



ESSEMAR SPA

SAFETY DATA SHEET

In accordance with Regulation (EC) 1907/2006
(REACH), Annex II

1. IDENTIFICATION OF THE SUBSTANCE AND OF THE COMPANY

1.1 Product identifier

Trade name:	Sulphuric Acid >15% Sulphuric acid may be diluted with water to produce a variety of concentrations for industrial use, and the label must contain the concentration of the substance in the solution, expressed as w/w %
Other names:	Sulphuric acid x%
Chemical name:	SULPHURIC ACID
INDEX number as listed in Annex VI of CLP:	016-020-00-8
EC number:	231-639-5
CAS number:	7664-93-9
REACH registration n:	01-2119458838-20-0105

1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses: (see corresponding ES as attachment to this SDS)	Production of sulphuric acid Use of sulphuric acid as an intermediate in manufacture of inorganic and organic chemicals incl. fertilizers Use of sulphuric acid as a processing aid, catalyst, dehydrating agent, pH regulator Use of sulphuric acid for extractions and processing of minerals, ores Use of sulphuric acid in the process of surface treatments, purification and etching Use of sulphuric acid in electrolytic processes Use of sulphuric acid in gas purification, scrubbing, flue gas scrubbing Use of sulphuric acid in production of sulphuric acid contained batteries Use of sulphuric acid in maintenance of sulphuric acid contained batteries Use of sulphuric acid in recycling of sulphuric acid contained batteries Use of sulphuric acid contained batteries Use of sulphuric acid as laboratory chemicals Use of sulphuric acid in industrial cleaning Mixing, preparation and repackaging of sulphuric acid
Uses advised against:	Any use involving aerosol formation, vapor release (>10 ppm) or risk of splashes to eyes / skin where workers are exposed without respiratory, eye or skin protection

1.3 Details of the supplier of the safety data sheet

Manufacturer/Importer/Supplier:	ESSEMAR Spa – Via San Cassiano 99 – 28069 San martino di Trecate (NO) Tel +39 03217901, fax +39 0321779646
Person responsible for the Safety Data Sheet (with e-mail address)	laboratorio@marchi-industriale.it

1.4 Emergency telephone number

Emergency phone number (Poison centre H24)	Milano – 0266101029 / Napoli – 0817472870 Pavia – 038224444 / Bergamo - 035269469 Roma – 063054343 opp. 06490663
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2. HAZARDS IDENTIFICATION

2.1 Classification of the substance

Classification in accordance with Regulation 1272/2008 (CLP)		
Hazard statement(s):	H314: Skin Corr. 1A	Causes severe skin burns and eye damage
Classification in accordance with Directive 67/548 (DSD)		
Risk phrase(s):	C; R35	Corrosive, Causes severe burns



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2.1.3 Additional information	Risk advice to man and the environment Concentrated sulphuric acid (fuming v acid) forms acidic mists. Both the mist and the solution have a corrosive effect on human tissue. Environmental effects might occur on a local scale by pH effects.			
2.2 Label elements				
Labelling in accordance with Regulation 1272/2008 (CLP)				
Hazard pictogram:				
Signal word		Danger		
Hazard statement(s):		H314 Causes severe skin burns and eye damage		
Precautionary statement(s):		P260: Do not breathe dust/fume/gas/mist/vapours/spray. P264 Wash hands thoroughly after handling P280 Wear protective gloves/protective clothing/eye protection/face protection. P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P310 Immediately call a POISON CENTER or doctor/physician. P405 Store locked up. P501: Dispose of contents/container to permitted recycling or waste destruction company		
In case of a mixture: Labelling in accordance with 1999/45 (DPD)				
Hazard symbol(s):				
Contains:		SULPHURIC ACID		
Risk phrase(s):		C; R35 Corrosive, Causes severe burns		
2.3 Other hazards				
PBT/vPvB criteria:		According to Annex XIII of Regulation (EC) No 1907/2006, no PBT and vPvB assessment has been conducted since the substance is inorganic.		
Other hazards:		None known.		
3. COMPOSITION/INFORMATION ON INGREDIENTS				
Substances				
According to the REACH Regulation the product is a mono-constituent.				
Chemical name	CAS no.	EC no.	IUPAC name	Purity
Sulphuric acid	7664-93-9	231-639-5	Sulfuric acid	>15% <100%
4. FIRST-AID MEASURES				
4.1 Description of first aid measures				
Eye contact:		Immediately wash eyes with plenty of running water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses, if present and easy to do. Seek medical advice if irritation develops and persists.		



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Skin contact:	Wash affected skin area with plenty of water and soap for at least 15 minutes thoroughly while removing contaminated clothing and shoes. Seek medical advice if irritation develops and persists.
Ingestion:	Seek medical advice if the victim feels unwell. Wash out mouth with plenty of water and give plenty of water to drink. Do not induce vomiting. Never give anything by mouth to an unconscious person.
Inhalation:	Remove the victim from exposure into fresh air immediately if adverse effects (e.g. dizziness, drowsiness or respiratory irritation) occur. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. Also seek medical advice if cough or other symptoms appear. Do not use mouth-to-mouth respiration. Seek medical advice immediately when vapors are intensively inhaled.
4.2 Most important symptoms and effects	
Symptoms	corrosive to the eyes, mucous membranes and exposed areas of skin.
Risks	Causes severe skin burns and eye damage
4.3 Indication of any immediate medical attention and special treatment needed	
Remove/Take off immediately all contaminated clothing. Rinse skin/eyes with water/shower. Move out of dangerous area	
5. FIRE-FIGHTING MEASURES	
5.1 Extinguishing media	
Suitable:	All media
Not suitable:	No unsuitable extinguishing media known
5.2 Special hazards arising from the substance or mixture	
Product is nonflammable and does not support combustion. Move away from container and cool with water from a protected position. The product reacts with most metals producing explosive hydrogen gas and sulphur oxides. Sulphuric acid is readily dissociated in water into hydrated protons and sulphur ions	
5.3 Advice for firefighters	
In case of insufficient ventilation wear suitable respiratory equipment Spillages or uncontrolled discharges into watercourses must be IMMEDIATELY alerted to the Environmental Agency or other appropriate regulatory body. Absorb with inert, damp, non-combustible material, then flush area with water. Collect spillage in containers, seal securely and deliver for disposal according to local regulations.	
6. ACCIDENTAL RELEASE MEASURES	
6.1 Personal precautions, protective equipment and emergency procedures	
For personal protection see section 8. Use personal protective equipment. Ensure adequate ventilation	
6.2 Environmental precautions	
Spillages or uncontrolled discharges into watercourses must be IMMEDIATELY alerted to the Environmental Agency or other appropriate regulatory body. Absorb with inert, damp, non-combustible material, then flush area with water. Collect spillage in containers, seal securely and deliver for disposal according to local regulations	
6.3 Methods and material for containment and cleaning up	
Neutralize large spillages with lime or soda ash. Rinse remnant with plenty of water. Refer to section 13 for disposal of spilled material.	
6.4 Reference to other sections	
See section 8 for personal protective equipment and section 13 for waste disposal	



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7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Technical measures/ Precautions:	For personal protection see section 8. The usual precautions for handling chemicals should be observed. Avoid any direct contact with the material and formation of aerosol. Do not breathe gas/fumes/ vapor/spray and avoid contact with skin and eyes. Smoking, eating and drinking should be prohibited in the application area. Product is nonflammable and does not support combustion.
General occupation hygiene:	Do not to eat, drink and smoke in work areas. Wash hands after use. Remove contaminated clothing and protective equipment before entering eating areas.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/ Storage conditions:	No smoking. Keep in a well-ventilated place. Do not store together with alkalies and oxidants. Keep container tightly closed. Store in plastic tanks Eye wash facilities and emergency shower must be available when handling this product For safety, store below: 40 °C
Incompatible products:	Use only metal containers with acid resistand innerlayers, product may be corrosive to metals.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Regulated occupational exposure limit values:

Components	CAS-No.	Value	Control parameters	Update	Form of exposure
Sulfuric acid	7664-93-9	STEL (15 min) TWA 8 hours	0,05 mg/m ³ 0,1 mg/m ³	recent	aerosols mist and gas
Further information	STEL and TWA for sulphuric acid are derived and are EU Indicative Occupational Exposure Limits (1994)				

Recommended occupational and consumer exposure limit values (following from the performed CSA):	DNEL: Acute inhalation exposure: the SCOEL recommends a STEL (15 min) of 0,1 mg/m ³ long term inhalation exposure: the SCOEL recommends a TWA 8 hour of 0,05 mg/m ³ PNEC: PNEC aqua (marine water): 0,002 mg/L PNEC aqua (freshwater): 0,0025 mg/L
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8.2 Exposure controls

Appropriate engineering controls:	Effective exhaust ventilation system Ensure that eyewash stations and safety showers are close to the workstation location. Attachd Exposure Scenarios provide a 360 days/year exposition.
Environmental exposure controls:	Dispose of rinse water in accordance with local and national regulations.

Individual protection measures, such as personal protective equipment

Respiratory protection:	Provide extract ventilation to material transfer points and other openings. Carry out in a vented booth provided with laminar airflow. Automate activity where possible. Wear acid vapour mask (eg DIN 3181 ABEK)
Hand protection:	Wear suitable gloves tested to EN374 (e.g. PVC or rubber gloves)
Eye protection:	Use safety eyewear designed to protect against splash of liquids. Tightly fitting safety goggles.
Skin and body protection:	Protective suit, apron and boots. Choose body protection according to the amount and concentration of substance at the work place
Hygiene measures:	Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. When using do not smoke.



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	Wash hands before breaks and at the end of workday. Plan first aid action before beginning work with this product.
General advice Air Soil Water	Do not flush into surface water or sanitary sewer system. Do not flush into surface water or sanitary sewer system.Hose down gases, fumes and/or dust with water. Avoid subsoil penetration.Do not let product enter drains.
9. PHYSICAL AND CHEMICAL PROPERTIES	
9.1 Information on basic physical and chemical properties	
Appearance:	Colourless to brown, viscous liquid.
Odour:	odourless
pH (20°C)	<0,3
Melting/Freezing temperature:	Depends on concentration (from -37°C conc. 65% to +11 °C conc. 100%)
Boiling temperature:	Depends on concentration (from 106°C conc. 25% to 315°C conc. 98%)
Flash-point:	Not relevant as the substance is an inorganic solid.
Flammability:	Non flammable (based on molecular structure)
Explosive properties:	Not explosive
Oxidizing properties:	Not oxidising
Vapour pressure:	Depends on concentration (from 214 Pa conc. 65% to 6 Pa conc. 90% - at 20°C)
Relative density (D4 (20)):	>1835 kg/m ³ (20 °C) (conc. al 100%)
Solubility in water:	Completely miscible at ca. 20 °C
Partition coefficient n-octanol/water:	Not relevant as the substance is inorganic, but considered to be low (based on high water solubility)
Viscosity:	Damic: ca. 22,5 mPa.s at ca. 20 °C (conc. 95%)
9.2 Other information	
10. STABILITY AND REACTIVITY	
10.1 Reactivity Stable under recommended storage and handling conditions (see section 7, handling and storage).	
10.2 Chemical stability Reaction with strong oxidising agents. Reaction with alkaline substances (bases).	
10.3 Possibility of hazardous reactions The product reacts with metals with evolution of highly flammable hydrogen. The acid reacts violent with alkalies with evolution of heat.	
10.4 Conditions to avoid Any use involving aerosol formation or vapor release in excess of 0,05 mg/m ³ where workers are exposed without respiratory protection. Any use carrying a risk of splashes to eyes / skin where workers are exposed without eye/skin protection	
10.5 Incompatible materials Metals, oxidant, alkali, hydrochloric acid	
10.6 Hazardous decomposition products Sulphur oxides / Hydrogen.	
11. TOXICOLOGICAL INFORMATION	
11.1 Information on toxicological effects	



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Sulphuric acid is a strong, highly corrosive acid. The substance only causes local effects and no systemic effects. It rapidly dissociates almost completely in contact with water, releasing the sulphur ion and the hydrogen ion which combines with water to form the hydronium ion. Both sulphur and hydronium ions are normally present in the body.

