable to potassium carbonate regarding hygroscopic properties. For KOH an OECD SIDS assessment was made. The KOH OECD SIDS on Human Exposure – makes a statement on inhalation that is assigned to potassium carbonate in the following paragraph, as both substances are comparable regarding risk from inhalation:

Furthermore, due to a negligible vapour pressure and highly hygroscopic properties of potassium carbonate, dust and vapour exposure are not expected. For production and major uses of potassium carbonate, aerosols/mists do normally not occur. In any case, it should be realised that aerosols of potassium carbonate are not stable. They are rapidly transformed due to an uptake of carbon dioxide from the atmosphere resulting in the formation of potassium bicarbonate.

Analytical measurements, to determine potassium carbonate concentrations in the air of working places during production and use, seem to be unavailable.

International occupational exposure limits for potassium carbonate are not known.

Due to the low vapour pressure of potassium carbonate, the atmospheric concentration of this substance based on vaporisation from the liquid will be very low. There are no measured inhalation data available for potassium carbonate. However, measured data from the analogous NaOH can be used as a worst case read across substance for potassium carbonate. An overview of the estimated and measured exposure concentrations can be found in the following table.

Table 11: Measured data from the read-across substance - NaOH exposure concentrations to workers

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

Routes of exposure	Estimated Exposure Concentrations		Measured exposure concentrations		Explanation / source of measured data
	Value	unit	Value	unit	
	0.17	mg/m ³			From EU RAR (2007) Drumming liquid NaOH Typical and reasonable worst case exposure level

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.

Modelled data

Worst case inhalation exposure to vapour or aerosols (PROCs 7 and 11) is estimated by ECETOC TRA to be 100 ppm (575.8 mg/m³), assuming liquid potassium carbonate with very low vapour pressure, exposure duration of more than 4 hours/day and no local exhaust ventilation or respiratory equipment. The same process (PROCs 7 and 11) is estimated by ECETOC to be 0.17 ppm (1 mg/m³) for solid potassium carbonate (e.g. use of powders) and therefore is still quite below the inhalative DNEL of 10 mg/m³.

The following table gives an overview of the modelled worst case exposure estimates according to ECETOC TRA:

Table 12: Exposure estimates for workers (worst case scenarios)

Routes of exposure	Estimated Exposure Concentrations			Measured exposure concentrations		Explanation / source of measured data
	value for industrial settings - liquid (value solid, low dustiness)	value for professional settings - liquid (value solid, low dustiness)	unit	Value	unit	
Inhalation exposure	0.058 (0.01)	0.058 (0.01)	mg/m ³	---	---	Default value PROC 1 (ECETOC)
	0.58 (0.01)	0.58 (0.01)	mg/m ³	---	---	Default value PROC 2 (ECETOC)
	0.58 (0.1)	0.58 (0.1)	mg/m ³	---	---	Default value PROC 3 (ECETOC)
	0.58 (0.5)	0.58 (1)	mg/m ³	---	---	Default value PROC 4 (ECETOC)
	0.58 (0.5)	0.58 (1)	mg/m ³	---	---	Default value PROC 5 (ECETOC)
	0.58 (0.1)	0.58 (1)	mg/m ³	---	---	Default value PROC 6 (ECETOC)
	575.8 (1)	N/A (N/A)	mg/m ³	---	---	Default value PROC 7 (ECETOC)
	0.58 (0.5)	0.58 (0.5)	mg/m ³	---	---	Default value – worst case PROC 8a-8b (ECETOC)
	0.58 (0.1)	0.58 (0.5)	mg/m ³	---	---	Default value PROC 9 (ECETOC)

Routes of exposure	Estimated Exposure Concentrations			Measured exposure concentrations		Explanation / source of measured data
	value for industrial settings - liquid (value solid, low dustiness)	value for professional settings - liquid (value solid, low dustiness)	unit	Value	unit	
	57.58 ⁵ (0.5)	144 ⁵ (0.5)	mg/m ³	---	---	Default value PROC 10 (ECETOC)
	N/A (N/A)	575.8 (1)	mg/m ³	---	---	Default value PROC 11 (ECETOC)
	0.58 (0.1)	0.58 (0.5)	mg/m ³	---	---	Default value PROC 13 (ECETOC)
	0.58 (0.1)	0.58 (1)	mg/m ³	---	---	Default value PROC 14 (ECETOC)
	0.58 (0.1)	0.58 (0.1)	mg/m ³	---	---	Default value PROC 15 (ECETOC)
	0.58 (0.1)	0.58 (5)	mg/m ³	---	---	Default value PROC 16 (ECETOC)
	57.58 ⁶ (0.5)	144 ⁶ (0.5)	mg/m ³	---	---	Default value PROC 19 (ECETOC)
	N/A (1)	N/A (3)	mg/m ³	---	---	Default value PROC 21 (ECETOC)
	N/A (10)	N/A (N/A)	mg/m ³	---	---	Default value – worst case PROC 22 (ECETOC)
	N/A (10)	N/A (20)	mg/m ³	---	---	Default value – worst case PROC 23 (ECETOC)
	N/A (10)	N/A (20)	mg/m ³	---	---	Default value – worst case PROC 24 (ECETOC)

1.2.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for potassium carbonate. Any potential for exposure to potassium carbonate due to environmental releases will only have relevance at the local scale. Any potential pH effect of local releases will be neutralised by the natural buffer capac-

⁵ This value is considered to be overestimated by ECETOC which does not take into account the absence of volatility-aspects of liquid potassium carbonate. Hence, no RMM target factor is calculated for this process category (exposure estimation considered to be max. 0.5 mg/m³).

