Safety data Sheet

(drafted pursuant to Reg. (EC) 1907/2006 as amended - art. 31)

SULFURIC ACID

1. Identification of the substance and of the company	
1.1 Product Identifier	
Trade name	**Sulfuric acid** (vitriol, battery acid)
Chemical name	Sulfuric acid > 15%
EC number	231-639-5
CAS number	7664-93-9
Index number	016-020-00-8
REACH registration number:	01-2119458838-20-XXXX

PRODUCT	Ufi CODE
SULPHURIC ACID 17-20	4300-F0DF-3001-AS9W
SULPHURIC ACID 24-27	2M00-G0HT-X000-9TT9
SULPHURIC ACID 38-42	R800-F0S7-Q001-NFG1
SULPHURIC ACID 60-64	CC00-Y0FN-000H-9T23
SULPHURIC ACID 80-84	EE00-G051-A001-Y4N5

1.2 Relevant identified uses of the substance or mixture and uses advised against	
Identified uses (see the corresponding exposure scenario, attached to this MSDS)	Use by workers in industrial environments and use by other professionals Production of the substance Recycling/recovery of the substance Sampling, loading, filling, transfer, unloading, distribution Use of the substance as an intermediate for the synthesis of other chemical formulation of mixtures and re-packaging Use as: pH regulator, flocculant, precipitant, neutralization agent in the production of mixtures such as cleaning and washing products, batteries and electrolytic processes, laboratory reagent Consumer uses: Battery content
Uses advised against	Any use that involves the formation of aerosols, the release of steam or the risk of splashes into eyes/onto skin to which workers who are not equipped with respiratory tract, eyes or skin protective devices, are exposed
1.3 Information on safety data sheet supplier	
Manufacturer	Marchi Industriale Spa – Via Trento, 16 – 50139 Florence (FI) Ph. +39 055475547, fax +39 055496626
e-mail of the person responsible for the MSDS	laboratorio@marchi-industriale.it

1.4 Emergency telephone number

Marco Marano	*CAV "Osp. Bambino Gesù"*	*Rome*	*Piazza Sant'Onofrio, 4*	*06 68593726*
Anna Lepore	*Az. Osp. Univ. Foggia*	*Foggia*	*V.le Luigi Pinto, 1*	*0881-732326*
Gennaro Savoia	*Az. Osp. "A. Cardarelli"*	*Naples*	*Via A. Cardarelli, 9*	*081-7472870*
M. Caterina Grassi	*CAV Policlinico "Umberto I"*	*Rome*	*V.le del Policlinico, 155*	*06-49978000*
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2. Identification of hazards

2.1 Substance classification:

Pursuant to EC Regulation 1272/2008 (CLP)

Classification/ Hazard statements	Corrosive to the skin (cat. 1A) H314	Causes severe skin burns and eye injuries

Other information

Risk advice for man and the environment. Sulfuric acid has a corrosive effect on human tissues, with the possibility of damage to the respiratory tract, the eyes, the skin, and the intestine. Environmental effects may occur on a local level due to the pH. The full text of the hazard statements (H) is given in section 16.

2.2 Label elements

Labeling pursuant to Regulation 1272/2008 (CLP)

Hazard symbols		
Danger indication		Danger
Hazard statements	H314	Causes severe skin burns and eye injuries
Safety phrases	P280 P301+P330+P331 P305+P351+P338 P303+P361+P353 P304+P340 P310 The complete list of the P precautionary statements is given in section 16	Wear protective gloves/clothing/Protect eyes/face IF SWALLOWED: rinse mouth. DO NOT induce vomiting IF IN EYES: rinse continuously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. P303+P361+P353 – IN CASE OF CONTACT WITH THE SKIN (or with hair): take off immediately all contaminated clothing Rinse skin with water/shower IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing Immediately contact a local POISON CONTROL CENTER or a doctor

2.3 Other hazards

PBT/vPvB criteria:	The substance is not considered persistent, bioaccumulative or toxic (PBT)
Other hazards	Not known

3. Composition/information on ingredients

3.1 Substances

Under REACH regulation, the product is a single-component and is not included in the SVHC candidate list