ACUTE TOXICITY	
Acute oral toxicity:	Rat Oral LD50 2140 mg/kg bw
Acute dermal toxicity:	No data available
Acute inhalation toxicity:	Sulfuric acid was severely irritating to the eyes, mucous membranes and exposed areas of skin. Aerosol data LC ₅₀ : (rat) 375 mg/m ³ LC ₅₀ (mouse – 4 h exposition): 0,85 mg/L air LC ₅₀ (mouse – 8 h exposition): 0,60 mg/L air LC ₅₀ (rabbit – 7 h exposition): 1,61 mg/L air Vapour data: LC ₅₀ : (rat - 2 h exposition): 0, 51 mg/L air LC ₅₀ (mouse – 2 h exposition): 0, 32 mg/L air
LOCAL EFFECTS	
Skin irritation:	Corrosive. Studies with results indicating corrosivity to the skin
Eye irritation:	Risk of serious damage to eyes (not reversible)
Skin sensitization:	Not sensitizing (OECD 406)
OTHER	
Repeated dose toxicity	Oral: No data available from repeated dose oral studies with sulphuric acid Dermal: No data available from repeated dose dermal studies with sulphuric acid. Inhalation: Sub-chronic inhalation NOAEC is 150 ppm for rats/mice, 30-90-days, 12-23,5 hours/days Chronic inhalation NOAEL is 10 mg/m ³ for rats/mice, 26-weeks, 6 hours/days, 5 days/week.
Mutagenicity:	Not mutagenic, not clastogenic
Reproductive toxicity:	No data available
Carcinogenicity:	The available animal data do not support the classification of sulphuric acid for carcinogenicity
12. ECOLOGICAL INFORMATION	
12.1 Toxicity	
It is accepted that the aquatic toxicity of sulphuric acid results if sufficient acid is present to produce a very low pH (i. e. pH 3-5). Given that the environmental exposure assessment shows insignificant perturbation of aquatic pH levels from the formulation of the product and its proposed use, it is considered that there is no long-term risk to aquatic organisms and therefore chronic fish effects data are not required.	
Fish (short-term):	96-h LC ₅₀ : 16-28 mg/l (pH 3,25-3,5)
Fish (long-term):	EC10/LC10 o NOEC : 0,025 mg/L
Daphnia magna (short-term):	48-h EC ₅₀ : >100 mg/l (OECD 202)
Daphnia magna (long-term):	EC10/LC10 o NOEC : 0,15 mg/L
Algae:	72-h ErC ₅₀ : > 100 mg/l
M factor	10
Inhibition of microbial activity:	No available data



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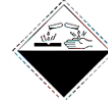
12.2 Persistence and degradability			
Biodegradation:	As the active substance, is an inorganic compound, which is not biologically degradable, the ready biodegradability, inherent biodegradability and biodegradation in seawater are scientifically impossible to perform. In addition, the proposed use of sulphuric acid is not expected to lead to significant releases to marine water.		
Hydrolysis:	Due to its intrinsic properties, it is scientifically impossible to perform a hydrolysis test. In addition, since the behaviour of sulphuric acid in water is known, it is also not scientifically necessary		
12.3 Bioaccumulative potential			
Bioconcentration factor (BCF):	No bioaccumulation expected.		
12.4 Mobility in soil			
Adsorption coefficient:	Terrestrial compartment is not expected to be relevant. If emitted to soil, adsorption to soil particles will be negligible. Depending on the buffer capacity of the soil, H ⁺ will be neutralized in the soil pore water by natural organic or inorganic matter or the pH may decrease.		
12.5 Results of PBT and vPvB assessment			
The substance does not fulfil all criteria to be classified as a PBT or vPvB substance			
Persistence Assessment			
The substance can be regarded as non biodegradable in the aquatic and terrestrial environment. The test results suggest that the substance is persistent. Therefore the criteria for the P classification are met.			
Bioaccumulation Assessment			
The substance is considered cationic at environmental pH levels, the log Kow was calculated to a value of -1. Following the Annex VIII Guidance this value does not impose any bioaccumulation potential			
13. DISPOSAL CONSIDERATIONS			
Waste from residues:	Do not dispose of waste into sewer. Do not contaminate ponds, waterways or ditches with chemical or used container. Hazardous waste CER code 06 01 01 Do not dispose of waste into sewer. Do not contaminate ponds, waterways or ditches with chemical or used container. All contaminated waste water must be processed in an industrial or municipal wastewater treatment plant that incorporates both primary and secondary treatments Site should have a spill plan to ensure that adequate safeguards are in place to minimize the impact of episodic releases.		
Container:	Empty remaining contents. Contaminated packaging According to local regulations		
14. TRANSPORT INFORMATION			
ADR UN Number: 1830 / 2796 UN proper shipping name: Sulphuric acid >51% / Sulphuric acid <51% (for battery) Transport hazard class: 8 Classification Code: C1 Packing group: II Label: 8 Tunnel restriction code: (E) Hazard identification n. : 80 Environmentally hazardous: no	IATA UN number: 1830 / 2796 UN proper shipping name: Sulphuric acid >51% / Sulphuric acid <51% (for battery) Transport hazard class: 8 Packing group: II Labels: 8 Packing instruction (cargo aircraft): no Packing instruction (passenger aircraft): no Packing instruction (LQ): no Environmentally hazardous: no	IMDG UN number: 1830 / 2796 UN proper shipping name: Sulphuric acid >51% / Sulphuric acid <51% (for battery) Transport hazard class: 8 Packing group: II Labels: 8 EmS Number: 8-06 Marine pollutant: no	RID UN Number: 1830 / 2796 UN proper shipping name: Sulphuric acid >51% / Sulphuric acid <51% (for battery) Transport hazard class: 8 Classification Code: C1 Packing group: II Label: 8 Hazard identification n. : 80 Environmentally hazardous: no



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15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulation/legislation specific for the substance or mixture:

15.2 Chemical safety assessment:

Chemical Safety Assessments have been carried out for these substances.

16. OTHER INFORMATION

The information provided in this safety data sheet is correct to the best of our knowledge, information, and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any proceed, unless specified in the text.

Specific concentration limits:
≥15% Skin Corr. 1A
≥5 <15% Skin Irrit 2 – Eye Irrit. 2

Version:

1.0

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n.a.

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This version replaces all previous documents

Created/Revised by:

SILC FERTILIZZANTI SRL – Via delle Acque, 43 – 48124 Ravenna



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ANNEX

ES 1 Production of sulphuric acid

Exposure scenario

Sector of Use:
Not applicable

Product Category:
Not applicable

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

Environmental Release Category:

ERC01: Manufacture of Substances

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The production of sulphuric acid is generally a continuous production, with the process running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with production continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to the specialised systems and closed nature of the production process.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	1,200,000 t/y	Worst case production site
Emission days per site	Up to 365 d/y	Estimate number of emission days, based on continuous production

Operational conditions and risk management measures related to product characteristics

Product Characteristics

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	25 – 100 %	



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Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Risk management measures

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors.
Local exhaust ventilation if required	Effectiveness : Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to



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Information type	Data field	Explanation
		minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated by on site WWTP which will be neutralised before it reaches the biological tower of the WWTP or will be treated on site by chemical neutralisation methods before release to the municipal STP or to the environment.
Resulting fraction of initially applied amount in waste water released from site to the external sewage system	Varies depending on system.	The neutralisation process is extremely efficient and pH monitors are in place to ensure that complete neutralisation and removal have taken place.
Air emission abatement	Effectiveness: Adequate measures in place	Exhaust gases may be treated by scrubbers or emissions may be measured and controlled according to local legislation.
Resulting fraction of applied amount in waste gas released to environment	33 kg/d	Worst case measured values. This value has been inputted into the environmental risk assessment and is determined to be safe for the environment. As such the actual release will pose no threat to the environment.
Onsite waste treatment	Effectiveness: complete	The waste water neutralisation process is extremely efficient with almost total neutralisation achieved. pH alarms are in place to ensure that successful neutralisation has taken place.
Effluent (of the waste water treatment plant) discharge rate	2000 m ³ /d	Default: 2.000 m ³ /d
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	0.01%	In the second tier assessment 99.99% removal by neutralization has been considered.

Exposure estimation

The assessment of worker exposure to sulphuric acid from production (ES1) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement was carried out using the Advanced REACH Tool (ART). Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

The ECETOC exposure estimation is considered to be unsatisfactory and is not considered relevant for risk characterisation



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purposes.

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,2,3,4	Hot processes (50-150°C)
	PROC 8a,8b, 9	Room temperature (15-25°C)
Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,4,8a,8b,9	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	All	Transfer of liquid products
Containment	PROC 1,2,3,9	Handling reduces contact between product and adjacent air
	PROC 4	Open process, submerged loading
	PROC 8a,8b	n/a
Localised controls	PROC 1,3,8b,	Vapour recovery systems; LEV
	PROC 2,4,9	Vapour recovery
	PROC 8a	None
Segregation	PROC 1,2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,3,8b,9	Process fully enclosed – not breached for sampling
	PROC 2,4,8a,	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2, 8a, 8b	Outdoors not close to buildings
	PROC 3,4	Outdoors near to buildings
	PROC 9	Indoors, any sized room, only good natural ventilation



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Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Production (High integrity closed system, sampling via closed loop)	1	Liquid	8.2 x 10 ⁻¹⁰	9.3 x 10 ⁻⁹	3.6 x 10 ⁻⁹	9.4 x 10 ⁻⁹
Production and sampling (Occasional exposure system)	2	Liquid	8.2 x 10 ⁻⁹	9.2 x 10 ⁻⁸	3.6 x 10 ⁻⁸	9.2 x 10 ⁻⁸
Production, transfer and sampling	3	Liquid	3.7 x 10 ⁻⁵	4.2 x 10 ⁻⁴	1.6 x 10 ⁻⁴	4.2 x 10 ⁻⁴
Production, transfer and sampling (Exposure likely)	4	Liquid	1.2 x 10 ⁻³	1.4 x 10 ⁻²	5.4 x 10 ⁻³	1.4 x 10 ⁻²
Loading/transfer	8a	Liquid	2.0 x 10 ⁻³	2.3 x 10 ⁻²	8.8 x 10 ⁻²	2.3 x 10 ⁻²
Loading/transfer	8b	Liquid	1.1 x 10 ⁻⁵	1.2 x 10 ⁻⁴	4.8 x 10 ⁻⁵	4.8 x 10 ⁻⁶
Loading/transfer (Small containers)	9	Liquid	8.1 x 10 ⁻⁴	3.2 x 10 ⁻³	3.2 x 10 ⁻³	2.8 x 10 ⁻³

Consumer exposure

Consumers are not directly exposed to sulphuric acid during the processes associated with ES1 as this exposure scenario involves only closed industrial processes.