⁶ This value is considered to be overestimated by ECETOC which does not take into account the absence of volatility-aspects of liquid potassium carbonate. Hence, no RMM target factor is calculated for this process category (exposure estimation considered to be max. 0.5 mg/m³).

ity of the receiving water . Therefore, *indirect* exposure of humans via the environment (oral) is not relevant in the case of potassium carbonate.

1.2.2.3. Environmental exposure

Potassium carbonate will rapidly dissolve and dissociate in water when released to water. The environmental exposure assessment for solid potassium carbonate is consequently the same as for liquid potassium carbonate (see ES 1).

1.2.2.3.1. 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.

1.2.2.3.2. Exposure concentration in waste water treatment plants (WWTP)

In general RMMs related to the environment will aim to avoid discharging potassium carbonate solutions into municipal wastewater unless it is considered to be beneficial. The influent of municipal wastewater treatment plants is normally circum-neutral and strongly buffered and therefore no effect on the biological activity is expected.

1.2.2.3.3. Exposure concentration in aquatic pelagic compartment

The exposure concentration in aquatic pelagic compartment is similar to the assessment done in ES 1.

1.2.2.3.4. Exposure concentration in sediments

The exposure concentration in sediment compartment is similar to the assessment done in ES 1.

1.2.2.3.5. Exposure concentrations in soil and groundwater

The exposure concentration in soil and groundwater compartment is similar to the assessment done in ES 1.

1.2.2.3.6. Atmospheric compartment

The exposure concentration in atmospheric compartment is similar to the assessment done in ES 1.

1.2.2.3.7. 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 ES 1.

1.3. Exposure Scenario 3: Consumer use of potassium carbonate in solid or liquid preparations and articles (private/domestic use)

1.3.1. Exposure scenario

1.3.1.1. Generic description of the exposure scenario

This scenario covers the consumer use of anti-freeze and deicing products, disinfectants, coatings and paints, thinners, paint removers, fertilizers, ink and toners, plant protection products, photo-chemicals, washing and cleaning products (including solvent based products) as well as stone-, plaster-, cement-, glass-, ceramic-, metal-, paper-, rubber-, wood- and plastic articles.

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

Based on information provided by industry, less than 12% of the potassium carbonate production is applied in wide dispersive uses and enters in consumer products, i.e. approx. 2.25% supplied as powder and about 9.6% supplied as granules containing potassium carbonate through glass production and chemical-mechanical polishing products. However, the use of granules by consumers is estimated by industry to not exceed 2% of the total production (dmt) and that the use of potassium carbonate powder by consumers is very unlikely.

The amounts used will interact with other ingredients in acid-base reactions and thus practically no potassium carbonate is left in the final consumer product. However, some cleaning products may contain up to 40% of potassium carbonate (photo-chemicals), which however, are diluted by the consumer to 3% before use. Regular laundry powder or liquids contain up to 9.6% of potassium carbonate, toilet cleaners are expected to contain 0.025% and surface cleaners (liquid, powder, gel neat, spray neat) contain up to 5% in the formulated product. Germ care and other disinfectants contain max 0.15% of potassium carbonate. However, since the risk of harmful exposure to potassium carbonate needs to be considered during product design by setting the pH in consumer products to between 5 and 8 (see further details below), no health effects are expected from any consumer use of potassium carbonate.

1.3.1.3. Risk management measures

1.3.1.3.1. Risk management measures related to consumers

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

Measures related to the design of the product

1. since the hazard of potassium carbonate to man is driven by pH only, all consumer products need to be designed so that the pH is between pH 5-8 in the product itself and during any use where exposure can be expected.
2. for consumer products where the pH range of 5-8 is not maintained, the following measures related to the design of products should be maintained
 - All consumer products should be designed so that exposure by inhalation of aerosols and powder is inhibited (see also recommended risk management measure on viscosity).
 - It is required to use resistant labelling-package to avoid its auto-damage and loss of the label integrity, under normal use 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 carbonate in concentrations > 3%, 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 carbonate, 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 for consumer products were the pH range of 5-8 is not maintained

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

PPE required under regular conditions of consumer use of products were the pH range of 5-8 is not maintained

	PPE	concentration in product	PPE	concentration in product
Respiratory protection: In case of dust or aerosol formation (e.g. spraying): use respiratory protection with approved filter (P2)	required	> 3 %	Not needed	< 3 %
Hand protection: In case of potential dermal contact: use impervious chemical resistant protective gloves	required	> 3 %	No	< 3 %
Eye protection: If splashes are likely to occur, wear tightly fitting goggles, face – shield	required	> 3 %	No	< 3 %

1.3.1.3.2. Risk management measures related to environment

There are no specific risk management measures related to environment.

1.3.1.4. 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.

1.3.2. Exposure estimation

1.3.2.1. Consumer exposure

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

Potassium carbonate is not expected to be systemically available in the body under normal handling and use conditions and therefore systemic effects of potassium carbonate after oral, dermal or inhalation exposure are not expected to occur and a quantitative assessment is not performed for systemic toxicity.

Furthermore, absence of intrinsic systemic toxicity of potassium carbonate is generally taken for granted, which is proved by its long-standing safe use in food and pharmaceuticals and its GRAS (generally recognized as safe) status in the USA. In accordance with the European Parliament and Council Directive No 95/2/EC, potassium carbonate (E 501 i) may be added to almost all foodstuffs - including foodstuffs for infants and children - following the quantum satis principle. This means that no maximum level is specified. However, potassium carbonate shall be used in accordance with good manufacturing practice, at a level not higher than is necessary to achieve the intended purpose. Also according to JECFA (Joint FAO/WHO Expert Committee on Food Additives) Potassium carbonate (501(i)) has the ADI evaluation "not limited" and may therefore be used in food stuffs with no limitations other than current good manufacturing practice (Codex Alimentarius specification INS number 501 (i), <http://www.fao.org/ag/agn/jecfa-additives/specs/Monograph1/Additive-333.pdf>) and FAO/WHO Codex Alimentarius GSFA (General Standard for Food Additives) online, <http://www.codexalimentarius.net/gsfonline/additives/details.html?id=199>).