Chemical name	CAS no.	EC no.	Concentration	Classification	Note B, Ann.VI Reg. CE

					1278-2008
Sulfuric acid	7664-93-9	231-639-5	>15% <100%	GHS05/ H314	Skin Corr. 1A; H314: C ≥ 15 %

4. First aid measures

4.1 Description of the first aid measures

General recommendations	In case of exposure or sickness, contact a POISON CENTER or a doctor. Show this safety data sheet to the doctor in attendance. In case of contact with the SKIN (or with hair): take off immediately all contaminated clothing. Rinse skin with water/shower. Move away from the danger zone. IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes, lifting the upper and lower eyelids from time to time. Remove contact lenses, if it is easy to do. Seek medical advice if irritation increases and persists.
Skin contact	Wash thoroughly the affected area of skin with plenty of water for at least 10 minutes and remove contaminated clothing and shoes. Seek medical advice if irritation increases and persists.
Ingestion	Seek medical advice if the victim feels bad. Rinse 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. Seek medical advice if symptoms persist.
Inhalation	Immediately take the victim to fresh air in case of adverse effects (ex. dizziness, drowsiness or irritation of the respiratory tract). If the victim is not breathing, give artificial respiration or if breathing is difficult, administer oxygen and seek medical attention. Do not use mouth-to-mouth ventilation.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	The substance is severely corrosive to the eyes, mucous membranes and exposed skin parts
Risks	Causes severe skin burns and eye injuries

4.3 Indication of any immediate medical attention and special treatment needed

Take off immediately all contaminated clothing. Rinse skin with water/shower. Move away from the danger zone.

5. Fire-Fighting Measures

5.1 Extinguishing means

Suitable	Any means of extinction, however suitable for the circumstances (for example, in case of fire with product spillage, do not use water but carbon dioxide or dry agent)
Not suitable	There are no known restrictions

5.2 Special hazards arising from the substance or mixture

Sulfuric acid is not flammable or combustible. Move away from containers and cool with water from a protected position. The product reacts with most metals producing explosive hydrogen gas and sulfur oxides. The sulfuric acid readily dissociates in water by composing in hydrated protons and sulfur ions.

5.3 Advice for fire-fighters

In case of uncontrolled spillage or discharge into watercourses you should immediately inform the competent local authorities (e.g. Environmental Agency, Local Health Authority, etc.). Collect (dry) with inert and non-combustible materials, then rinse the area with water. The collected substance must be stored in airtight containers and handed over for disposal according to local regulations. Protective equipment for fire-fighters: anti-gas facial masks with universal filter or self-contained breathing apparatus.

6. Measures in case of accidental release.

6.1 Personal precautions, protective equipment and procedures in case of emergency

6.1.1. *For those who do not intervene directly*

Do not take any action if this involves any personal risk or if you don't have suitable training. Remove unnecessary and unprotected personnel. Do not touch or walk on spilled material. Avoid breathing vapors or mists. Wear appropriate protective equipment (see section 8).

6.1.2 For those who intervene directly:

Provide adequate ventilation if the area involved is closed. Wear appropriate protective equipment (see section 8). Avoid aerosol formation and dispersion due to wind. Ensure adequate ventilation. Avoid contact with eyes, skin and clothing.

6.2 Environmental precautions

Keep spillage from entering surface water or sewers. Do not drain directly into a source of water. In case of accidental spill or leakage into drains or waterways, contact your local authorities.

6.3 Methods and materials for containment and remediation:

For recovery or disposal, vacuum or clean, and place spilled material in suitable labelled containers. Clean the affected area with plenty of water. Avoid dispersion due to wind. If you want to neutralize the substance, use sodium carbonate, sodium bicarbonate, sodium hydroxide, with caution.

6.4 References to other sections

See section 8 (personal protective equipment) and section 13 (waste disposal).

7. Handling and storage

7.1 Precautions for safe handling

Technical Measures/precautions	Avoid contact with eyes, skin and clothing. Avoid the formation of aerosols and dispersion due to the wind. Avoid contamination from any source and incompatible materials. Carefully clean the used equipment before carrying out any maintenance or repairs.
General hygiene	Do not put your hands in your eyes during use. Do not eat, drink or smoke in work areas. Remove contaminated clothing and protective equipment before entering dining areas. Carefully remove potentially contaminated clothing and wash it before re-use. Wash hands, arms and face after touching chemical products, before eating, smoking and using the toilet, and at the end of the work shift.