Environmental releases

The environmental releases are determined primarily by tonnage and the ERC in the first tier with conservative estimations and defaults being implemented by the terms of the ERC. For the second tier assessment in EUSES refined inputs are chosen to best suit the description of the production and uses of sulphuric acid. Emission defaults are those specified by the ECHA "Guidance on information requirements and chemical safety assessment: Chapter R.16: Environmental Exposure Estimation". Regional data and emission fractions were calculated using EUSES. Full EUSES inputs are shown below.

EUSES inputs for production of sulphuric acid

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Production		
Environmental Release Class	ERC1		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	300
Default Release to Air	5	%	5



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Input parameter:	Value:	Unit:	ERC default (if applicable)
Default Release to water	6	%	6
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	Local: 1.2 Regional: 19	Million tonnes/annum	Worst case local tonnage for any one site is 1.2 million tpa. The total EU production tonnage is 19 million. For the purposes of a worst case regional assessment this tonnages has been employed as the regional tonnage.

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the generation and use of sulphuric acid.

RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous production
Sludge removal	Sludge removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.
Measured stack gas emissions	Atmospheric losses of 1.375kg/hour.	Emission to the air of 33.3 kg/day.	Worst case emissions



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ES 2 Use of sulphuric acid as an intermediate in manufacture of inorganic and organic chemicals including fertilizers

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU4: Manufacture of food products

SU6b: Manufacture of pulp, paper and paper products

SU8: Manufacture of bulk, large scale chemicals (including petroleum products)

SU9: Manufacture of fine chemicals

SU14: Manufacture of basic metals, including alloys

Product Category:

PC19: Intermediate

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

Environmental Release Category:

ERC6a: Industrial use resulting in manufacture of another substance (use of intermediates)

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The intermediate use of sulphuric acid is generally a continuous/batch production, with the process running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with activity continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker contact is generally very low as most operations are remotely controlled and sampling/analysis events are of short duration.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	300,000 t/y	Worst case for single site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous production

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	N/A	Sulphuric acid is used up in the process

Remarks or additional information:

As noted previously, use and processing of sulphuric acid involves high temperatures, and high integrity contained systems with little or no potential for exposure. Pipelines and vessels are sealed and insulated. Workers generally operate in a separate control room, with no direct contact to the installations housing the material. Workers involved in sampling and transfer of materials to road tankers



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are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

As described in previous sections use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Note that there is no direct consumer use of sulphuric acid.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides. The outflow is continually analysed for SO₂ content. Typical daily average concentration of SO₂: 625 (range 200 – 770) mg / Nm³. Flow through specific SO₂: <2 kg SO₂ / T H₂SO₄.

Workers involved in use, handling, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Handling of sulphuric acid involves special equipment and controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Local exhaust ventilation if required	Effectiveness : Unknown	Handling of sulphuric acid involves special equipment and controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Handling of sulphuric acid involves special equipment and controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e.



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Information type	Data field	Explanation
		removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated by on site WWTP which will be neutralised before it reaches the biological tower of the WWTP or will be treated on site by chemical neutralisation methods before release to the municipal STP or to the environment.
Resulting fraction of initially applied amount in waste water released from site to the external sewage system	Varies depending on system.	The neutralisation process is extremely efficient and pH monitors are in place to ensure that complete neutralisation and removal have taken place.
Air emission abatement	Effectiveness: Adequate measures in place	Exhaust gases treated by scrubbers .
Onsite waste treatment	Effectiveness: complete	The waste water neutralisation process is extremely efficient with almost total neutralisation achieved. pH alarms are in place to ensure that successful neutralisation has taken place.
Effluent (of the waste water treatment plant) discharge rate	2000 m ³ /d	Default: 2.000 m ³ /d
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used as an intermediate in the manufacture of organic and inorganic chemicals (ES 2) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

The ECETOC exposure estimation is considered to be unsatisfactory and is not considered relevant for risk characterisation purposes.



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Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,2,3,4	Hot processes (50-150°C)
	PROC 8a,8b, 9	Room temperature (15-25°C)
Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,4,8a,8b,9	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	All	Transfer of liquid products
Containment	PROC 1,2,3,9	Handling reduces contact between product and adjacent air
	PROC 4	Open process, submerged loading
	PROC 8a,8b	n/a
Localised controls	PROC 1,3,8b,	Vapour recovery systems; LEV
	PROC 2,4,9	Vapour recovery
Segregation	PROC 8a	None
	PROC 1,2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,3,8b,9	Process fully enclosed – not breached for sampling
	PROC 2,4,8a,	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2, 8a, 8b	Outdoors not close to buildings
	PROC 3,4	Outdoors near to buildings
	PROC 9	Indoors, any sized room, only good natural ventilation



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Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.2 x 10 ⁻¹⁰	9.3 x 10 ⁻⁹	3.6 x 10 ⁻⁹	9.4 x 10 ⁻⁹
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.2 x 10 ⁻⁹	9.2 x 10 ⁻⁸	3.6 x 10 ⁻⁸	9.2 x 10 ⁻⁸
Use in closed batch process (synthesis or formulation)	3	Liquid	3.7 x 10 ⁻⁵	4.2 x 10 ⁻⁴	1.6 x 10 ⁻⁴	4.2 x 10 ⁻⁴
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	1.2 x 10 ⁻³	1.4 x 10 ⁻²	5.4 x 10 ⁻³	1.4 x 10 ⁻²
Loading/transfer	8a	Liquid	2.0 x 10 ⁻³	2.3 x 10 ⁻²	8.8 x 10 ⁻²	2.3 x 10 ⁻²
Loading/transfer	8b	Liquid	1.1 x 10 ⁻⁵	1.2 x 10 ⁻⁴	4.8 x 10 ⁻⁵	4.8 x 10 ⁻⁶
Loading/transfer (Small containers)	9	Liquid	8.1 x 10 ⁻⁴	3.2 x 10 ⁻³	3.2 x 10 ⁻³	2.8 x 10 ⁻³



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ES 3 Use of sulphuric acid as a processing aid, catalyst, dehydrating agent, pH regulator.

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU4: Manufacture of food products

SU5: Manufacture of textiles, leather, fur

SU6b: Manufacture of pulp, paper and paper products

SU8: Manufacture of bulk, large scale chemicals (including petroleum products)

SU9: Manufacture of fine chemicals

SU11: Manufacture of rubber products

SU23: Electricity, steam, gas water supply and sewage treatment

Product Category:

PC20: Products such as ph-regulators, flocculants, precipitants, neutralization agents

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

PROC13: Treatment of articles by dipping and pouring

Environmental Release Category:

ERC06b: Industrial use of reactive processing aids

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The industrial scale of this exposure scenario and the associated use of sulphuric acid is generally a continuous process, running for long periods without interruption, for up to 330 days per year. Operators work a standard shift and normal working week, with work continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to the specialised systems and closed nature of the process.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	100,000 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous use

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98%	Concentrated acid generally used



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Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

As described in previous sections use and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides. The outflow is continually analysed for SO₂ content. Typical daily average concentration of SO₂: 625 (range 200 – 770) mg / Nm³. Flow through specific SO₂: <2 kg SO₂ / T H₂SO₄.

Workers involved in use, handing, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Working with sulphuric acid involves special equipment and high controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Local exhaust ventilation if required	Effectiveness : Unknown	Working with sulphuric acid involves special equipment and high controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid



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Information type	Data field	Explanation
		are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Working with sulphuric acid involves special equipment and high controlled systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated by on site WWTP which will be neutralised before it reaches the biological tower of the WWTP or will be treated on site by chemical neutralisation methods before release to the municipal STP or to the environment.
Resulting fraction of initially applied amount in waste water released from site to the external sewage system	Varies depending on system.	The neutralisation process is extremely efficient and pH monitors are in place to ensure that complete neutralisation and removal have taken place.
Air emission abatement	Effectiveness: Adequate measures in place	Exhaust gases treated by scrubbers.
Resulting fraction of applied amount in waste gas released to environment	274 kg/d	Refinement of atmospheric emissions not required for this exposure scenario. Safe use demonstrated in tier 1. The differences between tier 1 and tier 2 are due only to the alteration of emission days.
Onsite waste treatment	Effectiveness: complete	The waste water neutralisation process is extremely efficient with almost total neutralisation achieved. pH alarms are in place to ensure that successful neutralisation has taken place.
Effluent (of the waste water treatment plant) discharge rate	2000 m ³ /d	Default: 2.000 m ³ /d
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.



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Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used as a processing aid, catalyst, dehydrating agent, pH regulator (ES 3) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

The exposure estimation is considered to be unsatisfactory and is not considered relevant for risk characterisation purposes. As such the refined outputs using the ART model are presented below.

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,2,3,4	Hot processes (50-150oC)
	PROC 8a,8b, 9,13	Room temperature (15-25oC)
Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,4,8a,8b,9,13	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 1,2,3,4,8a,8b,9	Transfer of liquid products
	PROC 13	Activities with open liquid surface or reservoirs
Containment	PROC 1,2,3,9	Handling reduces contact between product and adjacent air
	PROC 4	Open process, submerged loading
	PROC 8a,8b,13	n/a
Localised controls	PROC 1,2,3,8b,	Vapour recovery systems; LEV
	PROC 2,4,9	Vapour recovery
	PROC 8a,13	None
Segregation	PROC 1,2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,3,8b,9	Process fully enclosed – not breached for sampling
	PROC 2,4,8a,13	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2, 8a, 8b	Outdoors not close to buildings
	PROC 3,4	Outdoors near to buildings
	PROC 9,13	Indoors, any sized room, only good natural ventilation



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Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile Value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.20 x 10 ⁻¹⁰	9.30E-09	3.60E-09	9.40E-09
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.20 x 10 ⁻⁰⁹	9.20E-08	3.60E-08	9.20E-08
Use in closed batch process (synthesis or formulation)	3	Liquid	3.70 x 10 ⁻⁰⁵	4.20E-04	1.60E-04	4.20E-04
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	1.2 x 10 ⁻³	0.014	0.0054	0.014
Loading/transfer: Loading and unloading a tanker (non-dedicated site)	8a	Liquid	2.0 x 10 ⁻³	0.023	0.0088	0.023
Loading/transfer: Loading and unloading a tanker (dedicated site)	8b	Liquid	1.10 x 10 ⁻⁰⁵	1.20E-04	4.80E-05	4.80E-06
Loading/transfer (filling small containers with sulphuric acid)	9	Liquid	8.1 x 10 ⁻⁴	0.0032	0.0011	0.0028
Treatment of articles by dipping and pouring (immersion operations)	13	Liquids	4.5x 10 ⁻³	0.018	0.0062	0.016

Consumer exposure

Indirect exposure of humans via the environment (oral)

EUSES inputs for environmental assessment

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use		
Environmental Release Class	ERC 6B		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	300 (bases on tonnage band and use)
Default Release to Air for ERC 6B	0.10	%	0.10
Default Release to Water for ERC 6B	5	%	5



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Input parameter:	Value:	Unit:	ERC default (if applicable)
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	100,000	tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members.

RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous use
Sludge removal	Sludge removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.

Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
6B	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	333 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC6B. No refinement needed.
	Soil (direct only) Agricultural soil	0 kg/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.



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ES 4 Use of sulphuric acid for extractions and processing of minerals, ores

Sector of Use:

SU2a: Mining

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU14: Manufacture of basic metals, including alloys

Product Category:

PC20: Products such as ph-regulators, flocculants, precipitants, neutralization agents

PC40: Extraction agents

Process Categories:

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

Environmental Release Category:

ERC 04: Industrial use of processing aids in processes and products, not becoming part of articles

ERC 06b: Industrial use of reactive processing aids

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The industrial scale processing and extraction of minerals and ores and the associated use of sulphuric acid is generally a continuous large scale industrial process, running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week. Processing would generally continue at the weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	438 t/y	Worst case extraction site
Emission days per site	365 d/y	Estimated number of emission days, based on continuous use

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 %	Generally concentrated sulphuric acid is used initially but it may be diluted somewhat for certain applications and in the formulation of the extraction solution.

Remarks or additional information:

Use of sulphuric acid in the extraction and processing of minerals and ores often involves specialised processes, systems and machinery. Workers involved in extraction work are generally separated from the leaching and extraction heaps and systems with no direct contact to the acid. Workers involved in sampling and transfer of materials (new or waste acids to be recycled) to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.



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Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers involved are either housed in a control room, with no direct contact to the installations housing the extraction material or the leaching is carried out in the open air.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Note that there is no direct consumer use of sulphuric acid associated with its use in the extraction and processing of minerals and ores.

Risk management measures

Exhaust gasses from the formulation process can be filtered and scrubbed; typically this removes >99% of sulphur trioxide and acid mist. As sulphuric acid can be re-used in the processing of minerals and ores captured acid waste may be returned to the leaching heaps and re-used.

Workers involved in use, handing, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions proceeding from the closed systems are scrubbed and may also then be diverted to the wastewater stream. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for residual metal recovery, incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation. Downstream treatment may also take place after these procedures.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. The heap leaching processes in Europe do not take place in the open air usually.



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Information type	Data field	Explanation
Local exhaust ventilation is not required	Effectiveness : Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and processed for residual metal recovery, incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used for extractions and processing of minerals and ores (ES 4) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	All	Hot processes (50-150oC)



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Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,4	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	All	Transfer of liquid products
Containment	PROC 2,3	Handling reduces contact between product and adjacent air
	PROC 4	Open process, submerged loading
Localised controls	PROC 2	Vapour recovery systems; LEV
	PROC 2,4	Vapour recovery
Segregation	PROC 2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 3	Process fully enclosed – not breached for sampling
	PROC 2,4	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 2	Outdoors not close to buildings
	PROC 3,4	Outdoors near to buildings

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.20E-09	9.20E-08	3.60E-08	9.20E-08
Use in closed batch process (synthesis or formulation)	3	Liquid	3.70E-05	4.20E-04	1.60E-04	4.20E-04
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	0.0012	0.014	0.0054	0.014

Indirect exposure of humans via the environment (oral)



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EUSES inputs for extraction and processing of minerals and ores

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use		
Environmental Release Class	ERC 6B and 4		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	330 (manufacturer information)	Days	20
Default Release to Air	ERC 4: 95 ERC 6B: 0.1	%	ERC 4: 95 ERC 6B: 0.1
Default Release to water	ERC 4: 100 ERC 6B: 5	%	ERC 4: 100 ERC 6B: 5
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	438	tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the use of sulphuric acid. RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous use
Sludge removal	Sludge processed for metal recovery, removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.



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Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
6B	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	1.2 kg/d	-	No refinement needed from tier 1, only the number of emission days has been refined.
	Soil (direct only) Agricultural soil	0 kg/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
4	Aquatic freshwater (after STP)	0 kg/d		Based on effective neutralization and pre-treatment
	Release to air	1,140 kg/d		No refinement needed from tier 1, only the number of emission days has been refined.
	Soil (direct only) Agricultural soil	0 kg/d		No directly loss to soil is expected for this ERC and no sludge spreading.



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ES 5 Use of sulphuric acid in the process of surface treatments, purification and etching

Sector of Use:

SU2a: Mining

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU14: Manufacture of basic metals, including alloys

SU15: Manufacture of fabricated metal products, except machinery and equipment

SU16: Manufacture of computer, electronic and optical products, electrical equipment

Product Category:

PC14: Metal surface treatment products, including galvanic and electroplating products

PC15: Non-metal-surface treatment products

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

PROC13: Treatment of articles by dipping and pouring

Environmental Release Category:

ERC06b: Industrial use of reactive processing aids

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The industrial scale use of sulphuric acid as a metallurgical surface treatment and etching agent is generally a continuous process, running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with surface treatment processes continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure should be low and controlled
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	10,000 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous use

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 %	Concentrated acid. Slightly diluted concentrations may also be used

Remarks or additional information:

Use of sulphuric acid as a metallurgical surface treatment and etching agent involves specialised processes used to etch the surface of produced metals and to remove oxidation and surface contamination. High integrity contained systems are utilised with little or no potential for exposure to workers. Transfer pipelines and vessels are sealed and insulated to prevent losses and exposure. Workers involved in metal surface treatment work are generally separated from the treatment areas and systems with no direct contact to the



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installations housing the acid material. Workers involved in sampling and/or transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

As described in previous sections use of sulphuric acid may involve special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the surface treatment of metals using sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Note that there is no direct consumer use of sulphuric acid associated with this exposure scenario.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides. As sulphuric acid can be re-used in the surface treatment process acid waste may be returned to the treatment vessels and re-used in certain situations.

Workers involved in use, handing, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream for further treatment. This significantly lessens the possible emission by atmospheric deposition of atmospheric contaminants to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation to remove metal contamination that may have been picked up during the etching or surface treatment processes.

Downstream treatment may also take place after these procedures.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Working with sulphuric acid involves, special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and



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Information type	Data field	Explanation
		scrubbed and /or filtered.
Local exhaust ventilation is not required	Effectiveness : Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in the process of surface treatments, purification and etching (ES 5) was carried out for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	



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Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,2,3,4	Hot processes (50-150oC)
	PROC 8a,8b, 9,13	Room temperature (15-25oC)
Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,4,8a,8b,9,13	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 1,2,3,4,8a,8b,9	Transfer of liquid products
	PROC 13	Activities with open liquid surface or reservoirs
Containment	PROC 1,2,3,9	Handling reduces contact between product and adjacent air
	PROC 4	Open process, submerged loading
	PROC 8a,8b,13	n/a
Localised controls	PROC 1,2,3,8b,	Vapour recovery systems; LEV
	PROC 2,4,9	Vapour recovery
	PROC 8a,13	None
Segregation	PROC 1,2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,3,8b,9	Process fully enclosed – not breached for sampling
	PROC 2,4,8a,13	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2, 8a, 8b	Outdoors not close to buildings
	PROC 3,4	Outdoors near to buildings
	PROC 9,13	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model



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Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.20E-10	9.30E-09	3.60E-09	9.40E-09
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.20E-09	9.20E-08	3.60E-08	9.20E-08
Use in closed batch process (synthesis or formulation)	3	Liquid	3.70E-05	4.20E-04	1.60E-04	4.20E-04
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	0.0012	0.014	0.0054	0.014
Loading/transfer: Loading and unloading a tanker (non-dedicated site)	8a	Liquid	0.002	0.023	0.0088	0.023
Loading/transfer: Loading and unloading a tanker (dedicated site)	8b	Liquid	1.10E-05	1.20E-04	4.80E-05	4.80E-06
Loading/transfer (filling small containers with sulphuric acid)	9	Liquid	0.00081	0.0032	0.0011	0.0028
Treatment of articles by dipping and pouring (immersion operations)	13	Liquids	0.0045	0.018	0.0062	0.016

Indirect exposure of humans via the environment (oral)

EUSES inputs for surface treatments and etching

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use		
Environmental Release Class	ERC 6B		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	20
Default Release to Air	0.1	%	0.1
Default Release to water	5	%	5
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	10,000	tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case



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measured values obtained from consortium members to cover the use of sulphuric acid.
RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous use
Sludge removal	Sludge processed for metal recovery, removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.



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ES 6 Use of sulphuric acid in electrolytic processes

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU14: Manufacture of basic metals, including alloys

SU15: Manufacture of fabricated metal products, except machinery and equipment

SU17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment

Product Category:

PC14: Metal surface treatment products, including galvanic and electroplating products

PC20: Products such as ph-regulators, flocculants, precipitants, neutralization agents

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

PROC13: Treatment of articles by dipping and pouring

Environmental Release Category:

ERC05: Industrial use resulting in inclusion into or onto a matrix

ERC6b: Industrial use of reactive processing aids

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The large scale use of sulphuric acid in electrolytic processes is generally continuous, running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with work continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	2,306 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous use

Operational conditions and risk management measures related to product characteristics

Product Characteristics

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	95-98 %	This concentration is used to prepare a diluted electrolyte solution.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure



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		is not considered relevant for risk characterisation as it must be prevented in all cases.
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Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material. When open electrolyte baths are used sufficient LEV is in place to preclude exposure.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides and acid mist. The outflow is continually analysed for sulphur oxides and acid mist content.

Workers involved in use, handing, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. Waste stream treatment may also be employed to reduce environmental exposure.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Working with sulphuric acid involves, special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Electrolysis is most commonly taking place not in the open air. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Local exhaust ventilation is not required	Effectiveness : Unknown	Working with sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Workign with sulphuric acid involves, special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed



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Information type	Data field	Explanation
		outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and processed for metal recovery, incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in electrolytic processes (ES6) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,2	Hot processes (50-150oC)
	PROC 8b, 9,13	Room temperature (15-25oC)
Vapour pressure	All	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)



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	PROC,8b,9,13	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 1,2,8b,9	Transfer of liquid products
	PROC 13	Activities with open liquid surface or reservoirs
Containment	PROC 1,2,9	Handling reduces contact between product and adjacent air
	PROC 8b,13	n/a
Localised controls	PROC 1,8b,	Vapour recovery systems; LEV
	PROC 2,9	Vapour recovery
	PROC 13	LE
Segregation	PROC 1,2	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,8b,9	Process fully enclosed – not breached for sampling
	PROC 2,13	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2, 8a, 8b	Outdoors not close to buildings
	PROC 9,13	Indoors, any sized room, only good natural ventilation (however LEV will be employed when needed).

