



Safety Data Sheet (SDS)

1. IDENTIFICATION

Issue Date: 06/01/2015, SDS # 004, Version #: 01

Product Name	Battery Acid
Synonyms	Battery Electrolyte (Acid) , Sulfuric Acid (Dilute)
Product Use	Used to Activate Dry Batteries
Manufacturer / Supplier / Address	Yacht Battery Co., Ltd. 4F-5, No. 925, Sec. 4, Taiwan Blvd., Taichung, 40767 Taiwan, R.O.C. Yacht Technology (Vietnam), Co., Ltd. Lot_A9H_CN, Bau Bang Industrial Park, Bau Bang District, Binh Duong Province, Vietnam www.yacht-battery.com
Transportation Emergency Number	Infotrac (24-Hour Emergency Contact Number) 1-800-535-5053 (North America) 1-352-323-3500 (International)

NOTE: The Yacht battery is considered an article as defined by 29 CFR 1910.1200 (OSHA Hazard Communication Standard). The information contained in this SDS is supplied at the customer's request for information only.

2. GHS HAZARD(S) IDENTIFICATION

Health		Physical
Skin corrosion / irritation	Category 1	Corrosive to metals, Category 1
Series eye damage / eye irritation	Category 1	
Carcinogenicity	Category 1A	
Specific target organ toxicity, Single exposure	Category 3 Respiratory Tract irritation	

GHS Label Elements:

	DANGER!
<p>DANGER!</p> <ul style="list-style-type: none"> • May be corrosive to metals. • Causes severe skin burns and eye damage. • May cause cancer. • May cause respiratory irritation. 	

• Precautionary Statements

Prevention	Do not breathe vapor or mist. Wash thoroughly after handling.
Response	If swallowed: Rinse mouth. Do NOT induce vomiting. If inhaled: Immediately, remove person to fresh air. If breathing difficulties develop, obtain medical treatment. If on skin (or hair): Immediately remove all contaminated clothing. Rinse skin with water / shower. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. Immediately call a poison center / doctor. Wash contaminated clothing before reuse. If exposed or concerned: Get medical advice / attention. Absorb spillage to prevent material damage.
Storage	Store in a well-ventilated place. Keep container tightly closed. Store in corrosive resistant container with a resistant inner line. Store locked up.
Disposal	Dispose of contents / container in accordance with local / regional / national / international regulations.



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3. COMPOSITION / INFORMATION ON INGREDIENTS

INGREDIENTS (Chemical / Common Names)	CAS Number	% by Weight
Electrolyte (H ₂ SO ₄ / H ₂ O)	7664-93-9	30-40
Water	7732-18-5	60-70

All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. FIRST AID MEASURES

Inhalation	IF INHALED: Immediately remove person to fresh air. Immediately call a poison control center or doctor for treatment advice.
Skin contact	Immediately take off all contaminated clothing. Rinse skin with water / shower. Call a physician or poison control center immediately. Chemical burns must be treated by a physician.
Eye contact	Immediately flush eyes for at least 15 minutes. Remove contact lenses if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. DO not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into lungs.
Most important symptoms / effects, acute and delayed	Burning pain and severe corrosive skin damage. May cause severe irritation or burns to the eyes, skin, gastrointestinal tract, and respiratory system. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Chemical burns: flush with water immediately. While flushing, remove clothes which do not adhere to affected areas. Call an ambulance. Continue flushing during transport to hospital. Keep victim under observation. Symptoms may be delayed.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.
Self-protection of the first aider	If artificial respiration is required, use a pocket mask equipped with a one-way valve or other proper respiratory medical device.

5. FIRE FIGHTING MEASURES

Suitable extinguishing media	CO ₂ ; foam; dry chemical. Trained fire-fighters may use water spray under certain conditions.
Unsuitable extinguishing media	Do not use water jet as an extinguisher as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Sulfuric acid will not burn, but is capable of igniting finely divided combustible materials on contact. Use dry chemical agents to smother combustible materials. Avoid breathing mists and vapors. Use full protective equipment (acid-resistant bunker gear) and self-contained breathing apparatus.
Unusual fire and explosion hazards	Battery fluid can evolve flammable hydrogen gas when exposed to metals (such as during charging of lead acid batteries) and may increase the fire risk near sparks, excessive heat or open flames. See Section 10 for list of fire by-products.
Specific hazards in case of fire	Battery Electrolyte (Sulfuric Acid) is corrosive.
Additional information	Reacts violently with metals, nitrates, chlorates, carbides and other organic materials. Reacts with most metals to yield explosive flammable hydrogen gas.



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6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency preparedness	Keep unnecessary personnel away. Keep people away from and upwind of spill / leak. Keep out of low areas. Wear appropriate protective equipment and clothing during clean-up. Do not breathe mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS. If toxic vapors are produced at unknown concentrations, wear a NIOSH-approved respirator or SCBA.
Methods and materials for containment and cleaning up	<p><u>Large spills:</u> Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand, or earth and place in containers. Prevent entry into waterways, sewer, basements or confined areas.</p> <p><u>Small spills:</u> Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Use clay, sand, or diatomaceous earth.</p> <p>Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.</p>
Environmental precautions	Avoid discharge into drains, water courses, or onto the ground.

7. HANDLING AND STORAGE

Handling	Do not breathe vapor. Do not get in eyes, on skin, or on clothing. Avoid prolonged exposure. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial practices.
Storage	Store locked up. Store in original tightly closed container. Store away from incompatible materials. Keep away from heat, sparks, and open flame. (See section 10 of the SDS)

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure limits (mg/m³)

Ingredient	CAS Number	OSHA PEL	ACGIH	US NIOSH	Quebec PEV	Ontario OEL	EU OEL
Sulfuric Acid (Dilute)	7664-93-9	1	0.2	1	1	0.2	0.05 (a)

NOTES:

(a) Thoracic fraction

- **OSHA:** US OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)
- **ACGIH:** US ACGIH Threshold Limit Values
- **NIOSH:** US NIOSH Pocket Guide to Chemical Hazards

Biological limit values

No biological exposure limits noted for the ingredient(s).



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Engineering Controls (Ventilation)	Good ventilation required (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Provide eyewashes station.
Personal protective equipmen (Pictograms)	
Respiratory Protection	NONE REQUIRED UNDER NORMAL HANDLING CONDITIONS When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.
Skin Protection	Wear appropriate chemical resistant gloves and clothing.
Eye Protection	Wear safety glasses with side shields (or goggles). Face shield is recommended.
General Hygiene Considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and / or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Liquid
Color	Clear / cloudy liquid
Odor	Slightly acid
Odor Threshold	Not available
pH	<1.0
Melting Point	-79.6 °F / -62 °C Not applicable unless individual components exposed.
Boiling Point	230 °F / 110 °C Not applicable unless individual components exposed.
Flash Point	Not available
Evaporation Rate (Butyl Acetate = 1)	Not determined
Flammability	Not available
Upper / lower flammability or explosive limits	Hydrogen Flammability Limit Lower – 4 % Flammability Limit Upper – 74 %
Vapor Pressure (mm Hg @ 20 ° C)	11.7
Vapor Density	Not available (Air = 1)
Relative Density	1.28 / 1.32
Solubility	100%
% Volatile by Weight	0%
Partition coefficient (n-octanol / water)	Not available
Auto-ignition temperature	932° F (500°C) (as hydrogen gas)
Decomposition temperature	Not available
Viscosity	Not available



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10. STABILITY AND REACTIVITY

Reactivity	This product is stable and non-reactive under normal conditions of use, storage, and transport.
Stability	Material is stable under normal conditions.
Conditions to Avoid	Keep away from heat, sparks, open flames, and / or hot surfaces. No smoking. Contact with incompatible materials.
Incompatibility (materials to avoid)	Strong reducing agents. Reacts with organic materials. Combustibles. Metals. Carbides. Nitrates.
Hazardous Decomposition Products	Sulfur dioxide (SO ₂) Sulfur trioxide. Hydrogen.
Hazardous Polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

INFORMATION ON LIKELY ROUTES OF EXPOSURE

Inhalation	Corrosive. Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Inhalation of vapors may cause lung edema. Prolonged inhalation may be harmful.
Skin Contact	Causes severe skins burns. Prolonged skin contact may cause dermatitis.
Eye Contact	Causes serious eye damage.
Ingestion	Causes digestive tract burns.
Symptoms related to the physical, chemical, and toxicological characteristics	Burning pain and severe corrosive skin damage. May cause severe irritation or burns to the eyes, skin, gastrointestinal tract, and respiratory system. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.

INFORMATION ON TOXICOLOGICAL EFFECTS

Acute Effects	Occupational exposure to the substance or mixture may cause adverse effects.
Chronic Effects	Prolonged inhalation may be harmful. Sulfuric acid fumes: Prolonged, repeated exposure to acid fumes / mists may cause chronic bronchitis, irritation of skin, mucous membranes and gastrointestinal tract and erosion of the teeth.