7.2 Conditions for safe storage, including any incompatibility

Technical measures / Storage methods	Keep only in the original container. Keep the container tightly closed in a cool, dry and well-ventilated place. Keep the product away from heat (<40 °C), from direct sunlight, away from incompatible materials (alkalis and oxidants) Materials suitable for packaging: plastic containers
Further information	The product is stable but can be corrosive to metals Do not freeze If metal containers are used, make sure that they are protected against corrosion
Incompatible products	Alkalis and oxidants

7.3 Particular end uses

Please refer to the identified uses and the exposure scenarios

8. Exposure controls/Personal protection

8.1 Control parameters

Occupational exposure limit values regulated:

Component	CS	Values TLV	Control parameters	Update	Form of exposure
Sulfuric acid	7664-93-9	STEL (15 min) TWA (8 hours)	0.1 mg/m³ 0.05 mg/m³	Recent	Aerosol gas mist
Further information		STEL and TWA were recommended by the Expert Scientific Group on Occupational Exposure Limits in 1994			

Exposure limit values for workers and consumers (following the chemical safety assessment performed)

Exposure model	Levels derived without effects (DNEL)	
	Acute (15 minutes)	Long term (8 hours)
Inhalation	0.1 mg/m³	0.05 mg/m³
	Predicted no effect concentration (PNEC) in water	
Sea water	0.002 mg/L	
Running water	0.0025 mg/L	

8.2 Exposure controls

Suitable technical checks

Use adequate and effective ventilation. It is also good practice to provide an eye wash unit and a safety shower near material storage or use areas. The exposure scenarios (attached) refer to a 360-day use per year.

Personal protection measures, personal protective equipment

Respiratory protection	Prepare exhaust points (with air discharge) where material is transferred, and also in other open points. Discharge outdoors in a ventilated cabin with laminar airflow. Automate these activities where possible. Wear mask suitable for acid vapours (e.g. DIN 3181 ABEK). For the proper choice of the device to protect the respiratory tract, refer to the standard EN 529.
Hand protection	Anti-acid protection gloves (e.g.: plastic, rubber, fluoroelastomer) EN374 marked. Recommended thickness: > 0.7 mm
Eye protection	Use goggles to prevent accidental penetration of liquids. Goggles (ref. standard EN 166).
Skin and body protection	Overalls. Choose the most appropriate type according to the quantity and concentration of the substance in the workplace. Wear work clothes with long sleeves and safety footwear for professional use (ref. Directive 89/686/EEC and standard EN ISO 20344).
Additional control measures	Handle in compliance with good industrial and safety hygiene standards. When using do not eat or drink. Do not smoke while using. Wash hands before breaks and at the end of the working day. Prepare appropriate first aid measures before starting to work with this product

Environmental exposure control

Do not discharge into surface water or domestic sewers.
Air: contain gas, fumes and / or dust with water.
Soil: avoid penetration into the subsoil.
Water: prevent the product from entering the drains.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Liquid (colorless if there are no impurities - to dark brown)
Odour	none
pH (20°C)	<0.3

Melting point	Variable depending on the concentration (from -37 °C to 65% to + 11 °C to 100%)
Boiling Point	Variable depending on the concentration (from 106°C to 25% to 315°C to 98%)
Flash point	Not relevant because the substance is an inorganic liquid
Flammability	Non-flammable (depending on the molecular structure)
Vapour pressure	Variable depending on the concentration (from 214 Pa to 65% to 6 Pa to 90% - to 20 °C)
Relative density	>1835 kg/m³ (20 °C) (conc. at 100%)
Solubility in water	Completely miscible at 20 ºC
Partition coefficient n- octanol/water:	Not that relevant because the substance is inorganic
Auto-ignition temperature	There is no spontaneous combustion
Dynamic viscosity	appr. 22.5 mPa.s to appr. 20° C (conc. 95%)
Dissociation constant	c.a. 1,9 pKa
Explosive properties	Non explosive
Oxidizing properties	Non-oxidising

9.2 Other information: nothing to report

10. Stability and reactivity

10.1 Reactivity
Stable under the recommended storage and handling conditions

10.2 Chemical stability

Stable under the conditions recommended for storage and handling, reacts with strong oxidizing agents and with alkaline substances (bases)

10.3 Possibility of dangerous reactions
The product reacts with metals and releases highly flammable hydrogen. The acid reacts violently with alkalis and generates heat, the same happens when water is added.