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.20E-10	9.30E-09	3.60E-09	9.40E-09
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.20E-09	9.20E-08	3.60E-08	9.20E-08
Loading/transfer: Loading and unloading a tanker (dedicated site)	8b	Liquid	1.10E-05	1.20E-04	4.80E-05	4.80E-06
Loading/transfer (filling small containers with sulphuric acid)	9	Liquid	0.00081	0.0032	0.0011	0.0028
Treatment of articles by dipping and pouring (immersion operations)	13	Liquids	0.14	0.54	0.19	0.47

Consumer exposure

Indirect exposure of humans via the environment (oral)



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EUSES inputs for sulphuric acid use during electrolytic processes

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use		
Environmental Release Class	ERC 6B and 5		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	100 (based on tonnages band and use)
Default Release to Air	ERC 6B: 0.1 ERC 5: 50	%	ERC 6B: 0.1 ERC 5: 50
Default Release to water	ERC 6B: 5 ERC 5: 50	%	ERC 6B: 5 ERC 5: 50
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	2306	Kilo-tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the generation and use of sulphuric acid. RMMs and measured values for tier 2 assessment. f

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous use
Sludge removal	Sludge removed to metal recovery landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.



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Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
6B	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	6.32 kg/d	-	No refinement needed from tier 1, only the number of emission days has been refined.
	Soil (direct only) Agricultural soil	0 kg/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
5	Aquatic freshwater (after STP)	0 kg/d		Based on effective neutralization and pre-treatment
	Release to air	3,160 kg/d		No refinement needed from tier 1, only the number of emission days has been refined.
	Soil (direct only) Agricultural soil	0 kg/d		No directly loss to soil is expected for this ERC and no sludge spreading.



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ES 7 Use of sulphuric acid in gas purification, scrubbing and flue gas scrubbing.

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU8: Manufacture of bulk, large scale chemicals (including petroleum products)

Product Category:

PC20: Products such as HpHpH-regulators, flocculants, precipitants, neutralization agents

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Environmental Release Category:

ERC07: Industrial use of substances in closed systems

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The purification of gases on an industrial-scale and the associated use of sulphuric acid is generally a continuous treatment process, running for long periods without interruption, on a 24-hour, 7-day per week basis. Operators work a standard shift and normal working week, with work continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	30,000 t/y	Worst case site. In addition to this amount one company has quoted an emission of around 1.5 tonnes per day direct to surface water after contamination removal.
Emission days per site	365 d/y	Estimate number of emission days, based on continuous use

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 %	

Remarks or additional information:

Use of sulphuric acid as an industrial gas purifier often involves specialised corrosion-resistant processes and high pressures and temperatures. High integrity contained systems are utilised to purify the waste industrial waste gases with little or no potential for exposure to workers. Pipelines and vessels are sealed and, if required, insulated. Workers involved are generally separated from the purification or scrubbing systems with no direct contact to the installations housing the material. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario (spillage or human contact), in order to minimise exposure and risks.

Operational conditions related to available dilution capacity and characteristics of exposed humans

As described in previous sections handling of sulphuric acid involves special equipment and high integrity contained systems with little



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or no potential for exposure. Facilities involved in the use of sulphuric acid as a gas purifier or scrubber are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Note that there is no direct consumer use of sulphuric acid associated with this exposure scenario.

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Risk management measures

Waste spent acid or acid exhaust gasses can be filtered and scrubbed themselves; typically this removes >99% of sulphur oxides. Workers involved in use, handing, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment processes designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and the resulting spent acid solution may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation. Downstream treatment may also take place after these procedures.

In addition to these RMMs a case of direct emission of de-contaminated sulphuric acid to surface water exists where around 560 tonnes of sulphuric acid per year is emitted to a large brackish river with a large acid buffering capacity and a very high flow rate. This emission will be considered in section 10 in a qualitative manner.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	The processes associated with sulphuric acid involve special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Local exhaust ventilation is not required	Effectiveness : Unknown	Use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for



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Information type	Data field	Explanation
		exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment. Spent acid solutions are neutralized to circumneutral pH prior to discharge.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill for disposal under regulatory requirements.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.
Buffering capacity and flow rate of receiving waters.	Dilution of acid emissions	Emissions are to a large river with a considerable buffering capacity and a very high flow rate; spent acid solutions are neutralized to circumneutral pH prior to release to receiving waters as required by water discharge permits.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in gas purification, scrubbing and flue gas scrubbing (ES7) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short -term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	



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Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Sulfuric acid only exists as a liquid.
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	All	Hot processes (50-150oC)
Vapour pressure	All	6 Pa – Substance is considered to be low-volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,2	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 8b	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	All	Transfer of liquid products
Containment	PROC 1,2,	Handling reduces contact between product and adjacent air
	PROC 8b	n/a
Localised controls	PROC 1,8b,	Vapour recovery systems; LEV
	PROC 2	Vapour recovery
Segregation	PROC 1,2	Complete segregation of workers in separate control room
FugitiveFugitive emission source	PROC 1,8b	Process fully enclosed – not breached for sampling
	PROC 2	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1,2,8b	Outdoors not close to buildings

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.20E-10	9.30E-09	3.60E-09	9.40E-09
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	8.20E-09	9.20E-08	3.60E-08	9.20E-08
Loading/transfer of sulphuric acid to/from large vessels/containers at dedicated site	8b	Liquid	1.10E-05	1.20E-04	4.80E-05	4.80E-06

Consumer exposure

Consumers are not directly exposed to the sulphuric acid associated with this exposure scenario as the relevant gas purification and scrubbing processes are industrial processes with no release to consumers.



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Indirect exposure of humans via the environment (oral)

Indirect exposure of humans via the environment is expected to be negligible. Sulphuric acid is fully miscible in water and, as such, will not persist in any environmental compartment where indirect exposure of humans could occur. Furthermore none of the uses associated with sulphuric acid involve any targeted environmental emissions or application and the primary receiving compartment is the STP (wastewater treatment facility). Because sulphuric acid dissociates completely. Removal in aqueous solutions to the sulphate ion, removal in a STP does not occur. Therefore, secondary/secondary exposure of the other receiving compartments is not possible/minimal. Similarly contamination of food crops or animals used as human food sources is not possible/envisaged.

EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use		
Environmental Release Class	ERC 7		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	300
Default Release to Air	5	%	5
Default Release to water	5	%	5
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	30,000 (560 tonnes per year emitted to surface water directly in one case)	tonnes/annum	

For the tier 2 assessment of environmental releases, the effects of several RMMs have been investigated alongside the worst case measured values obtained from Sulphuric Acid Consortium members to cover the use of sulphuric acid.



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RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous use
Sludge removal	Small amounts of treatment sludge removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.
River dilution	Emission to large river with a pH of 8 and a flow rate of 2000 M ³ /sec	Dealt with in a qualitative manner in section 10	Capacity of the river expected to sufficiently dilute any emissions of sulfate species (dissociation product of sulfuric acid in an aqueous environment).

Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
7	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	5000 kg/d	-	No refinement needed from tier 1, only the number of emission days has been refined.
	Soil (direct only) Agricultural soil	0 kg/d	-	No directly loss to soil is expected for this ERC and no sludge is released or spread on soils.



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ES 8 Use of sulphuric acid in production of sulphuric acid contained batteries

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

Product Category:

PC0: Other [UCN code E10100 (Electrolytes)]

Process Categories:

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC03: Use in closed batch process (synthesis or formulation)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

Environmental Release Category:

ERC02: Formulation of preparations

ERC05: Industrial use resulting in inclusion into or onto a matrix

Description of activities and processes covered in the exposure scenario

Operational conditions related to frequency, duration and amount of use

The industrial scale production of batteries and the associated use of sulphuric acid is generally a continuous production process, running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with production continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	2,500 t/y	Worst case production site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous production

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 % initially. Diluted to 25 – 40% in electrolyte solution.	

Remarks or additional information:

Use of sulphuric acid in the manufacture of batteries often involves specialised processes designed to limit exposure of workers to the acid itself. High integrity contained systems are utilised with little or no potential for exposure. Pipelines and vessels are sealed and insulated. Workers involved in production work are generally separated from the production machinery and systems with no direct contact to the installations housing the material. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for an 8hr work day in RIP 3.2



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Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid, dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.
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Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

As described in the previous sections, the production of lead acid batteries in which sulphuric acid is used as the electrolyte involves high temperatures, special equipment and high integrity contained systems with little or no potential for exposure. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Note that there is no direct consumer use of sulphuric acid itself associated with this exposure scenario however consumer exposure is considered in later exposure scenarios dealing with the use of the produced batteries..

Risk management measures

Waste acid from battery filling or acid exhaust gasses can be filtered and scrubbed typically this removes >99% of sulphur oxides. Workers involved in production of batteries, and in the handling, sampling and transfer of acids and acid solutions are trained in the procedures and protective equipment is intended to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation. Downstream treatment may also take place after these procedures.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.
Local exhaust ventilation is not required	Effectiveness : Unknown	Use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.



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Information type	Data field	Explanation
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Use of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment. In reality very little if any wastewater is generated.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in production of lead acid batteries containing sulphuric acid (ES 8) was carried out for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	(214 Pa for the diluted electrolyte).
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	PROC 2,3	Liquid (medium viscosity – like oil)
	PROC 4,9	Liquid (low viscosity – like water)
Process temperature	All	Room temperature (15-25oC)
Vapour pressure	All	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	PROC 2,3	0.98



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	PROC 4,9	0.25
Primary emission source proximity	All	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	All	Transfer of liquid products
Containment	All	Handling reduces contact between product and adjacent air
Localised controls	All	LEV
Fugitive emission source	PROC 2	Process fully enclosed – not breached for sampling
	PROC 3,4,9	Not fully enclosed – effective housekeeping practices in place.
Dispersion	All	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	4.00E-04	1.60E-03	5.50E-04	1.40E-03
Use in closed batch process (synthesis or formulation)	3	Liquid	0.0041	0.016	0.0056	0.014
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	0.00034	0.0014	0.00048	0.0012
Loading/transfer (small containers): Filling lead-acid batteries with sulphuric acid electrolyte, diluted 25%	9	Liquid	0.00034	0.0014	0.00048	0.0012

Consumer exposure

Consumers are not directly exposed to sulphuric acid from the battery manufacturing process, as it is an industrial process with no consumer access.

Indirect exposure of humans via the environment (oral)



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EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Production and industrial use		
Environmental Release Class	ERC 2, 5		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	100 (based on tonnage band and use)
Default Release to Air	ERC 2: 2.5 ERC 5: 50	%	ERC 2: 2.5 ERC 5: 50
Default Release to water	ERC 2: 2 ERC 5: 50	%	ERC 2: 2 ERC 5: 50
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	2,500	tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the generation and use of sulphuric acid.

RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous production
Sludge removal	Sludge removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.



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Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
2	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	625 kg/d	-	No refinement needed from tier 1 to demonstrate safe use. As such the tier 1 value is presented here.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
5	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	12,500 kg/d	-	No refinement needed from tier 1 to demonstrate safe use. As such the tier 1 value is presented here.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.