Local irritation is the only activity of potassium carbonate relevant to human health. This activity becomes effective once the substance is present in dissociated state. Potassium carbonate has an ionic structure and dissociates in an aqueous milieu including biological fluids like gastric juice or lacrimal fluid to yield carbonate ions (CO₃²⁻) and potassium ions (K⁺). Due to its alkalinity, the resulting solution may potentially cause local irritating effects.

No irritation was induced by undiluted potassium carbonate applied to the skin and moistened with saline in tests performed for twenty four hours under occlusive conditions with rabbits. Slight irritating effects observed in humans after accidental exposure were fully reversible. Nevertheless, potassium carbonate has an intrinsic irritating activity and is classified accordingly. The activity of potassium carbonate is solely based on alkalinity. In mixtures (= consumer products) the acid reserve of the additional compounds of the mixtures may compensate the alkalinity of potassium carbonate and thus its irritancy. Therefore, with reference to Directive 67/548/EEC, Annex VI, 3.2.5 and CLP Regulation (EC) No 1272/2008, Annex I, 3.2.3.1.2, for classification of potassium carbonate in mixtures it is justified to take the acid reserve of the mixture into account. Further on, it is highly unlikely that the general population will be dermally exposed to potassium carbonate. Based upon these considerations no quantitative assessment was performed concerning skin and eye effects.

If the recommended RMMS are respected, local exposure through inhalation will not be higher compared to inhalation exposures in ES1 and 2. Therefore, the consumer exposure through inhalation is not further quantitatively assessed.

The use in food and pharmaceuticals is regulated by constituted authorities. Potassium carbonate is regarded as 'Generally Recognized as safe' (GRAS) substance in food with no limitations other than current good manufacturing practice by the (EC, 2000, U.S. Government Printing Office (Publisher), 2003).

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).

Accidental exposure is not assessed in this dossier.

1.3.2.2. Indirect exposure of humans via the environment (oral)

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for potassium carbonate. Any potential for exposure to potassium carbonate due to environmental releases will only have relevance at the local scale. Any potential pH effect of local releases will be neutralised by the natural buffer capacity of the receiving water. Therefore, *indirect* exposure of humans via the environment (oral) is not relevant in the case of potassium carbonate.

1.3.2.3. 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.

The environmental release from the consumer use during service life is negligible because batteries are sealed articles with a long service life (service life only applies if substance is contained in article >1 year). After use, batteries normally are recycled and even in case it is disposed as municipal waste, potassium carbonate is not expected to cause a significant (pH) effect to the environment when incinerated or landfilled.

1.4. Regional exposure concentrations

Any effects of potassium carbonate that might occur are 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. also EU RAR for NaOH, 2007). Predicted environmental concentrations (PECs) of potassium carbonate cannot be calculated, as the carbonate ion reacts with natural water to give hydrogen carbonate according to buffer capacity of natural waters.

The emissions of potassium carbonate during production and use apply to the aquatic environment. In water (including pore water of sediment and soil), potassium carbonate dissociates into the potassium ion, carbonate ion and reacts further to hydrogen carbonate and the hydroxyl ion (OH⁻), which all are ubiquitous in nature.

1.4.1. Freshwater (surface waters)

As stated above, potassium carbonate undergoes an equilibrium reaction with water to form the ions potassium, hydrogencarbonate, carbonate, hydroxyl and the neutral carbon dioxide. The equilibrium and the corresponding concentrations (except for the potassium ion) are dependent on the pH. The concentration of hydroxyl ions OH⁻ 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 10th -percentile, mean and 90th -percentile were 0.8 , 3.2 and 6.0 mg/l, respectively. The potassium concentration of top-soils is 0.2-3.3% (Chemical Economics Handbook, 1999), 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 – CSR K₂CO₃ PPC SAS) 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 13. 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 13 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 CaCO₃/l and low pH. For example, in Sweden the 50th percentile value for hardness is 15 mg CaCO₃/l, which is 10-times lower than that for whole Europe. In Sweden the 50th percentile value for pH is just below 7, which is about 1 pH unit lower than that for whole Europe (De Schampelaere et al., 2003; Heijerick et al., 2003; The Netherlands, 2004).

Table 13: Physico-chemical properties of European freshwaters (De Schampelaere et al., 2003; Heijerick et al., 2003 in EU RAR, 2007)

Percentile value	pH	Hardness ¹ (mg/l, as CaCO ₃)	Alkalinity (mg/l, as CaCO ₃)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)
5 th percentile	6.9	26	3	8	1.5	3
10 th percentile	7.0	41	6	13	2	5
20 th percentile	7.2	70	15	23	3	7
30 th percentile	7.5	97	31	32	4	10
40 th percentile	7.7	126	53	42	5	13
50 th percentile	7.8	153	82	51	6	17
60 th percentile	7.9	184	119	62	7	22
70 th percentile	7.9	216	165	73	8	29
80 th percentile	8.0	257	225	86	10	40
90 th percentile	8.1	308	306	103	12	63
95 th percentile	8.2	353	362	116	15	90

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

The buffer capacity of surface waters can be calculated from alkalinity in combination with pH. The buffer capacity may be expressed as hydrogen carbonate concentration. The mean HCO₃⁻ concentration (106 mg/l) indicated a relatively high buffer capacity and makes the corresponding surface waters relatively insensitive to pH changes.