Toxicological Data

Constituents	Sulfuric Acid absorbed in glass-fiber material (CAS 7664-93-9)	
Species	Rat	
Test Results	2140 mg/kg	510 mg/m3
Acute toxicity	LD50	LC50
Skin corrosion / irritation	Causes severe skin burns	
Serious eye damage / eye irritation	Causes severe eye damage	
Respiratory Sensitization	No data available	
Skin Sensitization	Not a skin sensitizer	
Germ Cell Mutagenicity	No data available to indicate product or any components present a greater than 0.1% are mutagenic or genotoxic.	

CARCINOGENICITY

Mist: May cause cancer by inhalation
 ACGIH Group A2 (Suspected human carcinogen)

Carcinogenic Effects			
	CAS Number	IARC	NTP
Sulfuric acid	7664-93-9	Group 1-Carcinogenic	Not established



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• OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050 / 1200)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified
Specific target organ toxicity - repeated exposure	Not classified
Aspiration hazard	Not classified

12. ECOLOGICAL INFORMATION

Persistence and degradability	Sulfuric acid is reactive and not very persistent in the ecosystem.
Bio-Accumulative potential (including Mobility)	Very high mobility and solubility indicate very low risk of bioaccumulation.
Aquatic toxicity (test results and comments)	24-hr LC50, fresh water fish (Brachydanio rerio): 82 mg/l 96-hr LOEC, fresh water fish (Cyprinus carpio): 22 mg/l (lowest observable effect concentration)
Additional Information	No known effects on stratospheric ozone depletion. Volatile organic compounds: 0% (by Volume) Water Endangering Class (WGK): NA

13. DISPOSAL CONSIDERATIONS

Disposal Instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents / container in accordance with local / regional / national / international regulations.
Hazardous waste code	D002: Corrosive waste The waste code should be assigned in discussion between the user, the producer, and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or lines may retain some product residues. This material and its container must be disposed of in a safe manner. (see: Disposal Instructions)
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. TRANSPORT INFORMATION

Ground – US-DOT / CAN-TDG / EU-ADR / APEC-ADR

Proper shipping name	Battery fluid, acid		
Hazard class	8	ID number	UN2796
Packing group	II	Labels	Corrosive

Aircraft – ICAO-IATA

Proper shipping name	Battery fluid, acid		
Hazard class	8	ID number	UN2796
Packing group	II	Labels	Corrosive

Reference IATA packing instructions Y840, 851, 855



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Vessel – IMO-IMDG

Proper shipping name		Battery fluid, acid	
Hazard class	8	ID number	UN2796
Packing group	II	Labels	Corrosive

Reference IMDG packing instructions P001.

15. REGULATORY INFORMATION

US Federal Regulations

All components are on the U.S. EPA TSCA Inventory List

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200

TSCA

- **TSCA Section 8b Inventory Status**

All chemicals comprising this product are either exempt or listed on the TSCA Inventory.

- **TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)**

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sulfuric Acid (Dilute) (CAS 7664-93-9)	LISTED
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Superfund Amendment and Reauthorization Act of 1986 (SARA)

Hazard Categories	Immediate Hazard – Yes Delayed Hazard – Yes Fire Hazard – Yes Pressure Hazard – Yes Reactivity Hazard – Yes
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SARA 302 Extremely hazardous substance

Chemical Name	CAS Number	Weight-%	Reportable Quantity	Threshold Planning Quantity
Sulfuric Acid (dilute)	7664-93-9	30-40	1000 lb EPCRA RQ	1000 lb TPQ
Water	7732-18-5	60-70	Not Listed	Not Listed

- **Section 311/312 Hazard Chemical:** Yes

- **Section 313 (TRI Reporting)**

Chemical Name	CAS Number	% by Weight
Sulfuric Acid (Dilute)	7664-93-9	30-40

Other Federal Regulations

- **Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List**

Not regulated

- **Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)**

Sulfuric Acid (Dilute) (CAS 7664-93-9)



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- **Safe Drinking Water Act (SDWA)**

Not regulated

- **Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number**

Sulfuric Acid (Dilute) (CAS 7664-93-9), 6552

- **Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))**

Sulfuric Acid (Dilute) (CAS 7664-93-9), 20 % WV

- **DEA Exempt Chemical Mixtures Code Number**

Sulfuric Acid (Dilute) (CAS 7664-93-9), 6552

US State Regulations

Sulfuric Acid (Dilute) (CAS 7664-93-9)	US. Massachusetts RTK – Substance List
	US New Jersey Worker and Community Right-to-know Act
	US Pennsylvania Worker and Community Right-to-know Law
	US Rhode Island RTK

- **US. California Proposition 65**

The following chemicals identified to exist in the finished product as distributed into commerce are known to the State of California to cause cancer, birth defects, or other reproductive harm:

Chemical Name	CAS Number	% by Weight
Strong inorganic acid mists including sulfuric acid	NA	30-40

California Consumer Product Volatile Organic Compound Emissions

International Inventories

Country(s) or Region	Inventory Name	On inventory (yes / no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

* A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

- **Canadian Domestic Substance List (DSL)**

All ingredients remaining in the finished product as distributed into commerce are included on the Domestic Substances List.

WHMIS Classifications

Class E: Corrosive materials present at greater than 1%

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the Controlled Products Regulations.

- **NPRI and Ontario Regulation 127/01**

This product contains the following chemicals subject to the reporting requirements of Canada NPRI +/-or Ont. Reg. 127/01:

Chemical Name	CAS Number	% by Weight
None	NA	NA



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• **European Inventory of Existing Commercial Chemical Substances (EINECS)**

All ingredients remaining in the finished product as distributed into commerce are exempt from, or included on, the European Inventory of Existing Commercial Chemical Substances.

European Communities (EC) Hazard Classification according to directives 67/548/EEC and 1999/45/EC.

H	P
H314	P264, P280, P301+P330+P331, P303+P361+P353, P305+P351+P338

Relevant H-, P- number and full text

Hazard Abbreviations:

C: Corrosive

Hazard statements:

H314: Causes severe skin burns and eye damage.

Precautionary statements:

P264: Wash hands thoroughly after handling.

P280: Wear protective gloves / protective clothing / eye protection / face protection.

P301+P330+P331:

IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

P303+P361+P353:

IF ON SKIN (or hair): Remove / Immediately remove all contaminated clothing. Rinse skin with water / shower.

P305+P351+P338:

IF IN EYES: Rinse cautiously with water for several minutes.

Remove contact lenses, if present and easy to do. Continue rinsing.

16. OTHER INFORMATION

Issue Date	06/01/2015
Revision Date	-
Version #	01
Further information	NFPA Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe
NFPA ratings	

DISCLAIMER:

This Safety Data Sheet is based upon information and sources available at the time of preparation or revision date. Information in the SDS was obtained from sources which we believe are reliable, but are beyond our direct supervision or control. We make no Warranty of Merchantability, Fitness for any particular purpose or any other Warranty, Expressed or Implied, with respect to such information and we assume no liability resulting from its use. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product. It is the obligation of each user of this product to determine the suitability of this product and comply with the requirements of all applicable laws regarding use and disposal of this product. For additional information concerning Yacht Battery Co., Ltd. products or questions concerning the contents of this SDS please contact your Yacht representative.



Extended Safety Data Sheet

According to Regulation (EC) No 1907/2006

Battery Electrolyte (Acid) (37%~42%)

Issue date: 30/05/2018

Version 2.0

Revision date: 30/05/2018

eSDS Record Number: CSSS-TCO-010-126882

Section 1 Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Identification on the label/Trade name: Battery Electrolyte (Acid) (37%~42%)
Additional identification: sulfuric acid
Identification of the product: CAS#: 7664-93-9 ; EC# : 231-639-5
Index Number: 016-020-00-8
REACH registration No.: 01-2119458838-20-0185

1.2 Relevant identified uses of the substance and uses advised against:

1.2.1 Identified uses:

Use of sulphuric acid in production of sulphuric acid contained batteries
Use of sulphuric acid in maintenance of sulphuric acid contained batteries
Use of sulphuric acid in recycling of sulphuric acid contained batteries
Use of sulphuric acid contained batteries

1.2.2 Uses advised against:

Not available.

1.3 Details of the supplier of the safety data sheet:

Supplier(Only Representative): Chemical Inspection & Regulation Service Limited
Supplier(Manufacturer): Yacht Technology (Vietnam), Co., Ltd.
Address: Lot_A9H_CN, Bau Bang Industrial Park, Bau Bang District, Binh Duong Province, Vietnam
Contact person(E-mail): sales@yacht-battery.com
Telephone: +886-4-2358-0578
Fax: +886-4-2358-0059

1.4 Emergency telephone Number:

+353 41 6871874

Available outside office hours?

YES

NO

Section 2 Hazards Identification

2.1 Classification of the substance/mixture

2.1.1 Classification:

The substance is classified as following according to REGULATION (EC) No 1272/2008:

REGULATION (EC) No 1272/2008	
Hazard classes/Hazard categories	Hazard statement
Skin Corr. 1A	H314

For full text of H- phrases: see section 2.2.