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ES 9 Use of sulphuric acid in maintenance of sulphuric acid contained batteries

Sector of Use:

SU22: Professional uses: Public domain (administration, education, entertainment, services, craftsmen)

Product Category:

PC0: Other [UCN code E10100 (Electrolytes)]

Process Categories:

PROC19: Hand-mixing with intimate contact and only PPE available

Environmental Release Category:

ERC08b: Wide dispersive indoor use of reactive substances in open systems

ERC09b: Wide dispersive outdoor use of substances in closed systems

Operational conditions related to frequency, duration and amount of use

As batteries are sealed articles with a long service life maintenance is required only rarely. However worst case assumptions have been taken into account below in order to demonstrate safe use.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	2,500 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous process

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	25-40%	

Remarks or additional information:

Maintenance of batteries is generally carried out by trained technicians in facilities with exposure and waste treatment procedures in place.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Facilities involved in the maintenance of batteries using sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered.

Risk management measures

Workers involved in handing and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. Waste stream treatment may also be employed to reduce environmental exposure however for this wide dispersive use particular risk management measures are not needed to demonstrate environmental safe use.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Local exhaust ventilation is not required	Effectiveness : Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Other risk management measures related to workers		



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

Information type	Data field	Explanation
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
None required to demonstrate safe use		

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in maintenance of lead acid batteries containing sulphuric acid (ES 9) was carried out for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	214 Pa	For dilute electrolyte solution (based on data for the most dilute mixture available).
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors with LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	PROC 19	240 mins exposure / day; 240 mins non-exposure/day
Product type	PROC 19	Liquid (low viscosity – like water)
Process temperature	PROC 19	Room temperature (15-25oC)
Vapour pressure	PROC 19	Substance is considered to be low volatile, exposure to acid mists is estimated
Liquid weight fraction	PROC 19	0.25
Primary emission source proximity	PROC 19	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 19	Handling of contaminated objects
Localised controls	PROC 19	None
Fugitive emission source	PROC 19	Not fully enclosed – effective housekeeping practices in place
Dispersion	PROC 19	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Hand-mixing with intimate contact: only PPE available	19	Liquid	0.00058	0.0023	0.00079	0.002

Consumer exposure



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

As batteries are sealed articles and as the maintenance of batteries is carried out by trained professionals no significant exposure to consumers is expected.

Indirect exposure of humans via the environment (oral)

EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Wide dispersive use		
Environmental Release Class	ERC 8b and 9b		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (chosen as it is likely that battery maintenance will be carried out at some site within the region on most days due to the small scale but wide dispersive nature of this use)	Days	365
Default Release to Air for worst case ERC	ERC 8B: 0.1 ERC 9B: 5	%	ERC 8B: 0.1 ERC 9B:5
Default Release to water	ERC 8B:2 ERC 9B:5	%	ERC 8B:2 ERC 9B:5
Dilution factor applied for PEC derivation			25 x 10 ⁹ M ³ /year (wide dispersive)
Tonnage assessed	2,500	tonnes/annum	Estimate of single site use

Predicted Releases to the Environment Tier 1

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
8B	Aquatic freshwater (after STP)	13.7kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Release to air	0.686 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
9B	Aquatic freshwater (after STP)	34.2 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC9B.
	Release to air	34.2 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC9B.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.

*The predicted releases were estimated using the EUSES 2.1 program.



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

ES 10 Use of sulphuric acid in recycling of sulphuric acid contained batteries

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

Product Category:

PC0: Other [UCN code E10100 (Electrolytes)]

Process Categories:

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC04: Use in batch and other process (synthesis) where opportunity for exposure arises

PROC05: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Environmental Release Category:

ERC01: Manufacture of Substances

Operational conditions related to frequency, duration and amount of use

As batteries are sealed articles with a long service life maintenance is required only rarely. The case is similar with the recycling of batteries as they are only recycled at the end of their service life period.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	2,500 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous recycling at the site

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	25-40%	

Remarks or additional information:

Recycling of batteries is generally carried out by trained technicians in facilities with exposure and waste treatment procedures in place.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.



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Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Any gas displaced from battery containers during the recycling process is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered for recovery.

Risk management measures

Waste acid from battery recycling that is not to be re-used or waste acid exhaust gases can be filtered and scrubbed typically this removes >99% of sulphur oxides.

Workers involved in recycling of batteries, and in the handling, sampling and transfer of acids and acid electrolyte solutions are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment process designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation. Downstream treatment may also take place after these procedures.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti
Local exhaust ventilation is not required	Effectiveness : Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required



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Information type	Data field	Explanation
		nearby in case of accidental spillage.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP. Extracted acid may also be collected and re-used and thus not directed to waste.	Waste waters are generally treated on site by chemical and/or biological methods before release to the municipal STP or to the environment.
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated or sent to landfill.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used in recycling of lead acid batteries containing sulphuric acid (ES 10) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	214 Pa	For dilute electrolyte solution (based on data for the most dilute mixture available).
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (low viscosity – like water)
Process temperature	All	Room temperature (15-25oC)
Vapour pressure	All	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.25
Primary emission source proximity	All	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 2,4 PROC 2,4, 8a	Transfer of liquid products Transfer of liquid products – falling liquids, 1-10 L/min
Containment	PROC 5 PROC 2	Activities with open surfaces Handling reduces contact between product and adjacent air
	PROC 8a	Handling reduces contact between product and adjacent air – submerged loading
	PROC 4	Open process – submerged loading



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	PROC 5	n/a
Localised controls	All	LEV
Fugitive emission source	All	Not fully enclosed – effective housekeeping practices in place.
Dispersion	All	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	0.00035	0.0014	0.00047	0.0012
Use in batch and other process (synthesis) where opportunity for exposure arises	4	Liquid	0.0012	0.0046	0.0016	0.004
Mixing or blending in batch process for formulation of preparations or articles (multistage and/or significant contact)	5	Liquid	0.0038	0.015	0.0053	0.013
Transfer of 10% sulphuric acid cleaning solution to/from large vessels/containers at non-dedicated facilities	8a	Liquid	0.0017	0.0069	0.0024	0.006

Consumer exposure

As batteries are sealed articles and as the recycling of batteries is carried out by trained professionals no significant exposure is to consumers is expected.

Indirect exposure of humans via the environment (oral)

EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use (recycling)		
Environmental Release Class	ERC1		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes



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Input parameter:	Value:	Unit:	ERC default (if applicable)
Emission events per year	365 (manufacturer information)	Days	100
Default Release to Air for worst casr ERC	5	%	5
Default Release to water	6	%	6
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	2,500	tonnes/annum	

For the tier 2 assessment of environmental releases the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the generation and use of sulphuric acid. RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous recycling process
Sludge removal	Sludge removed to landfill or incinerated.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.

Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
1	Aquatic freshwater (after STP)	0 kg/d	-	Based on effective neutralization and pre-treatment
	Release to air	34.2 kg/d	-	No refinement needed from tier 1 to demonstrate safe use. As such the tier 1 value is presented here.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

ES 11 Use of sulphuric acid contained batteries

Sector of Use:

SU21: Consumer uses: Private households (= general public = consumers)

Article Category:

AC3: Electrical batteries and accumulators

Process Categories:

No PROC as it is a consumer use, however, worst case PROC 19 was used.

PROC19: Hand-mixing with intimate contact and only PPE available

Environmental Release Category:

ERC09b: Wide dispersive outdoor use of substances in closed systems

Operational conditions related to frequency, duration and amount of use

As batteries are sealed articles with a long service life maintenance is required only rarely.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Not applicable as this task is carried out sporadically by the consumer
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	
Annual amount used per site	2,500 t/y	Worst case
Emission days per site	365 d/y	Estimate number of emission days, based on continuous processes

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	25-40%	

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the



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		open air. Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process.
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Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Risk management measures

Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process. Waste stream treatment may also be employed to reduce environmental exposure however for this wide dispersive use particular risk management measures are not needed to demonstrate environmental safe use.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice not required	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process.
Local exhaust ventilation is not required	Effectiveness : Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
None required to demonstrate safe use		

Exposure estimation

Workers exposure

No worker exposure as this is a consumer use.

Consumer exposure



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The assessment of consumer exposure to sulphuric acid during the use of lead acid batteries containing sulphuric acid (ES 11) was carried out based on intermittent exposure similar to that of workers in battery maintenance with the worst case assumption of no localised controls. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	214 Pa	For the diluted electrolyte
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	15 minutes to 1 hour	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	PROC 19	240 mins exposure / day; 240 mins non-exposure/day
Product type	PROC 19	Liquid (low viscosity – like water)
Process temperature	PROC 19	Room temperature (15-25oC)
Vapour pressure	PROC 19	6 Pa – Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	PROC 19	0.25
Primary emission source proximity	PROC 19	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 19	Handling of contaminated objects
Localised controls	PROC 19	None
Fugitive emission source	PROC 19	Not fully enclosed – effective housekeeping practices in place
Dispersion	PROC 19	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Hand-mixing with intimate contact: only PPE available	19	Liquid	0.00058	0.0023	0.00079	0.002

Indirect exposure of humans via the environment (oral)

Indirect exposure of humans via the environment is expected to be negligible. Sulphuric acid is fully miscible in water and, as such, will not persist in any environmental compartment where indirect exposure of humans could occur. Furthermore none of the uses associated with sulphuric acid involve any targeted environmental emissions or application and the primary receiving compartment is the STP. Removal in the STP is expected to be efficient and so secondary exposure of the other receiving compartments is expected to be minimal. Similarly contamination of food crops or animals used as human food sources is not envisaged.



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EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Wide dispersive use		
Environmental Release Class	ERC 9b		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	365 (chosen as it is likely that battery maintenance will be carried out at some site within the region on most days due to the small scale but wide dispersive nature of this use)	Days	365
Default Release to Air for worst case ERC	ERC 9B: 5	%	ERC 9B:5
Default Release to water	ERC 9B:5	%	ERC 9B:5
Dilution factor applied for PEC derivation			25 x 10 ⁹ M ³ /year (wide dispersive)
Tonnage assessed	2,500	tonnes/annum	Estimate of single site use

Predicted Releases to the Environment Tier 1

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
9B	Aquatic freshwater (after STP)	34.2 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC5.
	Release to air	34.2 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC5.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.

*The predicted releases were estimated using the EUSES 2.1 program.



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ES12 Use of sulphuric acid as laboratory chemicals

Sector of Use:

SU22: Professional uses: Public domain (administration, education, entertainment, services, craftsmen)

Product Category:

PC21: Laboratory chemicals

Process Categories:

PROC15: Use as laboratory reagent

Environmental Release Category:

ERC08a: Wide dispersive indoor use of processing aids in open systems

ERC08b: Wide dispersive indoor use of reactive substances in open systems

Description of activities and processes covered in the exposure scenario

Uses would generally be on a smaller scale and would be expected to be highly contained. Generally, acid waste capture and incineration and LEV would be employed to control personal exposure.