1.4.2. Seawater

In over 97% of the seawater in the world, the salinity (the amount of dissolved inorganic constituents), is 35‰ (equivalent to g/kg). The major constituents of seawater at 35 ‰ are Cl⁻ (19.35 g/kg), Na⁺ (10.77 g/kg), SO₄²⁻ (2.71 g/kg), Mg²⁺ (1.29 g/kg), Ca²⁺ (0.41 g/kg), K⁺ (0.40 g/kg) and HCO₃⁻ (0.142 g/kg, being the carbonate alkalinity expressed as though it were all HCO₃⁻, as this is the dominant species in seawater; the concentrations of CO₂ and CO₃²⁻ in seawater are very low compared to that of HCO₃⁻) (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 13). The bicarbonate (HCO₃⁻) concentration in seawater (142 mg/kg, equivalent to 137 mg/l) is between the mean HCO₃⁻ concentration (106 mg/l) and the 90th percentile HCO₃⁻ concentration (195 mg/l) in European freshwaters, indicating a relatively high buffer capacity in seawater.

According to the high buffer capacity, seawater is relatively insensitive to pH changes.

2. RISK CHARACTERISATION

The potential for human health effects is the occurrence of local effects after acute and repeated exposure at those places where potassium carbonate is produced and/or used. This is because potassium carbonate 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.

Techniques and equipment (including PPE) are used in industrial and professional settings providing a high level of protection to eyes and the respiratory system of workers.

2.1 Exposure Scenarios 1-2: Manufacturing of Potassium carbonate and industrial and professional use of substance related products and articles

2.1.1. Human health

2.1.1.1. Workers

Table 14: Risk characterisation for workers in industrial and professional settings

Route		ES 1- exposure concentration	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/	10 mg/m ³	0.099
	Long term	Not relevant	Skin/eye irritation/		
Inhalation- local	Acute/ Long term	max 0.99 mg/m ³ ⁷	Respiratory tract irritation		

⁷ Estimated exposure after implementation of appropriate risk management measures for worst case PROCs exceeding DNEL of 10 mg/m³

Since the risk characterisation ratios are below one, it is demonstrated that the manufacturing of liquid and solid potassium carbonate and industrial and professional use of solid and liquid products containing potassium carbonate is adequately under control for workers.

2.1.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for potassium carbonate. Any potential for exposure to potassium carbonate due to environmental releases will only have relevance at the local scale. Any potential pH effect of local releases will be neutralised by the natural buffer capacity of the receiving water. Therefore, *indirect* exposure of humans via the environment (oral) is not relevant in the case of potassium carbonate.

2.1.2. Environment

2.1.2.1. 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 potassium carbonate is adequately under control for environment.

It is noted that it cannot be excluded that there are (some) sites with potassium carbonate 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 potassium carbonate 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 potassium carbonate is adequately under control for the environment.

2.2. Exposure Scenario 3: Consumer use of potassium carbonate in solid or liquid preparations and articles (private/domestic use)

2.2.1. Human health

2.2.1.1. Consumers

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

Table 15 Risk characterisation for consumers

Route		ES 3- exposure concentrations (EC)	Leading toxic end point / Critical effect	DNEL	Risk characterisation ratio
Dermal-local	Acute	Not relevant	Skin/eye irritation/		Qualitative: Potassium carbonate has an intrinsic irritating activity and is classified accordingly. For handling the respective risk management measures (RMMs) are implemented. The activity of potassium carbonate is solely based on alkalinity. In mixtures, the acid reserve of the additional compounds of the mixtures may compensate the alkalinity of potassium carbonate and thus its irritancy. Therefore, with reference to Directive 67/548/EEC, Annex VI, 3.2.5 and CLP Regulation (EC) No 1272/2008, Annex I, 3.2.3.1.2, for classification of potassium carbonate in mixtures it is justified to take the acid reserve of the mixture into account. Further on, it is highly unlikely that the general population will be dermally exposed to potassium carbonate
	Long term	Not relevant	Skin/eye irritation		
Inhalation- local	Acute	Not relevant	Respiratory tract irritation		Qualitative: potassium carbonate will be rapidly neutralised as a result of its reaction with CO ₂ (or other acids). Since the potassium carbonate concentration and amount handled are smaller compared to professional use, the pH is set to between 5-8 by product design and since the DNEL and RMMs are similar, safe use can be concluded for consumer use.
	Long term	Not relevant	Respiratory tract irritation		

2.2.1.2. Indirect exposure of humans via the environment

Indirect exposure to humans, for example through the uptake of drinking water, is not relevant for potassium

carbonate. Any potential for exposure to potassium carbonate due to environmental releases will only have relevance at the local scale. Any potential pH effect of local releases will be neutralised by the natural buffer capacity of the receiving water. Therefore, *indirect* exposure of humans via the environment (oral) is not relevant in the case of potassium carbonate.

2.2.2. 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 potassium carbonate is adequately controlled for the environment.

2.3. Overall exposure (combined for all relevant emission/release sources)

No combined exposure is considered for potassium carbonate since no related systemic effects have been identified and any release of potassium carbonate is considered to be controlled due to neutralization in the sewer as described above.