2.2 label elements

Hazard Pictograms:



Signal Word(S):	Danger
Hazard Statement:	H314: Causes severe skin burns and eye damage.
Precautionary statement	P260: Do not breathe dust/fume/gas/mist/vapours/spray. P264: Wash ... thoroughly after handling. P280: Wear protective gloves/protective clothing/eye protection/face protection. P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P310: Immediately call a POISON CENTER or doctor/physician. P321: Specific treatment (see ...on this label). P363: Wash contaminated clothing before reuse. P405: Store locked up. P501: Dispose of contents/container toin accordance with local/regional/national /international regulations (to be specified). Manufacturer/supplier or the competent authority to specify whether disposal requirements apply to contents, container or both.

2.3 Other hazards

The substance is not considered a PBT/vPvB.

Section 3 Composition/information on ingredients

Substance/Mixture: Substance

Ingredient(s):

Chemical Name	Registration No.	CAS No.	EC No.	Concentration	Classification according to CLP
Sulphuric acid	01-2119458838-20-0185	7664-93-9	231-639-5	>99.9% (w/w)	Skin Corr. 1A; H314

The manufacturer is exporting sulfuric acid (37-42%), but the registered substance is a high concentration of sulfuric acid.

Section 4 First aid measures

4.1 Description of first aid measures:

Consult a physician. Show this extended safety data sheet to the doctor in attendance.

4.1.1 In case of inhalation:

Get medical attention immediately. Move exposed person to fresh air. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

4.1.2 In case of eyes contact:

Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek immediate medical attention.

4.1.3 In case of skin contact:

Get medical attention immediately. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

4.1.4 In case of ingestion:

Wash out mouth with water. In the event of swallowing, induce patient to drink plenty of water. Get medical attention immediately.

4.2 Most important symptoms and effects, both acute and delayed

4.2.1 After inhalation:

Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. ON CONTINUOUS EXPOSURE/CONTACT: Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Possible laryngeal spasm/oedema. Risk of pneumonia. Risk of lung oedema. Respiratory difficulties.

4.2.2 After skin contact:

Caustic burns/corrosion of the skin.

4.2.3 After eye contact:

Corrosion of the eye tissue. Permanent eye damage.

4.2.4 After ingestion:

Nausea. Abdominal pain. Blood in stool. Blood in vomit. Burns to the gastric/intestinal mucosa. AFTER INGESTION OF HIGH QUANTITIES: Shock.

4.3 Indication of any immediate medical attention and special treatment needed

In case of accident or feeling unwell, seek medical advice immediately. (If possible, show this label).

Section 5 Fire-Fighting measures

5.1 Extinguishing media:

Suitable extinguishing media: In case of fire, use water spray (fog), foam, dry chemical or CO₂.

Unsuitable extinguishing media: Not available

5.2 Special hazards arising from the substance or mixture

On burning: Release of toxic and corrosive gases/vapours (sulphur oxides). Violent exothermic reaction with water (moisture): release of corrosive gases/vapours.

5.3 Special fire fighting methods and special protective actions for fire-fighters:

Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

6.1.1 For non-emergency personnel: No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. Wear suitable protective equipment.

6.1.2 For emergency responders: Do not touch or walk through spilt material. Avoid breathing vapour or mist. Provide adequate ventilation. Put on appropriate personal protective equipment (see section 8).

6.2 Environmental Precautions:

Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods for Containment and Cleaning up:

Large spill: Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). The spilled material may be neutralized with sodium carbonate, sodium bicarbonate or sodium hydroxide. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Small spill: Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

6.4 Reference to other sections:

See Section 7 for information on safe handling.
See section 8 for information on personal protection equipment.
See Section 13 for information on disposal.

Section 7 Handling and storage

7.1 Precautions for safe handling:

7.1.1 Protective measures:

Put on appropriate personal protective equipment. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not ingest. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Keep away from alkalis. Empty containers retain product residue and can be hazardous.

7.1.2 Advice on general occupational hygiene:

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking.

7.2 Conditions for safe storage, including any incompatibilities:

Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Separate from alkalis. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination. Packaging materials: Recommended: Use original container.

Remarks: Vent waste air only via suitable separators or scrubbers.

7.3 Specific end use(s):

Follow the instructions in the owner's manual for filling the battery with the acid pack.

Section 8 Exposure Controls/Personal Protection

8.1 Control parameters:

8.1.1 Occupational exposure limits:

Finland: TWA=0.2 mg/m³, STEL=1 mg/m³
Spain: TWA=1 mg/m³, STEL=3 mg/m³
Sweden: TWA=1 mg/m³
France: TWA=1 mg/m³, STEL=3 mg/m³

8.1.2 Additional exposure limits under the conditions of use:

Not available

8.1.3 DNEL/DMEL and PNEC-Values:

DNEL/DMEL - Workers

sulfuric acid, conc=99.9%

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term local effects inhalation	0.05 mg/m ³	
	Acute local effects inhalation	0.1 mg/m ³	
	Acute local effects inhalation	2.7 mg/m ³	SO ₂
	Long-term local effects inhalation	1.3 mg/m ³	SO ₂

DNEL/DMEL - General population

sulfuric acid, conc=99.9%

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term local effects inhalation	0.53 mg/m ³	SO ₂

PNEC

sulfuric acid, conc=99.9%

Compartments	Value	Remark
Fresh water	0.0025 mg/l	
Marine water	0.00025 mg/l	
STP	8.8 mg/l	
Fresh water sediment	0.002 mg/kg sediment dw	
Marine water sediment	0.002 mg/kg sediment dw	

8.2 Exposure controls

- 8.2.1 Appropriate engineering controls:** Keep away from naked flames/heat. Measure the concentration in the air regularly. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.
- 8.2.2 Individual protection measures, such as personal protective equipment :**
- Eye/face protection:** Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. Recommended: Tightly-fitting goggles and face shield.
- Hand protection:** Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. After contamination with product change the gloves immediately and dispose of them according to relevant national and local regulations <1 hour (breakthrough time): Fluorinated rubber – FKM.
- Respiratory protection:** Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: Combination filter, e.g. DIN 3181 ABEK or self-contained breathing apparatus (SCBA).
- 8.2.3 Environmental exposure controls:** See headings 6.2, 6.3 and 13

Section 9 Physical and chemical properties

9.1 Information on basic physical and chemical properties

- Appearance** Liquid at 20 °C and 101.3 kPa
- Melting point/range (°C):** The melting point is dependant on the percent of sulfuric acid.
10.4 to 10.9 °C (100% sulphuric acid)
-1.11 to 3.0 °C (98% sulphuric acid)

	-13.89 to -10 °C (96% sulphuric acid) 7.56 °C (83% sulphuric acid)
Boiling point/range (°C):	The boiling point of sulfuric acid is dependant on the strength of the acid. 290 °C (100% sulphuric acid) 310-335 °C (98% sulphuric acid) 330 °C (96% sulphuric acid) 360 °C (77% sulphuric acid)
Flash point (°C):	Not available
Self-ignition temperature:	Not available
Vapour pressure:	130 Pa at 148.5 °C (97% sulphuric acid) 214 Pa at 20 °C (65% sulphuric acid) 6 Pa at 20 °C (90% sulphuric acid)
Relative Density:	1.8144 to 1.8305 kg/L at 20 °C (90-100% sulphuric acid)
Water solubility (mg/l):	Miscible with water
n-Octanol/Water (log Po/w):	Not available
Viscosity:	A viscosity of 22.5 cP (0.0025 PaS; 22.5 mPaS) is reported for 95% sulphuric acid at 20 degrees Celsius.
Surface tension:	Not available
Dissociation constant in water(pKa):	pKa= 1.92

9.2. Other information:

Flammability:	Non flammable
Explosive properties :	Non explosive
Oxidising properties :	Oxidising: no
Granulometry :	Not available
Stability in organic solvents and identity of relevant degradation products :	Not available

Section 10 Stability and reactivity

10.1 Reactivity:	The product is stable under normal temperatures and pressures.
10.2 Chemical stability:	Stable under normal temperatures and pressures.
10.3 Possibility of hazardous reactions:	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid:	Highly reactive with water and alkalis.
10.5 Incompatible materials:	Alkalis
10.6 Hazardous decomposition products:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11 Toxicological information

11.1 Toxicokinetics, metabolism and distribution

Non-human toxicological data:

Interpretation of results (migrated information): no bioaccumulation potential based on study results. Sulphate is rapidly absorbed from the lungs following inhalation exposure to sulphuric acid. The clearance of 35S-radiolabeled sulphuric acid aerosols from the respiratory tract was studied in rats, guinea pigs, and dogs exposed nose-only to I-20 mg/m³ (MMAD 0.4-1.2 µm) for 30 seconds, and in rats and guinea pigs following intranasal installation (Dahl et al. 1983). The results indicated that the sulphur from sulphuric acid is rapidly cleared from the lungs into the blood following inhalation exposure. The lung clearance half-times were 170,230, and 261 seconds in rats, guinea pigs, and dogs, respectively. Very little sulphate from the sulphuric acid placed in the nose was absorbed into the rest of the body. Five minutes after treatment, 97.1% and 96.8% of the dose remained in the nose of rats and guinea pigs, respectively. To further study absorption of sulphuric acid by the respiratory tract

of dogs, 35S-labeled sulphuric acid was instilled in one dog 1-2 cm past the nares, in a second generation bronchus of another dog, and in a seventh generation bronchus of a third dog. Clearance from the nasal region was insignificant. Clearance half-time from the second generation bronchus was 200 seconds; from the seventh generation bronchus it was 110 seconds.