10.4 Conditions to avoid

Any use that involves the formation of aerosols or the release of steam above 0.05 mg/m³ in the area where workers are exposed, without using adequate respiratory protection. Any use with risk of splashes in the eyes / onto skin in areas where workers are exposed, without adequate eye / skin protection

10.5 Incompatible materials

Metals, fuels, alkalis, chlorates, hydrochloric acid.

10.6 Hazardous decomposition products

Sulfur / hydrogen oxides

11. Toxicological Information

11.1 Information on toxicological effects

Information on the hazard classes defined in Regulation (EC) No. 1272/2008

Toxicological information of the substance:

sulfuric acid> 15% - CAS: 7664-93-9

Acute oral toxicity	LD_{50} oral rat 2140 mg / kg bw (calculated OECD data)
Acute skin toxicity	Data not available
Acute toxicity by inhalation	Sulfuric acid causes severe irritation to the eyes, mucous membranes and exposed parts of the skin. Data on substance in aerosol: LC_{50}: (rat) 375 mg/m³

	LC_{50} (mouse - 4 hours of exposure): 0.85 mg/L air LC_{50} (mouse - 8 hours of exposure): 0.60 mg/L air LC_{50} (rabbit - 7 hours of exposure): 1.61 mg/L air Data on vapour substance: LC_{50}: (rat - 2 hours of exposure): 0.51 mg/L air LC_{50} (mouse - 2 hours of exposure): 0.32 mg/L air
Skin corrosion/ irritation	The product is classified: Skin Corr. 1A H314 Corrosive to the skin
Eye corrosion / irritation	Risk of serious eye damage (non-reversible)
Irritation of the respiratory tract	May cause irritation of the respiratory tract
Skin sensitisation	Non-sensitizing
Respiratory tract sensitisation	Non-sensitizing
Toxicity at repeated dose	Oral: There is no data available Skin: There is no data available Inhalation: Sub-chronic - NOAEC is 150 ppm for rats / mice, 30-90 days, 12-23.5 hours/ day; Chronic - NOEC is 10 mg/m^3 for rats / mice, 6months, 6 hours/ day, 5 days/ week.
Carcinogenicity	Insufficient data for classification. Rats treated with sulfuric acid showed slight signs of carcinogenicity probably associated with chronic respiratory tract irritation
Mutagenicity of germ cells	Negative
Reproductive toxicity	There is no data available, further investigations were cancelled due to the typical properties of sulfuric acid
Specific toxicity to target organs (STOT) - single exposure	Strongly irritating.
Specific toxicity to target organs (STOT) - repeated exposure	Classification in relation to the severe effects after repeated or prolonged exposure has not been proposed because although studies conducted on sulfuric acid highlight the toxicity following repeated/ prolonged exposure to low concentrations, there is no possibility of systemic toxicity and the effects observed in these studies are basically a consequence of the corrosive / irritating action of the substance.
Aspiration toxicity	Data not available
12. Ecological Information	
12.1 Toxicity	
It is established that the aquatic toxicity of sulfuric acid occurs if sufficient acid is present to produce a very low pH (i.e. pH 3-5). Since the environmental exposure assessment shows insignificant changes in aquatic pH levels depending on the product formulation and its end use, it is considered that there is no long-term risk to aquatic organisms and, therefore, data on chronic effects on fish is not required	
Fish (short term)	96-hours LC_{50}: 16-28 mg/l (pH 3.25-3.5)
Fish (long term)	EC10/LC10 or NOEC : 0.025 mg/L
Daphnia magna (short term)	48-hours EC_{50}: >100 mg/l (OECD 202)
Daphnia magna (long term)	EC10/LC10 or NOEC : 0.15 mg/L
Algae	72-hours ErC_{50}: > 100 mg/l
M-Factor	10
Inhibition of microbial activity	Data not available, as no type of soil exposure is expected
12.2 Persistence and degradability	