Annex 1 – Identified uses

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU1	ES1	SU3			AC9
IU2	ES1	SU3	PROC1	PC12	
IU3	ES1	SU3	PROC1	PC16	
IU4	ES1	SU3	PROC1	PC19	
IU5	ES1	SU3	PROC1	PC20	
IU6	ES1	SU3	PROC1	PC22	
IU7	ES1	SU3	PROC1	PC30	
IU8	ES1	SU3	PROC1	PC32	
IU9	ES1	SU3	PROC1	PC37	
IU10	ES1	SU3	PROC1	PC40	
IU11	ES1	SU3	PROC10	PC35	
IU12	ES1	SU3	PROC11		
IU13	ES1	SU3	PROC13	PC12	
IU14	ES1	SU3	PROC13	PC14	
IU15	ES1	SU3	PROC13	PC18	
IU16	ES1	SU3	PROC13	PC20	
IU17	ES1	SU3	PROC13	PC30	
IU18	ES1	SU3	PROC13	PC35	
IU19	ES1	SU3	PROC13	PC37	
IU20	ES1	SU3	PROC14		
IU21	ES1	SU3	PROC15	PC12	
IU22	ES1	SU3	PROC15	PC19	
IU23	ES1	SU3	PROC15	PC20	
IU24	ES1	SU3	PROC15	PC21	
IU25	ES1	SU3	PROC15	PC22	
IU26	ES1	SU3	PROC15	PC32	
IU27	ES1	SU3	PROC19		
IU28	ES1	SU3	PROC2	PC12	
IU29	ES1	SU3	PROC2	PC14	
IU30	ES1	SU3	PROC2	PC16	
IU31	ES1	SU3	PROC2	PC19	
IU32	ES1	SU3	PROC2	PC20	
IU33	ES1	SU3	PROC2	PC22	
IU34	ES1	SU3	PROC2	PC30	
IU35	ES1	SU3	PROC2	PC35	
IU36	ES1	SU3	PROC2	PC37	
IU37	ES1	SU3	PROC2	PC40	
IU38	ES1	SU3	PROC21	PC18	
IU39	ES1	SU3	PROC21	PC30	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU40	ES1	SU3	PROC22		
IU41	ES1	SU3	PROC23		
IU42	ES1	SU3	PROC24		
IU43	ES1	SU3	PROC3	PC12	
IU44	ES1	SU3	PROC3	PC19	
IU45	ES1	SU3	PROC3	PC20	
IU46	ES1	SU3	PROC3	PC22	
IU47	ES1	SU3	PROC3	PC30	
IU48	ES1	SU3	PROC3	PC37	
IU49	ES1	SU3	PROC4	PC12	
IU50	ES1	SU3	PROC4	PC14	
IU51	ES1	SU3	PROC4	PC19	
IU52	ES1	SU3	PROC4	PC20	
IU53	ES1	SU3	PROC4	PC22	
IU54	ES1	SU3	PROC4	PC35	
IU55	ES1	SU3	PROC4	PC37	
IU56	ES1	SU3	PROC5	PC0	
IU57	ES1	SU3	PROC5	PC12	
IU58	ES1	SU3	PROC5	PC14	
IU59	ES1	SU3	PROC5	PC18	
IU60	ES1	SU3	PROC5	PC19	
IU61	ES1	SU3	PROC5	PC20	
IU62	ES1	SU3	PROC5	PC22	
IU63	ES1	SU3	PROC5	PC30	
IU64	ES1	SU3	PROC5	PC35	
IU65	ES1	SU3	PROC7	PC35	
IU66	ES1	SU3	PROC8	PC12	
IU67	ES1	SU3	PROC8	PC19	
IU68	ES1	SU3	PROC8	PC20	
IU69	ES1	SU3	PROC8	PC22	
IU70	ES1	SU3	PROC8	PC37	
IU71	ES1	SU3	PROC8b	PC18	
IU72	ES1	SU3	PROC8b	PC30	
IU73	ES1	SU3	PROC9	PC19	
IU74	ES1	SU3	PROC9	PC20	
IU75	ES1	SU3	PROC9	PC30	
IU76	ES1	SU3	PROC9	PC37	
IU77	ES1	SU8	PROC1	PC0	
IU78	ES1	SU8	PROC1	PC19	
IU79	ES1	SU8	PROC1	PC20	
IU80	ES1	SU8	PROC1	PC32	
IU81	ES1	SU8	PROC15	PC32	
IU82	ES1	SU8	PROC2	PC0	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU83	ES1	SU8	PROC2	PC19	
IU84	ES1	SU8	PROC2	PC2	
IU85	ES1	SU8	PROC22		
IU86	ES1	SU8	PROC3	PC0	
IU87	ES1	SU8	PROC3	PC19	
IU88	ES1	SU8	PROC3	PC29	
IU89	ES1	SU8	PROC4	PC0	
IU90	ES1	SU8	PROC4	PC19	
IU91	ES1	SU8	PROC4	PC20	
IU92	ES1	SU8	PROC4	PC27	
IU93	ES1	SU8	PROC5	PC19	
IU94	ES1	SU8	PROC8	PC19	
IU95	ES1	SU8	PROC8a		
IU96	ES1	SU8	PROC8b		
IU97	ES1	SU8	PROC9	PC19	
IU98	ES1	SU9	PROC1	PC 19	
IU99	ES1	SU9	PROC1	PC19	
IU100	ES1	SU9	PROC1	PC20	
IU101	ES1	SU9	PROC1	PC29	
IU102	ES1	SU9	PROC1	PC30	
IU103	ES1	SU9	PROC15	PC 19	
IU104	ES1	SU9	PROC15	PC19	
IU105	ES1	SU9	PROC15	PC20	
IU106	ES1	SU9	PROC15	PC21	
IU107	ES1	SU9	PROC2	PC19	
IU108	ES1	SU9	PROC2	PC20	
IU109	ES1	SU9	PROC2	PC29	
IU110	ES1	SU9	PROC2	PC30	
IU111	ES1	SU9	PROC22	PC19	
IU112	ES1	SU9	PROC3	PC 19	
IU113	ES1	SU9	PROC3	PC19	
IU114	ES1	SU9	PROC3	PC20	
IU115	ES1	SU9	PROC3	PC29	
IU116	ES1	SU9	PROC3	PC30	
IU117	ES1	SU9	PROC4	PC 19	
IU118	ES1	SU9	PROC4	PC19	
IU119	ES1	SU9	PROC4	PC20	
IU120	ES1	SU9	PROC4	PC29	
IU121	ES1	SU9	PROC4	PC30	
IU122	ES1	SU9	PROC5	PC30	
IU123	ES1	SU9	PROC8	PC19	
IU124	ES1	SU9	PROC8	PC20	
IU125	ES1	SU9	PROC8b	PC 19	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU126	ES1	SU9	PROC8b	PC19	
IU127	ES1	SU9	PROC8b	PC20	
IU128	ES1	SU9	PROC8b	PC30	
IU129	ES1	SU9	PROC9	PC19	
IU130	ES1	SU9	PROC9	PC20	
IU131	ES1	SU9	PROC9	PC30	
IU132	ES1	SU10	PROC0	PC27	
IU133	ES1	SU10	PROC1	PC12	
IU134	ES1	SU10	PROC1	PC18	
IU135	ES1	SU10	PROC1	PC23	
IU136	ES1	SU10	PROC1	PC27	
IU137	ES1	SU10	PROC1	PC30	
IU138	ES1	SU10	PROC1	PC34	
IU139	ES1	SU10	PROC1	PC35	
IU140	ES1	SU10	PROC11	PC22	
IU141	ES1	SU10	PROC11	PC27	
IU142	ES1	SU10	PROC11	PC8	
IU143	ES1	SU10	PROC14	PC12	
IU144	ES1	SU10	PROC14	PC27	
IU145	ES1	SU10	PROC14	PC35	
IU146	ES1	SU10	PROC15	PC12	
IU147	ES1	SU10	PROC15	PC27	
IU148	ES1	SU10	PROC15	PC35	
IU149	ES1	SU10	PROC19	PC22	
IU150	ES1	SU10	PROC19	PC27	