11.2 Information on toxicological effects

Acute toxicity:	
LD50(Oral, Rat):	2140 mg/kg bw (male/female)
LC50(Inhalation, Rat):	375 mg/m ³ air (male/female)
Skin corrosion/Irritation:	Causes severe skin burns and eye damage.
Serious eye damage/irritation:	Not classified
Respiratory or skin sensitization:	Not classified
Germ cell mutagenicity:	Not classified
Carcinogenicity:	Not classified
Reproductive toxicity:	Not classified
STOT- single exposure:	Not classified
STOT-repeated exposure:	Not classified
Aspiration hazard:	Not classified

Section 12 Ecological information

12.1 Toxicity:

Acute toxicity		Time	Species	Method	Remarks
LC50	16 mg/L	96h	Fish	<i>Lepomis macrochirus</i> freshwater static 96-hour LC50 measurement	2 (reliable with restrictions) key study experimental result Test material (EC name): sulphuric acid
EC50	100 mg/L	48h	Daphnia	<i>Daphnia magna</i> freshwater static OECD Guideline 202 (Daphnia sp. Acute Immobilisation Test)	1 (reliable without restriction) key study experimental result Test material (EC name): sulphuric acid
EC50	> 100 mg/L	72h	Algae	<i>Desmodesmus subspicatus (algae)</i> freshwater static OECD Guideline 201 (Alga, Growth Inhibition Test)	1 (reliable without restriction) key study experimental result Test material (EC name): sulphuric acid
NOEC	0.025 mg/L	65 day(s)	Fish		2 (reliable with restrictions) key study experimental result Test material (EC name): sulphuric acid

12.2 Persistence and degradability: Not biodegradable (inorganic acids cannot be considered biodegradable)

12.3 Bioaccumulative potential: The substance is not considered to be bioaccumulative or very bioaccumulative.

12.4 Mobility in soil: Not available

12.5 Results of PBT&vPvB assessment: The substance is not considered a PBT/vPvB.

12.6 Other adverse effects: Not available

Section 13 Disposal considerations

13.1 Waste treatment methods:

Examine possibilities for reuse. Product residues and uncleaned empty containers should be packaged, sealed, labelled, in accordance with local and national regulations. Refer to manufacturer/supplier for information on recovery/recycling. Hazardous waste: The classification of the product may meet the criteria for a hazardous waste.

13.2 Packaging disposal:

The empty and clean containers are to be reused in conformity with regulations. Containers that cannot be cleaned must be treated as waste. For disposal within the EC, the appropriate code according to the European Waste List (EWL) should be used. It is among the tasks of the polluter to assign the waste to waste codes specific to industrial sectors and processes according to the European Waste List (EWL).

Section 14 Transport information

	Land transport (ADR/RID)	Sea transport (IMDG)	Air transport (ICAO/IATA)
UN-Number:	2796	2796	2796
UN Proper shipping name:	Sulphuric acid	Sulphuric acid	Sulphuric acid
Transport hazard Class:	8	8	8
Packaging group:	II	II	II
Environmental hazards:	No	No	No
Special precautions for user:	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)	Please contact manufacturer for most current information

Section 15 Regulation information

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

Relevant information regarding authorization:

Not applicable

Relevant information regarding restriction:

Not applicable

Other EU regulations:

Employment restrictions concerning young person must be observed. For use only by technically qualified individuals.

Other National regulations:

Not applicable

15.2 Chemical Safety Assessment has been carried out?

YES

NO

Section 16 Other information

16.1 Indication of changes

Version 1.0 Amended by (EU) 2015/830

Version 2.0 Exposure scenarios are placed after section 16.

16.2 Legend for abbreviations and acronyms used in the safety data sheet:

Hazard Statements (Section 3):

H314 = Causes severe skin burns and eye damage

Control Parameters (Section 8):

TWA = Time Weighted Average

DNEL = Derived no-effect level (DNEL).

PNEC = Predicted No Effect Concentration (PNEC).

Toxicological Information (Section 11):

LC50 = Lethal concentration, 50% (Median Lethal Concentration)

LD50 = Lethal Dose, 50% (Median Lethal Dose).

Environmental Information (Section 12):

LC50 = Lethal concentration, 50% (Median Lethal Concentration)

NOEC = No Observed Effect Concentration.

Transportation Information (Section 14):

ADR = European Agreement Concerning the International Carriage of Dangerous Goods by Road.

RID = European Agreement Concerning the International Carriage of Dangerous Goods by Rail.

IMDG = International Marine Dangerous Goods.

ICAO = International Civil Aviation Organization.

IATA = International Air Transport Association.

16.3 Further information:

This information is based upon the present state of our knowledge. This SDS has been compiled and is solely intended for this product.

16.4 Notice to reader:

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgment of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

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The exposed scenario section is extracted from the CSR.

1 EXPOSURE ASSESSMENT

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

ES number	Volume (single site tonnes per annum)	Manufacture	Identified uses			Resulting life cycle stage		Linked to Identified Use	Sector of Use (SoU)	Process category (PROC)	Product Category (PC)	Article category (AC)	Environmental Release Category (ERC)
			Formulation	End use	Consumer use	Service life (for articles)	Waste stage						
ES 1 Use of sulphuric acid in production of sulphuric acid contained batteries	2,500	Y	N	N	N	n/a	n/a		3 or 0 - NACE Code C27.2 (Manufacture of batteries and accumulators)	2,3,4,9	0 - UCN Code E10100 (Electrolytes)	n/a	2,5
ES 2 Use of sulphuric acid in maintenance of sulphuric acid contained batteries	2,500	Y	N	Y	N	n/a	n/a		22	19	0 - UCN Code E10100 (Electrolytes)	n/a	8b,9b
ES 3 Use of sulphuric acid in recycling of sulphuric acid contained batteries	2,500	Y	N	N	N	n/a	n/a		3	2,4,5,8a	0 - UCN Code E10100 (Electrolytes)	n/a	1
ES 4 Use of sulphuric acid contained batteries	2,500	Y	N	Y	N	Y	n/a		21	consumer use PROC 19 as a worst case		AC 3	9b

1.1 ES 1 Use of sulphuric acid in production of sulphuric acid contained batteries

1.1.1 Exposure scenario

1.1.1.1 Short title of the exposure scenario: Use of sulphuric acid in production of lead acid batteries containing sulphuric acid

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

1.1.1.2 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.

Table 2: 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]	8 hr/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 8 hr / 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

1.1.1.3 Operational conditions and risk management measures related to product characteristics

Table 3: 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 38 – 42% 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.

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

Table 4: 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 8 hr 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.

Table 5: 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.

Table 6: 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.

1.1.1.5 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.

Table 7: 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.
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.

1.1.1.6 Waste related measures

Table 8: 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	0 kg/d	Tier 2 value based on the specialised waste water treatment procedures. In reality no wastewater is generated in most cases.
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	

1.1.2 Exposure estimation

1.1.2.1 Workers exposure

The assessment of worker exposure to sulphuric acid used in production of lead acid batteries containing sulphuric acid (ES 1) 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).

1.1.2.2 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.

1.1.2.3 Environmental exposure

Use of sulphuric acid in the production of batteries may be carried out regularly and throughout the year with possible numbers of emission days approaching some 365 days. First tier conservative environmental exposure estimations were carried out using EUSES and implementing the specified defaults. ERC's 2 and 5 were used to determine the environmental emissions for ES15 in the first tier. Second tier worst case environmental exposure estimations were carried out using EUSES 2.1 to take into account more realistic factors that affect the environmental concentrations and partitioning including degradation and sorption parameters.

1.2 ES 2 Use of sulphuric acid in maintenance of sulphuric acid contained batteries

1.2.1 Exposure scenario

1.2.1.1 Short title of the exposure scenario: Use of sulphuric acid in the maintenance of lead acid 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

1.2.1.2 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.

Table 9: 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]	8 hr/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 8 hr / 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

1.2.1.3 Operational conditions and risk management measures related to product characteristics

Table 10: 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	38-42%	

Remarks or additional information:

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

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

Table 11: 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 8 hrs 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.

Table 12: 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.

Table 13: 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.

1.2.1.5 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.

Table 14: 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		
No further risk management measures required		
Risk management measures related to environmental emissions from industrial sites		
None required to demonstrate safe use		

1.2.1.6 Waste related measures

Table 15: 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	342 kg/d	Based on worst case estimated 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	Degradation in the STP into constituent ions. These are non-hazardous	
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	

1.2.2 Exposure estimation

1.2.2.1 Workers exposure

The assessment of worker exposure to sulphuric acid used in maintenance of lead acid batteries containing sulphuric acid (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).

1.2.2.2 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.

1.2.2.3 Environmental exposure

Use of sulphuric acid in battery maintenance would generally be continuous with maintenance most likely taking place on sites throughout the year.