Biodegradability	This test cannot be performed because the substance is inorganic. It is not expected that normal use would lead to a significant release of the substance in the sea.
Hydrolysis	It is not possible to perform hydrolysis tests, the substance completely dissociates into ions
12.3 Bioaccumulation potential	
N-octanol/water partition coefficient	Not relevant because the substance is inorganic.
Bioconcentration factor (BCF)	Very low potential for bioaccumulation, due to the properties of the substance
12.4 Mobility in soil	
Absorption coefficient	With regard to soil mobility, it should not be relevant. If in contact with the ground, the absorption by soil particles is negligible. Depending on the soil buffering capacity, the H^+ ions will be neutralized in the water of the soil pores by the organic or inorganic substance or the pH may decrease.
12.5 Results of PBT and vPvB assessments The substance does not meet all the criteria to be classified as PBT or vPvB Persistence assessment. The substance can be considered as non-biodegradable for the aquatic and terrestrial environment. Test results indicate that the substance is persistent (half-life in sea water> 60 days, in soil> 120 days). Therefore, the criteria for P classification are met. Bioaccumulation assessment. The substance is considered cationic at environmental pH levels, the log Kow was calculated on a value of -1. According to the Guide in Annex VIII, this value does not imply any bioaccumulation potential.	
12.6. Other information	
For the aquatic environment, the effects of sulfuric acid are clearly attributable to the effect of the pH, as acid dissociates completely into ions. The same substance, therefore, will not reach the sediment / terrestrial environment.	
13. Disposal Considerations.	
13.1. Methods of waste treatment	
Waste from residues	Waste management procedures should be assessed on a case-by-case basis, depending on the composition of the waste, considering the provisions set out by local and EC regulations in force. With regard to handling and provisions to be adopted in the event of accidental leaks of the waste, the provisions specified in sections 6 and 7 are valid; specific actions should however be assessed in relation to waste composition. Disposal of the waste constituted by the substance after having evaluated the possibility of reuse thereof in the same or another production cycle, or to send it for recycling to companies authorized pursuant to Legislative Decree no. 152/2006. The substance, if disposed as such, can be disposed of in authorized chemical-physical treatment plants, pursuant to Directive 2008/98 / EC and to Legislative Decree no. 152/2006, withdrawing the waste code attributed to the substance. Disposal via wastewater discharge systems is not permitted.
Waste from the product	Evaluate the possibility of a re-use of the substance. Do not discharge into the drain. Do not contaminate ponds, waterways or channels with the substance or the containers used. All contaminated waste must be transformed into an industrial or urban wastewater treatment plant that includes both primary and secondary treatments. The site must have an emission plan to ensure that adequate measures are implemented to minimize the impact of occasional releases.
Containers	Containers must be cleaned appropriately before being reused or disposed of as waste according to regional or national regulations deriving from EC provisions. Please do not remove the label until the container has been properly cleaned.
14. Transport Information.	

The substance is classified directly in the UN Recommendations.

14.1. UN Number

1830 SULFURIC ACID containing more than 51% of acid
2796 SULFURIC ACID not containing more than 51% of acid

14.2. UN proper shipping name

SULFURIC ACID containing more than 51% of acid
SULFURIC ACID not containing more than 51% of acid

14.3. Danger Classes connected to the transport

8
Classification code
C1
Subsidiary risks
None

14.4. Packaging group

II
Hazard identification number
80
Particular UN requirements
None
Labels
8
Procedural provisions
None

14.5. Dangers for the environment

ADR and RID: UN numbers 1830 and 2796 are not dangerous for the environment.
ADN: UN numbers 1830 and 2796 are only dangerous for the environment only in tanks according to ADN.
IMDG Code: UN numbers 1830 and 2796 are not marine pollutants.