IU151	ES1	SU10	PROC19	PC8	
IU152	ES1	SU10	PROC2	PC12	
IU153	ES1	SU10	PROC2	PC18	
IU154	ES1	SU10	PROC2	PC23	
IU155	ES1	SU10	PROC2	PC27	
IU156	ES1	SU10	PROC2	PC30	
IU157	ES1	SU10	PROC2	PC34	
IU158	ES1	SU10	PROC2	PC35	
IU159	ES1	SU10	PROC3	PC10	
IU160	ES1	SU10	PROC3	PC12	
IU161	ES1	SU10	PROC3	PC18	
IU162	ES1	SU10	PROC3	PC22	
IU163	ES1	SU10	PROC3	PC23	
IU164	ES1	SU10	PROC3	PC27	
IU165	ES1	SU10	PROC3	PC30	
IU166	ES1	SU10	PROC3	PC34	
IU167	ES1	SU10	PROC3	PC35	
IU168	ES1	SU10	PROC3	PC8	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU169	ES1	SU10	PROC4	PC12	
IU170	ES1	SU10	PROC4	PC23	
IU171	ES1	SU10	PROC4	PC27	
IU172	ES1	SU10	PROC4	PC34	
IU173	ES1	SU10	PROC4	PC35	
IU174	ES1	SU10	PROC5	PC10	
IU175	ES1	SU10	PROC5	PC12	
IU176	ES1	SU10	PROC5	PC18	
IU177	ES1	SU10	PROC5	PC21	
IU178	ES1	SU10	PROC5	PC22	
IU179	ES1	SU10	PROC5	PC23	
IU180	ES1	SU10	PROC5	PC27	
IU181	ES1	SU10	PROC5	PC30	
IU182	ES1	SU10	PROC5	PC34	
IU183	ES1	SU10	PROC5	PC35	
IU184	ES1	SU10	PROC5	PC8	
IU185	ES1	SU10	PROC7	PC35	
IU186	ES1	SU10	PROC8	PC10	
IU187	ES1	SU10	PROC8	PC12	
IU188	ES1	SU10	PROC8	PC22	
IU189	ES1	SU10	PROC8	PC27	
IU190	ES1	SU10	PROC8	PC35	
IU191	ES1	SU10	PROC8	PC8	
IU192	ES1	SU10	PROC8a	PC18	
IU193	ES1	SU10	PROC8b	PC18	
IU194	ES1	SU10	PROC8b	PC23	
IU195	ES1	SU10	PROC8b	PC30	
IU196	ES1	SU10	PROC8b	PC34	
IU197	ES1	SU10	PROC9	PC10	
IU198	ES1	SU10	PROC9	PC12	
IU199	ES1	SU10	PROC9	PC18	
IU200	ES1	SU10	PROC9	PC21	
IU201	ES1	SU10	PROC9	PC22	
IU202	ES1	SU10	PROC9	PC23	
IU203	ES1	SU10	PROC9	PC27	
IU204	ES1	SU10	PROC9	PC30	
IU205	ES1	SU10	PROC9	PC34	
IU206	ES1	SU10	PROC9	PC35	
IU207	ES1	SU10	PROC9	PC8	
IU208	ES2	SU0	PROC11	PC12	
IU209	ES2	SU0	PROC15	PC21	
IU210	ES2	SU0	PROC7	PC12	
IU211	ES2	SU0	PROC8a	PC12	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU212	ES2	SU0	PROC8b	PC12	
IU213	ES2	SU1	PROC0	PC12	
IU214	ES2	SU1	PROC11	PC12	
IU215	ES2	SU1	PROC11	PC22	
IU216	ES2	SU1	PROC11	PC27	
IU217	ES2	SU1	PROC11	PC8	
IU218	ES2	SU1	PROC19	PC22	
IU219	ES2	SU1	PROC19	PC27	
IU220	ES2	SU1	PROC19	PC8	
IU221	ES2	SU1	PROC2	PC12	
IU222	ES2	SU1	PROC3	PC22	
IU223	ES2	SU1	PROC3	PC27	
IU224	ES2	SU1	PROC3	PC8	
IU225	ES2	SU1	PROC5	PC22	
IU226	ES2	SU1	PROC5	PC27	
IU227	ES2	SU1	PROC5	PC8	
IU228	ES2	SU1	PROC7	PC12	
IU229	ES2	SU1	PROC8	PC22	
IU230	ES2	SU1	PROC8	PC27	
IU231	ES2	SU1	PROC8	PC8	
IU232	ES2	SU1	PROC8a	PC12	
IU233	ES2	SU1	PROC8a	PC27	
IU234	ES2	SU1	PROC8b	PC12	
IU235	ES2	SU1	PROC8b	PC27	
IU236	ES2	SU1	PROC9	PC12	
IU237	ES2	SU1	PROC9	PC22	
IU238	ES2	SU1	PROC9	PC27	
IU239	ES2	SU1	PROC9	PC8	
IU240	ES2	SU13	PROC10	PC10	
IU241	ES2	SU13	PROC11	PC0	
IU242	ES2	SU13	PROC13	PC10	
IU243	ES2	SU13	PROC14	PC10	
IU244	ES2	SU13	PROC2		
IU245	ES2	SU13	PROC2	PC0	
IU246	ES2	SU13	PROC22		
IU247	ES2	SU13	PROC22	PC0	
IU248	ES2	SU13	PROC23	PC0	
IU249	ES2	SU13	PROC3		
IU250	ES2	SU13	PROC3	PC0	
IU251	ES2	SU13	PROC4		
IU252	ES2	SU13	PROC7	PC0	
IU253	ES2	SU13	PROC8		
IU254	ES2	SU13	PROC8a	PC0	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU255	ES2	SU13	PROC8b	PC0	
IU256	ES2	SU13	PROC9		
IU257	ES2	SU19	PROC10	PC10	
IU258	ES2	SU19	PROC11	PC10	
IU259	ES2	SU19	PROC13	PC10	
IU260	ES2	SU19	PROC19	PC10	
IU261	ES2	SU19	PROC24	PC10	
IU262	ES2	SU19	PROC7	PC10	
IU263	ES2	SU2	PROC11	PC12	
IU264	ES2	SU2	PROC7	PC12	
IU265	ES2	SU2	PROC8a	PC12	
IU266	ES2	SU2	PROC8b	PC12	
IU267	ES2	SU4	PROC1		
IU268	ES2	SU4	PROC1	PC12	
IU269	ES2	SU4	PROC1	PC20	
IU270	ES2	SU4	PROC1	PC37	
IU271	ES2	SU4	PROC13	PC20	
IU272	ES2	SU4	PROC13	PC37	
IU273	ES2	SU4	PROC2		
IU274	ES2	SU4	PROC2	PC12	
IU275	ES2	SU4	PROC2	PC20	
IU276	ES2	SU4	PROC2	PC37	
IU277	ES2	SU4	PROC3		
IU278	ES2	SU4	PROC3	PC12	
IU279	ES2	SU4	PROC3	PC20	
IU280	ES2	SU4	PROC3	PC37	
IU281	ES2	SU4	PROC4		
IU282	ES2	SU4	PROC4	PC12	
IU283	ES2	SU4	PROC4	PC20	
IU284	ES2	SU4	PROC4	PC37	
IU285	ES2	SU4	PROC5		
IU286	ES2	SU4	PROC5	PC12	
IU287	ES2	SU4	PROC8	PC20	
IU288	ES2	SU4	PROC8	PC37	
IU289	ES2	SU4	PROC9	PC20	
IU290	ES2	SU4	PROC9	PC37	
IU291	ES2	SU5	PROC1		
IU292	ES2	SU5	PROC1	PC20	
IU293	ES2	SU5	PROC1	PC37	
IU294	ES2	SU5	PROC10	PC20	
IU295	ES2	SU5	PROC13	PC20	
IU296	ES2	SU5	PROC13	PC37	
IU297	ES2	SU5	PROC2		