First tier conservative environmental exposure estimations were carried out using EUSES with the specified defaults. ERC`s 8B and 9B was used to determine the environmental emissions for ES16 in the first tier. No second tier refinements were needed.

1.3 ES 3 Use of sulphuric acid in recycling of sulphuric acid contained batteries

1.3.1 Exposure scenario

1.3.1.1 Short title of the exposure scenario: Sulphuric acid used in recycling of lead acid batteries containing sulphuric acid

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

1.3.1.2 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.

Table 16: 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]	8 hr/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 8 hr / 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

1.3.1.3 Operational conditions and risk management measures related to product characteristics

Table 17: 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	38-42%	

Remarks or additional information:

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

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

Table 18: 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 8 hrs 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.

Table 19: 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.

Table 20: 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.

1.3.1.5 Risk management measures

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

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

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

Table 21: 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		
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.

1.3.1.6 Waste related measures

Table 22: 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	0 kg/d	Tier 2 value based on the specialised waste water treatment procedures.
Amount of substances in waste resulting from service life of articles	Not applicable	
Type of waste, suitable waste codes	Suitable EWC code(s)	

Information type	Data field	Explanation
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	

1.3.2 Exposure estimation

1.3.2.1 Workers exposure

The assessment of worker exposure to sulphuric acid used in recycling of lead acid batteries containing sulphuric acid (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).

1.3.2.2 Consumer exposure

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

1.3.2.3 Environmental exposure

Use of sulphuric acid in battery maintenance and recycling is generally continuous with constant recycling taking place at dedicated recycling facilities. First tier conservative environmental exposure estimations were carried out using the ECETOC TRA tool using the specified defaults. ERC 1 was used to determine the environmental emissions for ES16 in the first tier with refined inputs that are considered more realistic being chosen for second tier assessment. Second tier worst case environmental exposure estimations were carried out using EUSES 2.1 to take into account more realistic factors that affect the environmental concentrations and partitioning including degradation and sorption parameters.

1.4 ES 4 Use of sulphuric acid contained batteries

1.4.1 Exposure scenario

1.4.1.1 Short title of the exposure scenario: Use of lead acid batteries containing sulphuric acid

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

1.4.1.2 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.

Table 23: 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]	8 hr/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

1.4.1.3 Operational conditions and risk management measures related to product characteristics

Table 24: 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	38-42%	

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

Table 25: 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 8 hrs 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.

Table 26: 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.

Table 27: 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.

1.4.1.5 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.

Table 28: 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		

1.4.1.6 Waste related measures

Table 29: 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	34.2 kg/d	Based on worst case estimated 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	Degradation in the STP into constituent ions. These are non hazardous	
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	

1.4.2 Exposure estimation

1.4.2.1 Workers exposure

No worker exposure as this is a consumer use.

1.4.2.2 Consumer exposure

The assessment of consumer exposure to sulphuric acid during the use of lead acid batteries containing sulphuric acid (ES 4) 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).

1.4.2.3 Environmental exposure

Use of sulphuric acid containing batteries would generally be continuous with use most likely taking place on sites throughout the year.

First tier conservative environmental exposure estimations were carried out using EUSES with the specified defaults. ERC 9B was used to determine the environmental emissions for ES16 in the first tier. No second tier refinements were needed.

2 RISK CHARACTERISATION

The risk characterisations for human health and the environment for the production and uses of sulphuric acid are presented below. The RCR tables demonstrate that for all quantitative assessments safe use has been demonstrated. In addition to the quantitative assessments a specific qualitative assessment for one emission scenario is presented below. In addition to this the risk to human health due to the corrosive nature of sulphuric acid and the possibility of causing chemical burns when in dermal contact may arise for all the exposure scenarios and is assessed here in a qualitative manner.

Assessment of dermal risk

During the processes that will be carried out for all the exposure scenarios associated with production and use of sulphuric acid a risk may arise if sulphuric acid comes into contact with human skin. This is due to the nature of sulphuric acid and its ability to cause chemical burns. As this effect is considered to be related to the corrosivity of sulphuric acid a threshold DNEL cannot be established for this risk and so measures to control this risk should be assessed in a qualitative manner. Though this risk is most pertinent when workers may come into contact with concentrated sulphuric acid in an industrial setting the operational conditions (OCs) and risk management measures (RMMs) used to control and manage the risk of dermal contact events may be equally applicable across all the exposure scenarios.

In the industrial setting an acute risk of dermal burns from exposure to sulphuric acid in its concentrated form (or its dilute form) exists due to possible splashing of the liquid acid. This risk would be highest at times of transfer to tankers, filling of barrels and filling of small vessels etc. Though these events are considered unlikely due to the high degree of system closure and control the risk is still protected against in order to eliminate any possible routes of exposure.

The first aspect of the OCs that reduce the risk of dermal contact is the specialised nature of the systems involved and the degree of closure associated with them. All pipes and transfer lines are closed and sealed in order to reduce any possible exposure to leaks or splashes. The reactors themselves are similarly closed and sealed in order to reduce any possible emissions. During times of transfer to/from road tankers gas displacement lines are utilised in order to reduce the levels of gaseous emissions that could deposit to surfaces including human skin. Specialised tanker coupling/uncoupling systems and targeted purging systems may be employed in certain circumstances where large volumes and high concentrations are required. Training and certification plays an important part in ensuring the workers understand the correct procedures for use of these specialised systems so that the measures in place to reduce emission are not circumvented and so proper function can be maintained.

In addition to the measures in place to reduce system emission worker segregation also plays an important part in the reduction of risk in the industrial setting. Workers are generally housed in areas segregated from the main emission sources and time spent on tasks which require close proximity to the emission sources can be minimised effectively. Separate control rooms, screens and outdoor reactor units help to keep workers away from any potential sources of exposure. Emergency measures (and training on procedures and safe work practice) are in place in the industrial setting to ensure that any unforeseen events are safely dealt with in the case that they do arise. These measures would range from procedural policies which are in place to guide workers with respect to proper response in the case of splashes or spills to dedicated equipment (such as emergency showers or spill clean-up kits) which can be used to minimise any effects should unforeseen exposure arise.

In order to further protect the worker personal protective equipment (PPE) should be supplied to any personnel who may be working in areas where potential emission sources (such as transfer pipes) are located. Suitable PPE that should be used to prevent dermal contact for workers would be acid resistant clothing, helmets, gloves, goggles and boots. The PPE should be properly maintained and certified and should be replaced when required. These measures combined will effectively function to ensure three aspects of safe use. These are, firstly, reduction of potential emissions with specialised systems. Secondly reduction of the potential for exposure of workers by means such as segregation and training and thirdly physical protection of the worker with the use of correct PPE. With the combination of these measures it is considered that the risk of chemical burns to workers (be they in large scale industrial production plants, transfer depots or formulation sites) is adequately managed.

As mentioned above when the concentration of the acid decreases so does the potential for chemical burns to human skin. However measures are still in place to ensure that professionals (such as laboratory workers) and consumers (topping up batteries) are protected from risk.

For the professional the majority of measures in place for the industrial setting apply. These for example would be segregation (behind screens or through the use of glove boxes when required), proper training, presence of emergency control measures and the use of proper PPE. As with the industrial setting, professional users should be properly trained in the safe handling of chemicals to ensure that the correct measures to ensure safe use are in place. With this considered risk management can be assured.

In the listed exposure scenarios for sulphuric acid consumer exposure is only possible in one case. This is during the use of lead acid batteries when normally sealed units may be temporarily opened in order to top up the electrolyte solution with de-ionized water. These days the majority of produced batteries are fully sealed and do not require topping up and so this type of exposure is becoming less prevalent. In the case that a consumer does wish to top up a battery there are several factors in place which lessen any potential risk. Firstly the electrolyte solution contains only 38-42% sulphuric acid and so any potential exposure to this concentration would be less likely to cause burns than would exposure to the concentrated form. In addition to this the consumer does not actually need to handle any vessels which contain the acid, rather the acid remains in the battery chamber and the consumer needs only to pour water into the chamber. Slow controlled pouring is recommended to minimise any splashing (which is further lessened by the narrow chamber openings). Topping up is a task that a consumer will not need to perform regularly and as the volumes are small the duration of the task will be very short (most likely only in the region of a few minutes at most).

In addition to these inherent factors it is also recommended that consumers wear overalls, goggles and gloves to prevent any possible exposure during the pouring process. This will allow the covering of any skin which would be exposed and will mean that even when potential splashing occurs dermal contact cannot happen. Combined with the low concentrations, low potential for splashing, low frequency and duration and the recommended protective wear indicates that the risk is controlled in this case also.

2.1 ES 1 Use of sulphuric acid in production of sulphuric acid contained batteries

2.1.1 Human health

2.1.1.1 Workers

As discussed in Section 1.1, an assessment of worker exposure to sulphuric acid during production of lead acid batteries containing sulphuric acid (ES 1) was carried for processes relevant to this use scenario as identified by PROC codes.