14.6. Special precautions for users

The transport of dangerous goods, including loading and unloading, must be carried out by persons who have received the necessary training required by the procedural provisions.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code

Product name: SULFURIC ACID
Type of ship: 3
Pollution category: Y
The UN number of the product is 1830
Other information
None

15. Regulatory Information.

15.1 Standards and legislation on health, safety and environment, specific to the substance or mixture	. Indications related to the limitation of work activities: Follow the rules set out in the Legislative Decree 81/2008 and subsequent amendments and additions . Ordinance on interventions in case of failure Follow the rules set out in the Legislative Decree 81/2008 and subsequent amendments and additions . Water hazard classes: Follow the rules of Legislative Decree 152/2006 and subsequent amendments and additions Legislative Decree 26 June 2015, No. 105 (Seveso TER). Not applicable. Substance not subject to REACH authorization (Ann. XIV) Subject to REACH restrictions (Ann.XVII, item no. 3)
15.2. Chemical safety assessment	Pursuant to art. 14 of the Reg. EC 1907/2006, a chemical safety assessment of the substance was conducted

16 Other information

The information provided in this safety data sheet is correct to the best of our knowledge and information at the date of its publication. The information is provided only as a guide for handling, use, storage, transport, disposal and release and is not to be considered a specific guarantee of quality. The information refers only to the specific material and may not be valid for such material used in combination with other materials or in any other process, unless specifically specified in the text.

Acronyms and abbreviations
CER - Catalogo Europeo dei Rifiuti (European Waste Catalogue)
DNEL - Derived no-effect level (without effect)
ECETOC - European Centre for Ecotoxicology and Toxicology of Chemical
ECHA – European Chemicals Agency
IUPAC - International Union of Pure and Applied Chemistry
LEV – Local Exhaust Ventilation
NOAEL – No observed adverse effect *level*
NOEC – No Observed Effect Concentration
EC number – EINECS number (European Inventory of Existing Commercial Chemical Substances)
CAS Number: Chemical Abstracts Service
OECD - OCSE (Organisation for Economic Co-operation and Development)
PBT – Persistent Bioaccumulating and Toxic
bw/ d - body weight / day
PNEC - Predicted No Effect Concentration
REACH – Registration, Evaluation and Authorization of Chemicals
SCOEL - Scientific Commitee on Occupational Exposure Limits
STEL - Short Term Exposure Limit
SVHC – Substances of Very High Concern
TRA – Targeted Risk Assessment
TLV - Threshold Limit Value
TWA - Time-Weighed Average
vPvB – very Persistent very Bioaccumulating

Indications on training.
Adequately train workers potentially exposed to this substance, using the data specified in this safety data sheet
Main bibliographical references and data sources:
Registration Dossier

The supplier must indicate on the label the concentration of the solution, as a percentage. The concentration expressed as a percentage is always understood as weight/weight, unless otherwise indicated

Specific concentration limits (in case of production of mixtures containing the substance):
≥15% Classification: Corrosive to the skin 1A,
≥5 <15% Classification: Irritating to skin 2, Irritating to eyes 2

Relevant phrases - Code and full text as indicated in chapters 2 and 3:

Hazard statements	H314 Causes severe skin burns and severe eye lesions.
Safety phrases	P260 Do not breathe dust/fume/gas/mist/vapours/spray. P264 Wash your hands thoroughly after use. 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 continuously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. P303+P361+P353 IN CASE OF CONTACT WITH THE SKIN (or with hair): 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 local POISON CENTER or a doctor. P405 Store locked up P501 Dispose of product/ container to companies authorized for the recycling or disposal of waste

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Drawn up on	MARCH 2021
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Purpose of revision	Revision 11.1
Prepared by	SILC FERTILIZZANTI SRL – Via delle Acque, 43 – 48124 Ravenna

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 %	

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

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

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
Fugtive 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

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
Default Release to	6	%	6

Input parameter:	Value:	Unit:	ERC default (if applicable)
water			
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

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

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 SO_2 content. Typical daily average concentration of SO_2: 625 (range 200 – 770) mg / Nm^3. Flow through specific SO_2: <2 kg SO_2 / T H_2SO_4.

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.

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.

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.