Operational conditions related to frequency, duration and amount of use

Duration of use would generally be short and frequency sporadic as sulphuric acid is generally not used as commonly as a laboratory reagents. Amounts would vary depending on the scale but would generally be much smaller than quantities associated with industrial use. Chemists and laboratory workers would generally work under exhaust/fume hoods (LEV) all day when working with sulphuric acid.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	5,000 t/y	Worst case assumption
Emission days per site	365 d/y	Estimate number of emission days, based on continuous use in at least one site per day in any particular catchment. Wide dispersive use

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 %	

Remarks or additional information:

In laboratory settings capture and controlled disposal of waste acids is generally employed. LEV would be used to control gaseous exposure and waste.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2



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Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.
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Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Uses would generally be on a smaller scale and would be expected to be highly contained.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

Laboratory use and handling of sulphuric acid involves special equipment with little or no potential for exposure.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides. Workers involved in handling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. Waste stream treatment may also be employed to reduce environmental exposure however for this wide dispersive use particular risk management measures are not needed to demonstrate environmental safe use for laboratories. Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Uses would generally be on a smaller scale and would be expected to be highly contained. Laboratory workers involved in handling and use of sulphuric acid are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Local exhaust ventilation is not required	Effectiveness : Unknown	Uses would generally be on a smaller scale and would be expected to be highly contained. Laboratory workers involved in handling and use of sulphuric acid are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Uses would generally be on a smaller scale and would be expected to be highly contained. Laboratory workers involved in handling and use of sulphuric acid are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		



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Information type	Data field	Explanation
Risk management measures related to environmental emissions from industrial sites		
None required to demonstrate safe use		

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used as a laboratory chemical (ES12) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	PROC 15	240 mins exposure / day; 240 mins non-exposure/day
Product type	PROC 15	Liquid (medium viscosity – like oil)
Process temperature	PROC 15	Room temperature (15-25oC)
Vapour pressure	PROC 15	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	PROC 15	0.98
Primary emission source proximity	PROC 15	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 15	Transfer of liquids
Localised controls	PROC 15	LEV
Fugitive emission source	PROC 15	Not fully enclosed – effective housekeeping practices in place
Dispersion	PROC 15	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Handling sulphuric acid in a laboratory	15	Liquid	6.8 x 10 ⁻⁵	2.7 x 10 ⁻⁴	9.3 x 10 ⁻⁵	2.3 x 10 ⁻⁴

Consumer exposure

Consumers are not directly exposed to sulphuric acid, as it is either wholly consumed as an intermediate or processing aid and is not designed for release. In the case of ES12 exposure to consumers is not envisaged as sulphuric acid use in the laboratory is specialised and contained.

Indirect exposure of humans via the environment (oral)



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EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Formulation		
Environmental Release Class	ERC 8A and 8B		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	330 (manufacturer information)	Days	20
Default Release to Air	ERC 8A: 100 ERC 8B: 0.1	%	ERC 8A: 100 ERC 8B: 0.1
Default Release to water	ERC 8A: 100 ERC 8B:2	%	ERC 8A: 100 ERC 8B:2
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	5,000	tonnes/annum	

Predicted Releases to the Environment Tier 1

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
8A	Aquatic freshwater (after STP)	1,370 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8A.
	Release to air	1,370 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8A.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
8B	Aquatic freshwater (after STP)	27.4 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Release to air	1.37 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.

*The predicted releases were estimated using the EUSES 2.1 program.

No tier 2 refinements are needed.



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ES 13 Use of sulphuric acid in industrial cleaning.

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

Product Category:

PC35: Washing and cleaning products (including solvent based products)

Process Categories:

PROC02: Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)

PROC05: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

PROC10: Roller application or brushing

PROC13: Treatment of articles by dipping and pouring

Environmental Release Category:

ERC08a: Wide dispersive indoor use of processing aids in open systems

ERC08b: Wide dispersive indoor use of reactive substances in open systems

Description of activities and processes covered in the exposure scenario

In cases of heavy industrial contamination spraying of diluted sulphuric acid may be carried out by trained technicians in controlled environments.

Operational conditions related to frequency, duration and amount of use

Sulphuric acid cleaning would not be required regularly and duration of exposure would be short. Amounts used would vary by requirements and by facility but would generally be many times less than those involved with industrial processes.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Sulphuric acid cleaning would not be required regularly. Amounts used would vary by requirements and by facility but would generally be many times less than those involved with industrial processes.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	5,000 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on wide dispersive uses

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	10 %	Approximate concentration in cleaning products

Remarks or additional information:

Trained technicians wearing suitable protective clothes would apply and use sulphuric acid as an industrial cleaner. Use would involve emission to the STP where removal is expected to be efficient. Emissions are on a wide scale with many small point sources.



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Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Sulphuric acid cleaning would not be required regularly and duration of exposure would be short. Amounts used would vary by requirements and by facility but would generally be many times less than those involved with industrial processes.

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

As the amounts used are low and pre-diluted dilution in the waste stream is expected to be significant. There is no exposure to downstream users or consumers.

Risk management measures

Exhaust gasses may be removed by LEV. Workers involved in using sulphuric acid in industrial cleaning applications are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. Waste stream treatment may also be employed to reduce environmental exposure however for this wide dispersive use particular risk management measures are not needed to demonstrate environmental safe use.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Local exhaust ventilation is not required	Effectiveness : Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Personal protective equipment (PPE)		



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Information type	Data field	Explanation
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Loading and unloading of vessels of sulphuric acid for use in maintenance of batteries is usually performed in the open air. Workers wear protective clothing (face/eye protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
None required to demonstrate safe use		

Waste related measures

Fractions of substance in waste and waste management measures

Information type	Data field	Explanation
Amount of substances in waste water resulting from identified uses covered in the exposure scenario	1370 kg/d	Based on worst case emission to waste waters identified.
Amount of substances in waste resulting from service life of articles	Not applicable	
Type of waste, suitable waste codes	Suitable EWC code(s)	
Type of external treatment aiming at recycling or recovery of substances	None	
Type of external treatment aiming at final disposal of the waste	Incineration or landfill.	
Fraction of substance released into the environment via air from waste handling	Not applicable	
Fraction of substance released into the environment via waste water from waste handling	Not applicable	
Fraction of substance disposed of as secondary waste	Not applicable	

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid used as a heavy duty industrial cleaner (ES 13) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART). When present in cleaning solutions it is expected that sulphuric acid would be present in very small concentrations (certainly less than 10%) and as such a lower concentration has been considered for this exposure scenario. There is no expected exposure to the concentrated acid in this exposure scenario.

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	214 Pa	For dilute cleaning solution (based on data for the most dilute mixture available).
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors with LEV	



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Substance in preparation	1 – 5%	Expected dilution in any products
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Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (low viscosity – like water)
Process temperature	All	Room temperature (15-25oC)
Vapour pressure	All	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.1
Primary emission source proximity	All	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 2,8a,8b,9	Transfer of liquid products
	PROC 5,13	Activities with open liquid surface or reservoirs
	PROC 10	Spreading of liquid products
Containment	PROC 2,8a,9	Handling reduces contact between product and adjacent air
	PROC 5,8b,10,13	n/a
Localised controls	PROC 2,5	LEV
	PROC,8a,8b,9,10,13	none
Fugitive emission source	All	Not fully enclosed – effective housekeeping practices in place
Dispersion	All	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed, continuous process with occasional controlled exposure (including sampling and maintenance)	2	Liquid	1.40E-04	0.00055	1.90E-04	4.80E-04
Mixing or blending in batch process for formulation of preparations or articles (multistage and/or significant contact)	5	Liquid	0.015	0.061	0.021	0.053
Transfer of 10% sulphuric acid cleaning solution to/from large vessels/containers at dedicated facilities	8a	Liquid	0.0014	0.0055	0.0019	0.0048
Transfer of 10% sulphuric acid cleaning solution to/from large vessels/containers at non-dedicated facilities	8b	Liquid	0.0014	0.0055	0.0019	0.0048
Filling small containers with 10% sulphuric acid cleaning solution	9	Liquid	0.0014	0.0055	0.0019	0.0048
Applying 10% sulphuric acid cleaning solutions using brush or roller.	10	Liquid	0.15	0.61	0.21	0.53
Cleaning articles by dipping/immersing in 10% sulphuric acid solution	13	Liquid	1.50E-03	0.0061	2.10E-03	0.0053

Consumer exposure



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In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

Consumers are not directly exposed to sulphuric acid as it is only used for cleaning in a controlled industrial setting.

Indirect exposure of humans via the environment (oral)

EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Industrial use and professional use		
Environmental Release Class	ERC 8A and 8B		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	330 (manufacturer information)	Days	20
Default Release to Air	ERC 8A: 100 ERC 8B: 0.1	%	ERC 8A: 100 ERC 8B: 0.1
Default Release to water	ERC 8A: 100 ERC 8B:2	%	ERC 8A: 100 ERC 8B:2
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Tonnage assessed	5,000	tonnes/annum	

Predicted Releases to the Environment Tier 1

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
8A	Aquatic freshwater (after STP)	1,370 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8A.
	Release to air	1,370 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8A.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.
8B	Aquatic freshwater (after STP)	27.4 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Release to air	1.37 kg/d	-	Predicted values are those calculated by EUSES using the tonnage data and defaults for ERC8B.
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.

*The predicted releases were estimated using the EUSES 2.1 program.

No tier 2 refinements are needed.



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ES 14 Mixing, preparation and repackaging of sulphuric acid

Sector of Use:

SU3: Industrial uses: Uses of substances as such or in preparation at industrial sites

SU10: Formulation [mixing] of preparations and/or re-packaging (excluding alloys)

Process Categories:

PROC01: Use in closed process, no likelihood of exposure

PROC03: Use in closed batch process (synthesis or formulation)

PROC05: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)

PROC08a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

PROC08b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

PROC09: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

Environmental Release Category:

ERC02: Formulation of preparations

Description of activities and processes covered in the exposure scenario

For ES14, the processes utilising sulphuric acid in the manufacture of oleum are largely similar to those discussed for ES1 with regards to the degree of control and system closure. Generally the production and manufacture process would be continuous with use levels ranging between 100 and 500 tonnes per day in a large facility. The large size of the typical facility involved means that all vessels and reactors are housed out-doors or indoors, managed by a small number of operators working in a separate enclosed control room.

Waste and exhaust gases from the manufacture process would generally be filtered and scrubbed (typically this removes >99% of sulphur oxides that may be present). The gaseous outflow is typically continually analysed for waste gases associated with sulphuric acid use. Because of the high temperatures involved in the manufacturing processes (and the nature of sulphuric acid and the produced gases) all reactors and pipelines are sealed and insulated, to prevent loss of the reaction materials and maintain the necessary temperatures, and to protect the workforce and the environment.

Loading and unloading of tankers with sulphuric acid or oleum is usually performed in the open air. Workers wear protective clothing (face/eye protection, respiratory protection, helmet, anti-acid gloves boots and protective overall). A safety shower is required nearby in case of accidental spillage. Gas displacement lines are also used if filling of road tankers takes place under cover.

Operational conditions related to frequency, duration and amount of use

The industrial scale production of oleum is generally a continuous production process, running for long periods without interruption, for up to 365 days per year. Operators work a standard shift and normal working week, with production continuing at weekends.