The effects of sulphuric acid (38 – 42%) following dermal exposures are local irritation and chemical burns of the skin. There is no evidence of systemic effects following dermal exposures to sulphuric acid. Estimates of systemic dermal doses associated with acute/short-term and long-term exposures to sulphuric acid were not therefore derived. The critical effects associated with acute/short-term and chronic inhalation exposures to sulphuric acid are local respiratory irritation and chemical burns. Systemic toxicity is not therefore relevant to the inhalation route of exposure.

The ECETOC TRA Tier 1 model predicted an inhalation exposure that exceeded the inhalation DNEL value of 0.1 mg/m³ for acute local respiratory effects and the inhalation DNEL value of 0.05 mg/m³ for long-term respiratory effects respectively, indicating that risks to human health as predicted by the ECETOC TRA model were not acceptable. The Tier 1 assessment of inhalation exposures associated with ES 1 derived using the ECETOC TRA model was refined using the higher tier (Tier 2) inhalation model: the Advanced REACH tool (ART).

In the characterisation of the human health risks posed by acute/short term and long-term inhalation exposures to sulphuric acid associated with ES 1, the 90th percentile (e.g. worst case) inhalation exposure concentrations derived using the ART model for relevant PROC codes were compared with the DNEL value for acute local respiratory effects and the DNEL value for long-term local respiratory effects respectively. The results of the risk characterisation are shown in the table below.

The predicted acute/short-term and long-term inhalation exposure concentrations derived using the ART model were not found to exceed the DNEL value for acute local respiratory effects or the DNEL value for long-term local respiratory effects respectively for any of the processes associated with ES 1. On the basis of the assumptions made in the exposure assessment and this risk characterisation, it can be concluded that inhalation exposures to sulphuric acid that may potentially arise during processes associated with ES 1 do not pose an unacceptable health risk to workers.

Table 30: Quantitative risk characterisation for workers

	Route	PROC Code	ES 1 - 90 th exposure concentrations (mg/m ³)	Leading toxic end point / Critical effect	DNEL (mg/m ³)	Risk characterisation ratio
Acute-local effects	Inhalation	2	1.6 x 10 ⁻³	Respiratory irritation and corrosivity	0.1	1.6 x 10 ⁻²
		3	1.6 x 10 ⁻²	Respiratory irritation and corrosivity	0.1	1.6 x 10 ⁻¹
		4	1.4 x 10 ⁻³	Respiratory irritation and corrosivity	0.1	1.4 x 10 ⁻²
		9	1.4 x 10 ⁻³	Respiratory irritation and corrosivity	0.1	1.4 x 10 ⁻²
Long-term-local effects	Inhalation	2	1.4 x 10 ⁻³	Respiratory irritation and corrosivity	0.05	2.8 x 10 ⁻²
		3	1.4 x 10 ⁻²	Respiratory irritation and corrosivity	0.05	2.8 x 10 ⁻¹
		4	1.2 x 10 ⁻³	Respiratory irritation and corrosivity	0.05	2.4 x 10 ⁻²
		9	1.2 x 10 ⁻³	Respiratory irritation and corrosivity	0.05	2.4 x 10 ⁻²

2.1.1.2 Consumers

As discussed, consumers are not directly exposed to sulphuric acid, as it is either wholly consumed as an intermediate or processing aid, or if present in an article (such as a battery) is sealed and not designed for release. As such no consumer risk characterization is required.

2.1.1.3 Indirect exposure of humans via the environment

Environmental releases are shown to be minimal (see below). Sulphuric acid is readily degradable in atmospheric, aquatic and soil compartments, and does not bioaccumulate. Removal by hydrolysis and by the STP is effective. Therefore it is considered unlikely that humans will be exposed indirectly either by way of contact with the air, surface waters or soils, or by way of drinking water, or through exposure in the food chain.

2.1.2 Environment

For the tier 1 risk characterisation PECs derived using the ERC defaults are assessed. For the tier 2 risk characterisation the PECs calculated by EUSES with refined inputs taking into account the emission RMMs used to control environmental releases are used for the assessment.

2.1.2.1 Aquatic compartment (including sediment and secondary poisoning)

As noted previously, sulphuric acid is used in the production of lead acid batteries on a large scale, generally on major chemical sites, which may have dedicated effluent treatment facilities, involving both chemical and biological treatment, coping with many chemical substances. As such the modelled risk characterisation

below is very much worst case and actual contamination of the aquatic compartment is expected to be minimal. For Tier 1 the worst case PEC values covering all ERC's as determined by EUSES are presented below. PNEC sediment values are those as calculated by the equilibrium partitioning method (EPM) in EUSES.

Table 31: Risk characterisation for the aquatic compartment

Compartments	PEC mg/L	PNEC mg/L	PEC/PNEC	Comments
ERC 2 Tier 2 Freshwater	3.69×10^{-5}	0.0025	0.0147	Safe use demonstrated in tier 2
ERC 2 Tier 2 Sediment	2.97×10^{-5}	0.002 (EPM)	0.0148	Safe use demonstrated in tier 2
ERC 2 Tier 2 Marine sediment	4.3×10^{-6}	0.002 (EPM)	0.0021	Safe use demonstrated in tier 2
ERC 2 Tier 2 Marine	5.35×10^{-6}	0.00025	0.0212	Safe use demonstrated in tier 2
ERC 5 Tier 2 Freshwater	7.38×10^{-5}	0.0025	0.0295	Safe use demonstrated in tier 2
ERC 5 Tier 2 Sediment	5.94×10^{-5}	0.002 (EPM)	0.029	Safe use demonstrated in tier 2
ERC 5 Tier 2 Marine sediment	8.8×10^{-6}	0.002 (EPM)	0.0044	Safe use demonstrated in tier 2
ERC 5 Tier 2 Marine	1.07×10^{-5}	0.00025	0.042	Safe use demonstrated in tier 2

2.1.2.2 Terrestrial compartment (including secondary poisoning)

Given the lack of expected exposure and the fact that no terrestrial toxicity studies are available for sulphuric acid no PNEC has been derived for the soil compartment and so no risk characterisation is required.

2.1.2.3 Atmospheric compartment

Atmospheric contamination is minimal, with either the use of sealed systems or the use of scrubbers. Given that any sulphuric acid present in the atmosphere will be hydrolysed on contact with moisture any sulphuric acid incident on soils as a result of precipitation will be very dilute, and will be rapidly broken down. No atmospheric PNECs are derived and no atmospheric risk characterisation is required.

2.1.2.4 Microbiological activity in sewage treatment systems

In reality no direct exposure of STP to sulphuric acid is expected as sulphuric acid will completely dissociate in the waste stream into harmless ions. As such the tier 2 RCR below indicates no risk as no exposure of the STP is envisaged.

Table 32: Risk characterisation for STP

Compartments	PEC (mg/L)	PNEC (mg/L)	PEC/PNEC	Comments
ERC 2 Tier 1 STP	2.84	8.8	0.32	Safe use in tier 1
ERC 2 Tier 2 STP	0	8.8	0	In the second tier assessment all waste acid is neutralized and removed before it enters any biological phase of an STP. As such there is no exposure and no risk.
ERC 5 Tier 2 STP	0	8.8	0	In the second tier assessment all waste acid is neutralized and removed before it enters any biological phase of an STP. As such there is no exposure and no risk.

2.2 ES 2 Use of sulphuric acid in maintenance of sulphuric acid contained batteries

2.2.1 Human health

2.2.1.1 Workers

As discussed in Section 1, an assessment of worker exposure to sulphuric acid during maintenance of lead acid batteries containing sulphuric acid (ES 2) was carried for processes relevant to this use scenario as identified by PROC codes.

The effects of sulphuric acid (38 – 42%) following dermal exposures are local irritation and chemical burns of the skin. There is no evidence of systemic effects following dermal exposures to sulphuric acid. Estimates of systemic dermal doses associated with acute/short-term and long-term exposures to sulphuric acid were not therefore derived. The critical effects associated with acute/short-term and chronic inhalation exposures to sulphuric acid are local respiratory irritation and corrosivity. Systemic toxicity is not therefore relevant to the inhalation route of exposure.

The ECETOC TRA Tier 1 model predicted an inhalation exposure concentration which exceeded the inhalation DNEL value of 0.1 mg/m³ for acute local respiratory effects and the inhalation DNEL value of 0.05 mg/m³ for long-term respiratory effects respectively, indicating that risks to human health as predicted by the ECETOC TRA model were not acceptable. The Tier 1 assessment of inhalation exposures associated with ES 2 derived using the ECETOC TRA model was refined using the higher tier (Tier 2) inhalation model: the Advanced REACH tool (ART).

In the characterisation of the human health risks posed by acute/short term and long-term inhalation exposures to sulphuric acid associated with ES 2, the 90th percentile (e.g. worst case) inhalation exposure concentrations derived using the ART model for relevant PROC codes were compared with the DNEL value for acute local respiratory effects and the DNEL value for long-term local respiratory effects respectively. The results of the risk characterisation are shown in the table below.