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

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

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

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 SO_2 content. Typical daily average concentration of SO_2: 625 (range 200 – 770) mg / Nm^3. Flow through specific SO_2: <2 kg SO_2 / T H_2SO_4.

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

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.

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

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 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

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.

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.

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.

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)

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)

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 (1st 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.

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.

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

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

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 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 1,2,3,4	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

Description of activity	PROC	Physical state of material	Estimated Short-term Exposure Concentrations (mg/m^3)		Estimated Long-term Exposure Concentration (mg/m^3)	
			50th percentile value	90th percentile value	50th percentile value	90th 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 (1st 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

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.

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

		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. 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

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)

	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/m³)**		**Estimated Long-term Exposure Concentration (mg/m³)**	
			50th percentile value	**90th percentile value**	**50th percentile value**	**90th 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)

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 (1st 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.

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.

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

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

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	

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/m³)**		**Estimated Long-term Exposure Concentration (mg/m³)**	
			50th percentile value	**90th percentile value**	**50th percentile value**	**90th 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.

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 occure. Therefore, secondarysecondary exposure of the other receiving compartments is not possible.minimal. Similarly contamination of food crops or animals used as human food sources is not possibleenvisaged.
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 (1st 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.

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.

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	$10 m^3/d$	Default value for a worker breathing for an 8hr 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 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 handing, 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.

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

	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)

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 (1st 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.

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.

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.

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		

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 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

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 (1st 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.*

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	$10 m^3/d$	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	$480 cm^2$ (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 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 handing, 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

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	Transfer of liquid products
	PROC 2,4, 8a	Transfer of liquid products – falling liquids, 1-10 L/min
	PROC 5	Activities with open surfaces
Containment	PROC 2	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

	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/m³)**		**Estimated Long-term Exposure Concentration (mg/m³)**	
			50th percentile value	**90th percentile value**	**50th percentile value**	**90th 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 (1st Tier)			1
STP			Yes

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.

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

		open air. Consumers are advised to wear protective clothing, however, the worst case assumption is that no localised controls are used in the process.

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

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.

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 (1st 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 casr 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.*

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	$10 m^3/d$	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	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 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 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 handing 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 handing 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 handing 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		

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)

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 (1st 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.

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 con-tact)
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.

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)		

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	

Substance in preparation	1 – 5%	Expected dilution in any products

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

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 (1st 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.

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 con-tact)
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 %	

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 SO_2 content. Typical daily average concentration of SO_2: 625 (range 200 – 770) mg / Nm^3. Flow through specific SO_2: <2 kg SO_2 / T H_2SO_4.
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 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

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

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

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 facilites	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	

31)

ESSEMAR S.p.A.

FICHA DE DATOS DE SEGURIDAD

Redactada de acuerdo a los Reg. CE 1907/2006 s.m.i. (art. 31)

