Aquatrade Water Treatment Chemicals (Pty) Ltd

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1 Identification

GHS Product Identifier

SULPHURIC ACID 98%

Other means of identification

CAS:	7664-93-9
EC:	231-639-5
RTECS:	WS5600000
ICSC:	0362
NSC Number:	248648 38965
Index Number:	016-020-00-8
UN Number:	1830
Composition:	mono-constituent substance
Origin:	Inorganic
Synonyms:	SULFURIC ACID Oil of vitriol Sulphuric acid Dihydrogen sulfate Mattling acid Battery acid Dipping acid Acide sulfurique Electrolyte acid
Proper Shipping Name:	SULFURIC ACID with >51% acid
Chemical Formula:	H_2O_4S
Molecular Weight:	98.072 g/mol

Recommended use of the chemical and restriction on use

Adsorbents and absorbents
Agricultural chemicals (non-pesticidal)
Corrosion inhibitors and anti-scaling agents
Electrolyte
Fuels and fuel additives
Ion exchange agents
Laboratory chemicals
Munitions
Oxidizing/reducing agents
Paint additives and coating additives not described by other categories
Pigments
Plating agents and surface treating agents
Process regulators
Processing aids, not otherwise listed
Processing aids, specific to petroleum production
Raw material in other product manufacturing
Solids separation agents
Solvents (for cleaning and degreasing)
Solvents (which become part of product formulation or mixture)
Surface active agents

Utilities, steel mills.
Waste water ph ajustment
Water Treatment Processing
Lead acid battery processing
Waste water treatment.

Supplier's details

AQUATRADE WATER TREATMENT CHEMICALS (PTY) LTD

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Emergency phone number

E le Sar: +27 82 921 0643 (Available Mon - Fri, GMT 5:00 to 20:00)
Spilltech: +27 861 000 366 (Available 24/7)

2 Hazard(s) identification

Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Corrosive to Metals (Category 1), H290
Skin Corrosion/Skin Irritation (Category 1A), H314

For the full text of the H-Statements mentioned in this Section, see Section 16.

GHS label elements

Danger

May be corrosive to metals

Causes severe skin burns and eye damage

Keep only in original container.

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

IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

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

IF INHALED: Remove victim to fresh air and Keep at rest in a position comfortable for breathing.

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 or doctor/physician.

Wash contaminated clothing before reuse.

Absorb spillage to prevent material damage.

Store in a closed container.

Store locked up.

Dispose of contents and container in accordance with local, regional, national, international regulations.

Do not breathe dust/fume/gas/mist/vapours/spray. Wash thoroughly after handling.

Other hazards which do not result in classification

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

3 Composition/information on ingredients

Description	CAS Number	EINECS Number	%	Note
sulfuric acid	7664-93-9		0 - 99	Met. Corr. 1; H290 Skin Corr. 1A; H314

4 First-aid measures

Description of necessary first-aid measures

Protection of first-aiders
Acute exposure to sulfuric acid may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary. Rescue vehicles should carry supplies such as plastic sheeting and disposable plastic bags to assist in preventing spread of contamination.

Call 112 or 10177 or your local emergency help number immediately, for emergency assistance. Call the Poison Control Center at +27 21 931 6129 – Tygerberg or +27 21 658 5308 – Red Cross, Email: poisonsinformation@uct.ac.za, Website: https://www.afritox.co.za for further instructions. Provide them with information such as the compound taken, quantity and time of ingestion, age, weight and general health status of affected individual. Carefully remove the individual from the exposure area; move them to region of fresh air immediately.

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.

Skin/Eye Contact
If skin exposure or involvement of the eye has occurred, then wash thoroughly with copious amounts of water (for at least 15 minutes). Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek immediate medical attention.

Ingestion
Unless instructed by a healthcare professional, **DO NOT** induce vomiting in the affected individual. Following an ingestion of the substance, immediately give milk to drink. In case of symptoms that indicate difficulty in swallowing including vomiting or decreased alertness, **DO NOT** give anything by way of mouth.

Take individual to emergency room (ER) for further treatment. Always try to take the compound bottle/container to the ER.

Most important symptoms/effects, acute and delayed

When swallowed, the signs and symptoms may include
Signs and symptoms of acute ingestion of sulfuric acid may be severe and include salivation, intense thirst, difficulty in swallowing, pain, and shock. Oral, esophageal, and stomach burns are common. Vomitus generally has a coffee-ground appearance. The potential for circulatory collapse is high following ingestion of sulfuric acid. Severe burning and associated pain in the mouth, throat, and food-pipe. Drooling from the mouth. Loss of vision; unable to speak. Inflammation of the throat may cause respiratory difficulties. Sudden reduction in blood pressure (hypotension). Vomiting blood.

On skin contact, the signs and symptoms may include
Severe skin and tissue burns associated with pain. If the eyes have come in contact with sulfuric acid, irritation, pain, swelling, corneal erosion, and blindness may result.

When inhaled, the signs and symptoms may include
Coughing (including coughing-up blood), choking. Heaviness in the chest; chest pain. Bluish discoloration of lips and beneath fingernails. Respiratory difficulties. Reduced blood pressure (hypotension). Headache and weakness. Increased heart-rate. Collapse. Acute inhalation exposure may result in sneezing, hoarseness, choking, laryngitis, dyspnea (shortness of breath), respiratory tract irritation, and chest pain. Bleeding of nose and gums, ulceration of the nasal and oral mucosa, pulmonary edema, chronic bronchitis, and pneumonia may also occur.

Indication of immediate medical attention and special treatment needed, if necessary

Immediate first aid
Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. **DO NOT** induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention.