The predicted acute/short-term and long-term inhalation exposure concentrations derived using the ART model were not found to exceed the DNEL value for acute local respiratory effects or the DNEL value for long-term local respiratory effects respectively for any of the processes associated with ES 2. On the basis of the assumptions made in the exposure assessment and this risk characterisation, it can be concluded that inhalation exposures to sulphuric acid that may potentially arise during processes associated with ES 2 do not pose an unacceptable health risk to workers.

Table 33: Quantitative risk characterisation for workers

	Route	PROC Code	ES 2 - 90 th exposure concentrations (mg/m ³)	Leading toxic end point / Critical effect	DNEL (mg/m ³)	Risk characterisation ratio
Acute-local effects	Inhalation	19	2.3 x 10 ⁻³	Respiratory irritation and corrosivity	0.1	2.3 x 10 ⁻²
Long-term-local effects	Inhalation	19	2 x 10 ⁻³	Respiratory irritation and corrosivity	0.05	4x 10 ⁻²

2.2.1.2 Consumers

As discussed, consumers are not directly exposed to sulphuric acid, as it is either wholly consumed as an intermediate or processing aid, or if present in an article (such as a battery) is sealed and not designed for release. As such no consumer risk characterization is required.

2.2.1.3 Indirect exposure of humans via the environment

Environmental releases are shown to be minimal (see below). Sulphuric acid is readily degradable in atmospheric, aquatic and soil compartments, and does not bioaccumulate. Conversion to non-corrosive dissociation products (sulphate and hydronium ions) by hydrolysis and by the STP is effective. Therefore it is considered unlikely that humans will be exposed indirectly either by way of contact with the air, surface waters or soils, or by way of drinking water, or through exposure in the food chain.

2.2.2 Environment

For the tier 1 risk characterisation PECs derived using the ERC defaults are assessed. For the tier 2 risk characterisation the PECs calculated by EUSES with refined inputs taking into account the emission RMMs used to control environmental releases are used for the assessment.

2.2.2.1 Aquatic compartment (including sediment and secondary poisoning)

As noted previously, sulphuric acid is used in the maintenance lead acid batteries in a widespread small point source scale manner. For Tier 1 the worst case PEC values covering all ERC's as determined by EUSES are presented below. PNEC sediment values are those as calculated by the equilibrium partitioning method (EPM) in EUSES.

Table 34: Risk characterisation for the aquatic compartment

Compartments	PEC mg/L	PNEC mg/L	PEC/PNEC	Comments
ERC 8B Tier 1 Freshwater	2.26×10^{-5}	0.0025	0.009	Safe use in tier 1 for all compartments
ERC 8B Tier 1 Sediment	2.67×10^{-5}	0.002 (EPM)	0.0133	
ERC 8B Tier 1 Marine sediment	1.84×10^{-5}	0.002 (EPM)	0.009	
ERC 8B Tier 1 Marine	2.26×10^{-5}	0.00025	0.09	
ERC 9B Tier 1 Freshwater	5.64×10^{-5}	0.0025	0.02	Safe use in tier 1 for all compartments
ERC 9B Tier 1 Sediment	1.84×10^{-5}	0.002 (EPM)	0.0092	
ERC 9B Tier 1 Marine sediment	4.69×10^{-5}	0.002 (EPM)	0.0023	
ERC 9B Tier 1 Marine	5.64×10^{-5}	0.00025	0.22	

2.2.2.2 Terrestrial compartment (including secondary poisoning)

Sulphuric acid is produced on a large scale, generally at major industrial sites, which may have dedicated effluent treatment facilities, involving both chemical and biological treatment, coping with many chemical substances. There is therefore no direct exposure of soils, and no risk of contamination of groundwater (or of waters extracted from underground for drinking water), or via soils of crops or animals used in food production. Equally, wildlife will not be exposed via the soil or groundwater, and there is no potential for accumulation (secondary poisoning) through the wildlife food chain. Given this lack of expected exposure and the fact that no terrestrial toxicity studies are available for sulphuric acid no PNEC has been derived for the soil compartment and so no risk characterisation is required. In the case of this exposure scenario the wide dispersive nature of the scenario will mean that the emission dilutions are very large and will not be concentrated or will persist in the environment.

2.2.2.3 Atmospheric compartment

Atmospheric contamination is minimal, with either the use of sealed systems or the use of scrubbers. Given that any sulphuric acid present in the atmosphere will be hydrolysed on contact with moisture any sulphuric acid incident on soils as a result of precipitation will be very dilute, and will be rapidly broken down. No atmospheric PNECs are derived and no atmospheric risk characterisation is required.

2.2.2.4 Microbiological activity in sewage treatment systems

Table 35: Risk characterisation for STP

Compartments	PEC (mg/L)	PNEC (mg/L)	PEC/PNEC	Comments
ERC 8B Tier 1 STP	0.0779	8.8	0.0089	Safe use in tier 1
ERC 9B Tier 1 STP	0.195	8.8	0.0221	Safe use in tier 1

2.3 ES 3 Use of sulphuric acid in recycling of sulphuric acid contained batteries

2.3.1 Human health

2.3.1.1 Workers

As discussed in Section 1.3, an assessment of worker exposure to sulphuric acid during recycling of lead acid batteries containing sulphuric acid (ES 3) was carried for processes relevant to this use scenario as identified by PROC codes.

The effects of sulphuric acid (38 – 42%) following dermal exposures are local irritation and corrosivity of the skin. There is no evidence of systemic effects following dermal exposures to sulphuric acid. Estimates of systemic dermal doses associated with acute/short-term and long-term exposures to sulphuric acid were not therefore derived. The critical effects associated with acute/short-term and chronic inhalation exposures to sulphuric acid are local respiratory irritation and corrosivity. Systemic toxicity is not therefore relevant to the inhalation route of exposure.

The ECETOC TRA Tier 1 model predicted an inhalation exposure concentration which exceeded the inhalation DNEL value of 0.1 mg/m³ for acute local respiratory effects and the inhalation DNEL value of 0.05 mg/m³ for long-term respiratory effects respectively, indicating that risks to human health as predicted by the ECETOC TRA model were not acceptable. The Tier 1 assessment of inhalation exposures associated with ES 3 derived using the ECETOC TRA model was refined using the higher tier (Tier 2) inhalation model: the Advanced REACH tool (ART).

In the characterisation of the human health risks posed by acute/short term and long-term inhalation exposures to sulphuric acid associated with ES 3, the 90th percentile (e.g. worst case) inhalation exposure concentrations derived using the ART model for relevant PROC codes were compared with the DNEL value for acute local respiratory effects and the DNEL value for long-term local respiratory effects respectively. The results of the risk characterisation are shown in the table below.

The predicted acute/short-term and long-term inhalation exposure concentrations derived using the ART model were not found to exceed the DNEL value for acute local respiratory effects or the DNEL value for long-term local respiratory effects respectively for any of the processes associated with ES 3. On the basis of the assumptions made in the exposure assessment and this risk characterisation, it can be concluded that inhalation exposures to sulphuric acid that may potentially arise during processes associated with ES 3 do not pose an unacceptable health risk to workers.

Table 36: Quantitative risk characterisation for workers

	Route	PROC Code	ES 3 - 90 th exposure concentrations (mg/m ³)	Leading toxic end point / Critical effect	DNEL (mg/m ³)	Risk characterisation ratio
Acute-local effects	Inhalation	2	1.4 x 10 ⁻³	Respiratory irritation and corrositivity	0.1	1.4 x 10 ⁻²
		4	4.6 x 10 ⁻³	Respiratory irritation and corrositivity	0.1	4.6 x 10 ⁻²
		5	1.5 x 10 ⁻²	Respiratory irritation and corrositivity	0.1	1.5 x 10 ⁻¹
		8a	6.9 x 10 ⁻³	Respiratory irritation and corrositivity	0.1	6.9 x 10 ⁻²
Long-term-local effects	Inhalation	2	1.2 x 10 ⁻³	Respiratory irritation and corrositivity	0.05	2.4 x 10 ⁻²
		4	4 x 10 ⁻³	Respiratory irritation and corrositivity	0.05	8 x 10 ⁻²
		5	1.3 x 10 ⁻²	Respiratory irritation and corrositivity	0.05	2.6 x 10 ⁻¹
		8a	6 x 10 ⁻³	Respiratory irritation and corrositivity	0.05	1.2 x 10 ⁻¹

2.3.1.2 Consumers

As discussed, consumers are not directly exposed to sulphuric acid, as it is either wholly consumed as an intermediate or processing aid, or if present in an article (such as a battery) is sealed and not designed for release. As such no consumer risk characterization is required.

2.3.1.3 Indirect exposure of humans via the environment

Environmental releases are shown to be minimal (see below). Sulphuric acid is readily degradable in atmospheric, aquatic and soil compartments, and does not bioaccumulate. Removal by hydrolysis and by the STP is effective. Therefore it is considered unlikely that humans will be exposed indirectly either by way of contact with the air, surface waters or soils, or by way of drinking water, or through exposure in the food chain.

2.3.2 Environment

For the tier 1 risk characterisation PECs derived using the ERC defaults are assessed. For the tier 2 risk characterisation the PECs calculated by EUSES with refined inputs taking into account the emission RMMs used to control environmental releases are used for the assessment.