1. Identificación de la sustancia y de la sociedad	
1.1 Identificador del producto	
Nombre comercial	Acido sulfúrico >15 % (Aceite de vitriolo, ácido para baterías) El proveedor debe indicar en la etiqueta la concentración de la solución en su porcentaje. La concentración expresada en % se entenderá siempre como peso/peso. Salvo otra indicación
Nombre químico	ACIDO SULFURICO
Numero EC	231-639-5
Numero CAS	7664-93-9
Numero índice	016-020-00-8
Numero de registro REACH	01-2119458838-20-0105
1.2 Usos pertinentes identificados de la sustancia y usos aconsejados	
Usos identificados (ver el escenario de exposición correspondiente, en la presente SDS)	Usos por laboratorios en ambientes industriales y usos de otras figuras industriales Producción de la sustancia Reciclaje/Recuperación de la sustancia Muestras, cargas, rellenado, trasvases, descargas, distribución Uso de la sustancia como intermedio de sintésis de otras formulaciones de mezclas y de reconfeccionamiento Uso como: regulador de pH, floculante, precipitante, agente de neutralización en la producción de mezclas tipo de productos de limpieza y lavado, baterías y procesos electrolíticos, reagente de laboratorio Uso de los consumidores: Contenido en las baterías
Usos desaconsejados	Cualquier uso que comporte la formación de aerosol, emisión de vapores, o el riesgo de salpicaduras para ojos/piel a los cuales puedan ser expuestos los operadores privados de protección para las vías respiratorias, piel y ojos.
1.3 Información sobre el proveedor de la ficha de seguridad	
Productor	ESSEMAR Spa – Via San Cassiano 99 – 28069 San martino di Trecate (NO) Tel +39 03217901, fax +39 0321779646
e-mail del responsable SDS	laboratorio@marchi-industriale.it
1.4 Numero telefonico de emergencia	
Para informaciones urgentes dirigirse a los centros anti venenos abiertos 24 horas de 24:	Milano – 0266101029 / Napoli – 0817472870 Pavia – 038224444 / Bergamo - 035269469 Roma – 063054343 opp. 06490663
2. Identificación de los peligros	
2.1 Clasificación de la sustancia	
Según Reglamento CE 1272/2008 (CLP)	
Clasificación/Indicación y de peligro: Corrosivo para la piel (cat. 1A) H314	Provoca graves quemaduras cutáneas y graves lesiones oculares
Según la Directiva 67/548 (DSD)	
Classificación/Frases de riesgo: C, Corrosivo R35	Provoca graves quemaduras
Otras informaciones	
Consejos para el hombre y el ambiente. El ácido sulfúrico tiene un efecto corrosivo sobre los tejidos humanos, con la posibilidad de dañar las vias respiratorias, ojos, piel e intestino. Efectos ambientales podrían verificarse en escala local a causa del pH.	

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	ERC default (if applicable)
/annum	Worst case site formulation value

een investigated alongside the worst case
sulphuric acid.

Comments
Total neutralization to around pH 7.
Continuous production
No contamination of grassland or agricultural soil.
Based on scrubbing and gas removal. The values used in still considerably higher than the highest measured emission and should be considered conservative.

of measured data
tralization
mission amounts is required only the number been altered to derive this value
is expected for this ERC and no sludge

ES 15 Use of sulphuric acid in drain pipe cleaning
SU22: Professional use (cleaning of obstruction parts that are chemical removed by acid)

Product Category:
PC35:
Process Categories:
PROC08a:
Environmental Release Category:
ERC08a:

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 .
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	8hr/d	Standard number of hours in one work day

Information type	Data field	Explanation
worker]		
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 kg/event	Worst case 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 plastic bottle or tank
Physical state of product	Liquid	
Concentration of substance in product	98%	

Remarks or additional information:

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	Good natural ventilation	Workers wear protective clothing (face/eye/skin protection). 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.

Risk management measures
Workers involved in drain pipe, and in the handing, sampling and transfer of acid 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 where required.
Environmental emissions are not present

Exposure estimation
Workers exposure
The assessment of worker exposure to sulphuric acid used in pipe drain was carried for processes relevant to this use scenario as identified by PROC codes. A screening-level (Tier 1) assessment was carried out using the ECETOC Targeted Risk Assessment (TRA) model.

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	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	<15 minutes	
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	8a	10 mins
Product type	8a	Liquid (low viscosity – like water)
Process temperature	8a	Room temperature (15-25oC)
Vapour pressure	8a	Substance is considered to be low volatile, exposure to mists is estimated
Liquid weight fraction	8a	0.98
Primary emission source proximity	8a	Primary emission source located in the breathing zone of the workers (i.e. Within 1 metre)
Activity class	8a	Transfer of liquid products 0.1-1 lt/min
Containment	8a	Handling reduces contact between product and adjacent air
Localised controls	8a	n/a
Fugitive emission source	8a	Not fully enclosed – effective housekeeping practices in place.
Dispersion	8a	Indoors, any sized room, only good natural ventilation

Consumer exposure
Only for professional use.
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	ERC8a		
Fraction of Tonnage for Region (1st Tier)			1
STP			Yes
Emission events per year	365 (manufacturer information)	Days	100

Input parameter:	Value:	Unit:	ERC default (if applicable)
Default Release to Air for worst casr ERC	0	%	100
Default Release to water	100	%	100
Dilution factor applied for PEC derivation			10 (20,000 m^3/d)
Regional Tonnage assessed	2,500	tonnes/annum	