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU298	ES2	SU5	PROC2	PC20	
IU299	ES2	SU5	PROC2	PC37	
IU300	ES2	SU5	PROC3		
IU301	ES2	SU5	PROC3	PC20	
IU302	ES2	SU5	PROC3	PC37	
IU303	ES2	SU5	PROC4		
IU304	ES2	SU5	PROC4	PC20	
IU305	ES2	SU5	PROC4	PC37	
IU306	ES2	SU5	PROC5	PC20	
IU307	ES2	SU5	PROC6	PC20	
IU308	ES2	SU5	PROC7	PC20	
IU309	ES2	SU5	PROC8	PC20	
IU310	ES2	SU5	PROC8	PC37	
IU311	ES2	SU5	PROC8a	PC20	
IU312	ES2	SU5	PROC8b	PC20	
IU313	ES2	SU5	PROC9	PC20	
IU314	ES2	SU5	PROC9	PC37	
IU315	ES2	SU7	PROC1	PC30	
IU316	ES2	SU7	PROC13	PC18	
IU317	ES2	SU7	PROC13	PC30	
IU318	ES2	SU7	PROC2	PC30	
IU319	ES2	SU7	PROC21	PC18	
IU320	ES2	SU7	PROC21	PC30	
IU321	ES2	SU7	PROC3	PC30	
IU322	ES2	SU7	PROC5	PC18	
IU323	ES2	SU7	PROC5	PC30	
IU324	ES2	SU7	PROC8b	PC18	
IU325	ES2	SU7	PROC8b	PC30	
IU326	ES2	SU7	PROC9	PC30	
IU327	ES2	SU19	PROC10	PC10	
IU328	ES2	SU19	PROC11	PC10	
IU329	ES2	SU19	PROC13	PC10	
IU330	ES2	SU19	PROC19	PC10	
IU331	ES2	SU22	PROC1		
IU332	ES2	SU22	PROC1	PC20	
IU333	ES2	SU22	PROC1	PC37	
IU334	ES2	SU22	PROC10		
IU335	ES2	SU22	PROC10	PC35	
IU336	ES2	SU22	PROC11		
IU337	ES2	SU22	PROC11	PC12	
IU338	ES2	SU22	PROC11	PC22	
IU339	ES2	SU22	PROC11	PC35	
IU340	ES2	SU22	PROC11	PC4	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU341	ES2	SU22	PROC13		
IU342	ES2	SU22	PROC13	PC12	
IU343	ES2	SU22	PROC13	PC18	
IU344	ES2	SU22	PROC13	PC30	
IU345	ES2	SU22	PROC13	PC35	
IU346	ES2	SU22	PROC13	PC4	
IU347	ES2	SU22	PROC14		
IU348	ES2	SU22	PROC15	PC21	
IU349	ES2	SU22	PROC16	PC12	
IU350	ES2	SU22	PROC16	PC22	
IU351	ES2	SU22	PROC19		
IU352	ES2	SU22	PROC19	PC4	
IU353	ES2	SU22	PROC2		
IU354	ES2	SU22	PROC2	PC20	
IU355	ES2	SU22	PROC2	PC37	
IU356	ES2	SU22	PROC3		
IU357	ES2	SU22	PROC3	PC20	
IU358	ES2	SU22	PROC3	PC37	
IU359	ES2	SU22	PROC4		
IU360	ES2	SU22	PROC4	PC20	
IU361	ES2	SU22	PROC4	PC37	
IU362	ES2	SU22	PROC5		
IU363	ES2	SU22	PROC5	PC12	
IU364	ES2	SU22	PROC5	PC18	
IU365	ES2	SU22	PROC5	PC22	
IU366	ES2	SU22	PROC5	PC30	
IU367	ES2	SU22	PROC7		
IU368	ES2	SU22	PROC8		
IU369	ES2	SU22	PROC8	PC20	
IU370	ES2	SU22	PROC8	PC35	
IU371	ES2	SU22	PROC8	PC37	
IU372	ES2	SU22	PROC8a		
IU373	ES2	SU22	PROC8b		
IU374	ES2	SU22	PROC8b	PC12	
IU375	ES2	SU22	PROC8b	PC18	
IU376	ES2	SU22	PROC8b	PC22	
IU377	ES2	SU22	PROC8b	PC30	
IU378	ES2	SU22	PROC9		
IU379	ES2	SU22	PROC9	PC20	
IU380	ES2	SU22	PROC9	PC37	
IU381	ES3	SU21		PC10	
IU382	ES3	SU21		PC12	
IU383	ES3	SU21		PC22	