2.3.2.1 Aquatic compartment (including sediment and secondary poisoning)

As noted previously, sulphuric acid associated with battery recycling is processed in a specialised manner on a large scale, generally on major chemical sites, which may have dedicated effluent treatment facilities, involving both chemical and biological treatment, coping with many chemical substances. As such the modelled risk characterisation below is very much worst case and actual contamination of the aquatic

compartment is expected to be minimal. For Tier 1 the worst case PEC values covering all ERC's as determined by EUSES are presented below. PNEC sediment values are those as calculated by the equilibrium partitioning method (EPM) in EUSES.

Table 37: Risk characterisation for the aquatic compartment

Compartments	PEC mg/L	PNEC mg/L	PEC/PNEC	Comments
Tier 2 Freshwater	7.38×10^{-6}	0.0025	0.00292	Safe use demonstrated in tier 2
Tier 2 Sediment	5.94×10^{-6}	0.002 (EPM)	0.0029	Safe use demonstrated in tier 2
Tier 2 Marine sediment	8.6×10^{-7}	0.002 (EPM)	4.3×10^{-4}	Safe use demonstrated in tier 2
Tier 2 Marine	1.07×10^{-6}	0.00025	0.0042	Safe use demonstrated in tier 2

2.3.2.2 Terrestrial compartment (including secondary poisoning)

Sulphuric acid is produced on a large scale, generally on major chemical sites, which may have dedicated effluent treatment facilities, involving both chemical and biological treatment, coping with many chemical substances. There is therefore no direct exposure of soils, and no risk of contamination of groundwater (or of waters extracted from underground for drinking water), or via soils of crops or animals used in food production. Equally, wildlife will not be exposed via the soil or groundwater, and there is no potential for accumulation (secondary poisoning) through the wildlife food chain. Given this lack of expected exposure and the fact that no terrestrial toxicity studies are available for sulphuric acid no PNEC has been derived for the soil compartment and so no risk characterisation is required.

2.3.2.3 Atmospheric compartment

Atmospheric contamination is minimal, with either the use of sealed systems or the use of scrubbers. Given that any sulphuric acid present in the atmosphere will be hydrolysed on contact with moisture any sulphuric acid incident on soils as a result of precipitation will be very dilute, and will be rapidly broken down. No atmospheric PNECs are derived and no atmospheric risk characterisation is required.

2.3.2.4 Microbiological activity in sewage treatment systems

In reality no direct exposure of STP to sulphuric acid is expected as sulphuric acid will completely dissociate in the waste stream into harmless ions. As such the tier 2 RCR below indicates no risk as no exposure of the STP is envisaged.

Table 38: Risk characterisation for STP

Compartments	PEC (mg/L)	PNEC (mg/L)	PEC/PNEC	Comments
Tier 1 STP	0.195	8.8	0.022	Safe use demonstrated in tier 1
Tier 2 STP	0	8.8	0	In the second tier assessment all waste acid is neutralized and removed before it enters any biological phase of an STP. As such there is no exposure and no risk.

2.4 ES 4 Use of sulphuric acid contained batteries

2.4.1 Human health

2.4.1.1 Workers

As discussed in Section 1, an assessment of worker exposure to sulphuric acid using PROC 19 was used to estimate the consumer exposure from topping up of lead acid batteries with de-ionized water.

The effects of sulphuric acid (38 – 42%) following dermal exposures are local irritation and corrosivity of the skin. There is no evidence of systemic effects following dermal exposures to sulphuric acid. Estimates of systemic dermal doses associated with acute/short-term and long-term exposures to sulphuric acid were not therefore derived. The critical effects associated with acute/short-term and chronic inhalation exposures to sulphuric acid are local respiratory irritation and corrosivity. Systemic toxicity is not therefore relevant to the inhalation route of exposure.

The ECETOC TRA Tier 1 model predicted an inhalation exposure concentration which exceeded the inhalation DNEL value of 0.1 mg/m³ for acute local respiratory effects and the inhalation DNEL value of 0.05 mg/m³ for long-term respiratory effects respectively, indicating that risks to human health as predicted by the ECETOC TRA model were not acceptable. The Tier 1 assessment of inhalation exposures associated with ES 4 derived using the ECETOC TRA model was refined using the higher tier (Tier 2) inhalation model: the Advanced REACH tool (ART).

In the characterisation of the human health risks posed by acute/short term and long-term inhalation exposures to sulphuric acid associated with ES 4, the 90th percentile (e.g. worst case) inhalation exposure concentrations derived using the ART model for relevant PROC codes were compared with the DNEL value for acute local respiratory effects and the DNEL value for long-term local respiratory effects respectively. The results of the risk characterisation are shown in the table below.

The predicted acute/short-term and long-term inhalation exposure concentrations derived using the ART model were not found to exceed the DNEL value for acute local respiratory effects or the DNEL value for long-term local respiratory effects respectively for any of the processes associated with ES 4. On the basis of the assumptions made in the exposure assessment and this risk characterisation, it can be concluded that inhalation exposures to sulphuric acid that may potentially arise during processes associated with ES 4 do not pose an unacceptable health risk to workers.

Table 39: Quantitative risk characterisation for workers

	Route	PROC Code	ES 4 - 90 th exposure concentrations (mg/m ³)	Leading toxic end point / Critical effect	DNEL (mg/m ³)	Risk characterisation ratio
Acute-local effects	Inhalation	19	2.3 x 10 ⁻³	Respiratory irritation and corrosivity	0.1	2.3 x 10 ⁻²
Long-term-local effects	Inhalation	19	2 x 10 ⁻³	Respiratory irritation and corrosivity	0.05	4 x 10 ⁻²

2.4.1.2 Consumers

As discussed, consumers are not directly exposed to sulphuric acid, as it is either wholly consumed as an intermediate or processing aid, or if present in an article (such as a battery) is sealed and not designed for release. In the case of this exposure scenario any limited exposure to consumers during the very periodic topping up of lead acid batteries is considered to be the same process as PROC 19 which is assessed in the table above.

2.4.1.3 Indirect exposure of humans via the environment

Environmental releases are shown to be minimal (see below). Sulphuric acid is readily degradable in atmospheric, aquatic and soil compartments, and does not bioaccumulate. Removal by hydrolysis and by the STP is effective. Therefore it is considered unlikely that humans will be exposed indirectly either by way of contact with the air, surface waters or soils, or by way of drinking water, or through exposure in the food chain.

2.4.2 Environment

For the tier 1 risk characterisation PECs derived using the ERC defaults are assessed. For the tier 2 risk characterisation the PECs calculated by EUSES with refined inputs taking into account the emission RMMs used to control environmental releases are used for the assessment.

2.4.2.1 Aquatic compartment (including sediment and secondary poisoning)

As noted previously, lead acid batteries containing sulphuric acid is carried out in a widespread small point source scale manner. For Tier 1 the worst case PEC values covering all ERC's as determined by EUSES are presented below. PNEC sediment values are those as calculated by the equilibrium partitioning method (EPM) in EUSES.

Table 40: Risk characterisation for the aquatic compartment

Compartments	PEC mg/L	PNEC mg/L	PEC/PNEC	Comments
ERC 9B Tier 1 Freshwater	5.64×10^{-5}	0.0025	0.22	Safe use in tier 1 for all compartments
ERC 9B Tier 1 Sediment	1.84×10^{-5}	0.002 (EPM)	0.092	
ERC 9B Tier 1 Marine	5.64×10^{-5}	0.00025	0.22	
ERC 9B Tier 1 Marine sediment	4.69×10^{-5}	0.002 (EPM)	0.0023	

2.4.2.2 Terrestrial compartment (including secondary poisoning)

Sulphuric acid is produced on a large scale, generally on major chemical sites, which may have dedicated effluent treatment facilities, involving both chemical and biological treatment, coping with many chemical substances. There is therefore no direct exposure of soils, and no risk of contamination of groundwater (or of waters extracted from underground for drinking water), or via soils of crops or animals used in food production. Equally, wildlife will not be exposed via the soil or groundwater, and there is no potential for accumulation (secondary poisoning) through the wildlife food chain. Given this lack of expected exposure and the fact that no terrestrial toxicity studies are available for sulphuric acid no PNEC has been derived for the soil compartment and so no risk characterisation is required. In the case of this exposure scenario the wide dispersive nature of the scenario will mean that the emission dilutions are very large and will not be concentrated and will not persist in the environment.

2.4.2.3 Atmospheric compartment

Atmospheric contamination is minimal, with either the use of sealed systems or the use of scrubbers. Given that any sulphuric acid present in the atmosphere will be hydrolysed on contact with moisture any sulphuric acid incident on soils as a result of precipitation will be very dilute, and will be rapidly broken down. No atmospheric PNECs are derived and no atmospheric risk characterisation is required.

2.4.2.4 Microbiological activity in sewage treatment systems

Table 41: Risk characterisation for STP

Compartments	PEC (mg/L)	PNEC (mg/L)	PEC/PNEC	Comments
ERC 9B Tier 1 STP	0.195	8.8	0.0221	Safe use in tier 1