Duration, frequency and amounts

Information type	Data field	Explanation
Use amount per worker [workplace] per day	No data	Worker exposure considered to be negligible due to specialised systems.
Duration per day at workplace [for one worker]	8hr/d	Standard number of hours in one work day
Frequency at workplace [for one worker]	220 d/year	Standard number of work days / year
Other determinants related to duration, frequency and amount of use	Intermittent contact is expected	These tasks rarely take a full 8hr / day so worst case is assumed.
Annual amount used per site	300,000 t/y	Worst case site
Emission days per site	365 d/y	Estimate number of emission days, based on continuous process

Operational conditions and risk management measures related to product characteristics

Product Characteristic

Information type	Data field	Explanation
Type of product the information relates to	Substance as such	The product is in liquid form in a sealed tank container.
Physical state of product	Liquid	
Concentration of substance in product	98 %	



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Remarks or additional information:

Use of sulphuric acid during mixing, preparation, re-packaging or in the manufacture of oleum often involves specialised processes and high temperatures. High integrity contained systems are utilised with little or no potential for exposure. Pipelines and vessels are sealed and insulated. Workers involved are generally separated from the production machinery and systems with no direct contact to the installations housing the material. Workers involved in sampling and transfer of materials to road or rail tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.

Operational conditions related to available dilution capacity and characteristics of exposed humans

Respiration volume and skin contact under conditions of worker uses

Information type	Data field	Explanation
Respiration volume under conditions of use	10m ³ /d	Default value for a worker breathing for a 8hrs work day in RIP 3.2
Skin contact area with the substance under conditions of use	480cm ² (ECETOC default)	Please note that due to the corrosive nature of sulphuric acid dermal exposure is not considered relevant for risk characterisation as it must be prevented in all cases.

Conditions leading to dilution of initial release related to human health

Information type	Data field	Explanation
Room size and ventilation rate	NA	Not relevant as workers work in a control room, with no direct contact to the installations housing the material

Conditions leading to dilution of initial release related to environment

Information type	Data field	Explanation
Discharge volume of sewage treatment plant	2000 m ³ /d	EUSES default value for standard local STP
Available river water volume to receive the emissions from a site	20,000 m ³ /d	Standard ERC flow rate leading to a 10 fold dilution in receiving waters.

As described in previous sections industrial use of sulphuric acid can involve high pressures or temperatures, special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Any gas displaced from containers is conducted via pipeline to be processed i.e. removed and scrubbed and /or filtered. Note that there is no direct consumer use of sulphuric acid associated with this exposure scenario.

Risk management measures

Exhaust gasses can be filtered and scrubbed; typically this removes >99% of sulphur oxides. The outflow is continually analysed for SO₂ content. Typical daily average concentration of SO₂: 625 (range 200 – 770) mg / Nm³. Flow through specific SO₂: <2 kg SO₂ / T H₂SO₄.

Workers involved in use, handling, sampling and transfer of materials are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks. This may include chemical resistant clothing, goggles and respiratory equipment where required.

Environmental emissions are limited by designated waste treatment processes designed to limit environmental exposure to all relevant compartments. Waste gas emissions are scrubbed and may also then be diverted to the wastewater stream. This significantly lessens the possible emission by atmospheric deposition to soil or surface waters. Liquid wastes are treated (neutralisation to neutral pH) prior to emission to remove any sulphuric acid in the waste water and sludge from the waste water treatment plant is sent for incineration or landfill and is not used for agricultural spreading. This precludes any contamination of soil by sludge spreading. Waste water treatment is usually carried out by neutralisation followed by flocculation or decantation.

Risk management measures for industrial site

Information type	Data field	Explanation
Containment and local exhaust ventilation		
Containment plus good work practice required	Effectiveness: Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually



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Information type	Data field	Explanation
		housed outdoors.
Local exhaust ventilation is not required	Effectiveness : Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors.
Personal protective equipment (PPE)		
Type of PPE (gloves, respirator, face-shield etc)	Effectiveness: Unknown	Production and handling of sulphuric acid involves special equipment and high integrity contained systems with little or no potential for exposure. Facilities involved in the production and uses of sulphuric acid are usually housed outdoors. Workers involved in sampling and transfer of materials to road tankers are trained in the procedures and protective equipment is intended to cope with the worst case scenario, in order to minimise exposure and risks.
Other risk management measures related to workers		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
Onsite pre-treatment of waste water	Chemical pre-treatment or onsite STP.	Waste waters are generally treated on site by chemical neutralisation methods before release to the municipal STP or to the environment.
Resulting fraction of initially applied amount in waste water released from site to the external sewage system	Varies depending on system.	The neutralisation process is extremely efficient and pH monitors are in place to ensure that complete neutralisation and removal have taken place.
Air emission abatement	Measured emissions of waste gas	Exhaust gases treated by scrubbers .
Resulting fraction of applied amount in waste gas released to environment	1%	99% of waste gas removed by scrubbing
Onsite waste treatment	Effectiveness: complete	The waste water neutralisation process is extremely efficient with complete neutralisation achieved. pH alarms are in place to ensure that successful neutralisation has taken place.
Effluent (of the waste water treatment plant) discharge rate	2000 m ³ /d	Default: 2.000 m ³ /d
Recovery of sludge for agriculture or horticulture	No	All sludge is collected and incinerated and sent to landfill or recycled for reuse of recovered metals, if any.
Resulting fraction of initially applied amount in waste water released from site	Less than 0.01%	In the second tier assessment removal by neutralization has been considered.

Exposure estimation

Workers exposure

The assessment of worker exposure to sulphuric acid following mixing, preparation and repackaging of sulphuric acid (ES14) was carried for processes relevant to this use scenario as identified by PROC codes. Initially, a screening-level (Tier 1) assessment was



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carried out using the ECETOC Targeted Risk Assessment (TRA) model. A higher tier (Tier 2) refinement of the Tier 1 assessment was carried out using the Advanced REACH Tool (ART).

Acute/short-term and long-term exposure

Parameters used in the ECETOC TRA model to conduct a Tier 1 assessment of inhalation exposure concentrations

	Parameter	Explanation/source of data
Molecular weight	98.08 g/mol	
Vapour Pressure	6 Pa	
Water solubility	mg/L	
Is the substance a solid?	No – liquid	
Dustiness during process	n/a	Only in the case of solid
Duration of activity	>4 hours (default)	
Use of ventilation	Indoors without LEV	

Parameters and assumptions used in the ART model to conduct a Tier 2 assessment of inhalation exposure concentrations

	PROC	Parameters/ assumptions
Exposure duration	All	480 mins
Product type	All	Liquid (medium viscosity – like oil)
Process temperature	PROC 1,3	Hot processes (50-150oC)
	PROC 5,8a,8b, 9	Room temperature (15-25oC)
Vapour pressure	All	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	All	0.98
Primary emission source proximity	PROC 1,	Primary emission source is not located in the breathing zone of the worker - the assessment for this activity involves a primary far-field emission source only (workers are in a control room)
	PROC 3,5,8a,8b,9	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	PROC 1,3,8a,8b,9	Transfer of liquid products
	PROC 5	Activities with open liquid surfaces
Containment	PROC 1,3,9	Handling reduces contact between product and adjacent air
	PROC 5,8a8b	n/a
Localised controls	PROC 1,3,8b,	Vapour recovery systems; LEV
	PROC 2,9	Vapour recovery
	PROC 5	LEV
Segregation	PROC 1	Complete segregation of workers in separate control room
Fugitive emission source	PROC 1,3,8b,9	Process fully enclosed – not breached for sampling
	PROC 5,8a	Not fully enclosed – effective housekeeping practices in place.
Dispersion	PROC 1, 8a, 8b	Outdoors not close to buildings
	PROC 3	Outdoors near to buildings
	PROC 5,9	Indoors, any sized room, only good natural ventilation

Tier 2 acute/short-term and long-term inhalation exposure concentrations derived using the ART model



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Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m ³)		Estimated Long-term Exposure Concentration (mg/m ³)	
			50 th percentile value	90 th percentile value	50 th percentile value	90 th percentile value
Use in closed process, no likelihood of exposure	1	Liquid	8.20E-10	9.30E-09	3.60E-09	9.40E-09
Use in closed batch process (synthesis or formulation)	3	Liquid	3.70E-05	4.20E-04	1.60E-04	4.20E-04
Mixing or blending in batch process for formulation of preparations or articles (multistage and/or significant contact)	5	Liquid	0.0045	0.018	0.0063	0.016
Transfer of substances from/to vessels/large containers at non-dedicated facilities (exposure can occur)	8a	Liquid	0.002	0.023	0.0088	0.023
Transfer of substances from/to vessels/large containers at dedicated facilities	8b	Liquid	1.10E-05	1.20E-04	4.80E-05	4.80E-06
Transfer of substance into small containers (dedicated filling line - vapour/aerosol control)	9	Liquid	0.00081	0.0032	0.0011	0.0028

Consumer exposure

Consumers are not directly exposed to sulphuric acid during the processes associated with this exposure scenario as this exposure scenario involves only closed industrial processes.

Indirect exposure of humans via the environment (oral)

EUSES inputs

Input parameter:	Value:	Unit:	ERC default (if applicable)
Molecular Weight	98.08	g/mol	
Vapour Pressure (at 20 °C)	0.1	hPa	
Water Solubility	Miscible	mg/L	
Octanol/water partition coefficient	-1 (estimated)	logKow	
Koc	1 (estimated)		
Biodegradability	Not biodegradable (inorganic acids cannot be considered biodegradable)		
Life Cycle Step	Production and industrial use		
Environmental Release Class	ERC2		
Fraction of Tonnage for Region (1 st Tier)			1
STP			Yes
Emission events per year	330 (manufacturer information)	Days	20
Default Release to Air for worst case ERC	2.5	%	2.5
Default Release to water	2	%	2
Dilution factor applied for PEC derivation			10 (20,000 m ³ /d)
Regional tonnage	3 million	tonnes/annum	



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Input parameter:	Value:	Unit:	ERC default (if applicable)
Tonnage assessed	300,000	tonnes/annum	Worst case site formulation value

For the tier 2 assessment of environmental releases, the effects of several RMMs have been investigated alongside the worst case measured values obtained from consortium members to cover the generation and use of sulphuric acid.

RMMs and measured values for tier 2 assessment.

Description of RMM	Details	Effect taken into account in EUSES	Comments
No loss to waste water	0 mg/L	Lowering of concentration in STP effluent to 0 mg/L due to the very efficient neutralization process	Total neutralization to around pH 7.
Emission days	365 emission days per year	Increase emission days by 20%.	Continuous production
Sludge removal	Sludge removed to landfill or incinerated, or recycled.	Concentration in soil due to sludge spreading set to 0.	No contamination of grassland or agricultural soil.
Gas scrubbing	Waste gas scrubbing removes 99% of the emitted sulphur oxides	Reduction of emission to atmosphere	Based on scrubbing and gas removal. The values used in still considerably higher than the highest measured emission and should be considered conservative.

Predicted Releases to the Environment Tier 2

ERC	Compartments	Predicted releases	Measured release	Explanation / source of measured data
2	Aquatic freshwater (after STP)	0 kg/d	-	Based on efficient neutralization
	Release to air	205 kg/d	-	No refinement of the emission amounts is required only the number of emission days have been altered to derive this value
	Soil (direct only) Agricultural soil	0 kd/d	-	No directly loss to soil is expected for this ERC and no sludge spreading.