Identified Use	Exposure Scenario	SU	PROC	PC	AC
IU384	ES3	SU21		PC35	
IU385	ES3	SU21		PC8	
IU386	ES3	SU21		PC9a	
IU387	ES3	SU21		PC10	AC12-1
IU388	ES3	SU21		PC10	AC12-2
IU389	ES3	SU21	PROC11	PC22	
IU390	ES3	SU21	PROC11	PC27	
IU391	ES3	SU21	PROC11	PC4	
IU392	ES3	SU21	PROC11	PC8	
IU393	ES3	SU21	PROC13	PC18	
IU394	ES3	SU21	PROC13	PC30	
IU395	ES3	SU21	PROC13	PC4	
IU396	ES3	SU21	PROC15	PC10	
IU397	ES3	SU21	PROC15	PC35	
IU398	ES3	SU21	PROC19	PC22	
IU399	ES3	SU21	PROC19	PC27	
IU400	ES3	SU21	PROC19	PC4	
IU401	ES3	SU21	PROC19	PC8	
IU402	ES3	SU21	PROC3	PC22	
IU403	ES3	SU21	PROC3	PC27	
IU404	ES3	SU21	PROC3	PC8	
IU405	ES3	SU21	PROC5	PC18	
IU406	ES3	SU21	PROC5	PC22	
IU407	ES3	SU21	PROC5	PC27	
IU408	ES3	SU21	PROC5	PC30	
IU409	ES3	SU21	PROC5	PC8	
IU410	ES3	SU21	PROC8	PC22	
IU411	ES3	SU21	PROC8	PC27	
IU412	ES3	SU21	PROC8	PC8	
IU413	ES3	SU21	PROC8b	PC18	
IU414	ES3	SU21	PROC8b	PC30	
IU415	ES3	SU21	PROC9	PC22	
IU416	ES3	SU21	PROC9	PC27	
IU417	ES3	SU21	PROC9	PC8	