Basic treatment
Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist respirations if needed. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary. Monitor for shock and treat if necessary. For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with 0.9% saline (NS) during transport. **DO NOT** use emetics. Activated charcoal is not effective. For ingestion, rinse mouth and administer 5 mL/kg up to 200 mL of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. **DO NOT** attempt to neutralize, because of exothermic reaction. Cover skin burns with dry, sterile dressings after decontamination.

Advanced treatment
Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Early intubation, at the first sign of upper airway obstruction, may be necessary. Positive-pressure ventilation techniques with a bag valve mask device may be beneficial. Consider drug therapy for pulmonary edema. Consider administering a beta agonist such as albuterol for severe bronchospasm. Monitor cardiac rhythm and treat arrhythmias as necessary. Start IV administration of D5W TKO SRP: "To keep open", minimal flow rate. Use 0.9% saline (NS) or lactated Ringer's (LR) if signs of hypovolemia are present. For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if patient is hypotensive with a normal fluid volume. Watch for signs of fluid overload. Use proparacaine hydrochloride to assist eye irrigation.

5 Fire-fighting measures

Suitable extinguishing media

NO water. In case of fire in the surroundings, use appropriate extinguishing media. In case of fire: keep drums, etc., cool by spraying with water. **NO** direct contact of the substance with water.

Small Fire
CO2 (except for Cyanides), dry chemical, dry sand, alcohol-resistant foam.

Large Fire
Water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Use water spray or fog; do not use straight streams. Dike fire-control water for later disposal; do not scatter the material.

Fire involving Tanks or Car/Trailer Loads
Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire.

Specific hazards arising from the chemical

Acute hazards
Not combustible. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire. Risk of fire and explosion on contact with bases, combustible substances, reducing agents, water or organic materials.

Prevention
NO contact with incompatible substances. See Chemical Dangers. **NO** contact with incompatible materials: See Chemical Dangers.

Special protective actions for fire-fighters

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

6 Accidental release measures

Personal precautions, protective equipment and emergency procedures

No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. 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).

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).

Methods and materials 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.

7 Handling and storage

Precautions for safe handling

Personal precautions
No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. 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).

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).

Handling
Put on appropriate personal protective equipment. 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. 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.

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 wellventilated 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.

SANS 10263-0 Warehousing
8.4.3.2 Where flammable or **corrosive** substances are stored, the floor shall slope away from the storage area (primary collection area) to a secondary catch basin or sump of capacity at least 10 % of the total available storage volume of the

fire section concerned. The secondary catch basin shall be within the fire section, and shall be such that it can be well ventilated. Care shall be taken in the design of such areas to prevent contamination of the soil or ground water.

9.7.2 Every type of storage area inside a warehouse shall be clearly demarcated, for example separate storage areas for poisons, flammables and **corrosives** shall display the relevant hazard class diamond (see table 1). The dimensions of the hazard class diamonds shall be at least 250 mm x 250 mm.

12.8.5 Storage of flammable liquids of class 3, toxic substances of division 6.1 and **corrosives** of class 8

Nitro-methane class 3, UN No. 1261, shall be separated from substances of class 6.1, and cyanides of division 6.1 shall be separated from acids of class 8. Concentrated acids and bases shall be segregated by at least 1 m. Packaged flammable liquids of class 3, toxic substances of division 6.1 and **corrosives** of class 8 that are of category 3 can be stored in the same area, provided that

a) they are kept above floor level, and
b) liquid dangerous goods of one class are not stored above dangerous goods of another class.

12.8.8.4 Corrosives (see class 8 in SANS 10228) that leak or spill from their packaging can cause serious damage to other packages, with potentially hazardous consequences.

Corrosives shall be segregated from toxic substances, infectious substances, aerosols, flammables, oxidizing substances and organic peroxides.

The provisions of above apply to the storage of the following quantities of dangerous goods.

Corrosives (acids and bases)Class 8	
Category 1	> 50 kg
Category 2	> 200 kg
Category 3	> 1 000 kg

8 Exposure controls/personal protection

Control parameters

AEGLs (Acute Exposure Guideline Levels)
Interim AEGLs for Sulfuric acid (7664-93-9)

Exposure Period	AEGL-1	AEGL-2	AEGL-3
10 minutes	0.2 mg/m^3	8.7 mg/m^3	270 mg/m^3
30 minutes	0.2 mg/m^3	8.7 mg/m^3	200 mg/m^3
60 minutes	0.2 mg/m^3	8.7 mg/m^3	160 mg/m^3
4 hours	0.2 mg/m^3	8.7 mg/m^3	110 mg/m^3
8 hours	0.2 mg/m^3	8.7 mg/m^3	93 mg/m^3

(NAC/NRC, 2017)

ERPGs (Emergency Response Planning Guidelines)

Chemical	ERPG-1	ERPG-2	ERPG-3
Sulfuric Acid (Oleum [8014-95-7] Sulfur Trioxide [7446-11-9] Sulfuric Acid [7664-93-9])	2 mg/m^3 *	10 mg/m^3	120 mg/m^3

* indicates that odour should be detectable near ERPG-1.
(AIHA, 2016)

PACs (Protective Action Criteria)

Chemical	PAC-1	PAC-2	PAC-3
Sulfuric acid (7664-93-9)	0.2 mg/m^3	8.7 mg/m^3	160 mg/m^3

(DOE, 2016)

Component	ACGIH TLV	OSHA PEL	NIOSH REL

Sulphuric Acid	0.2 mg/m^3 Thoracic fraction	1 mg/m^3	1 mg/m^3

NOTE:
OEGs for individual jurisdictions may differ from those given above. Check with local authorities for the applicable OEGs in your jurisdiction.
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health.
TLV – Threshold Limit Value
PEL – Permissible Exposure Limit
REL – Recommended Exposure Limit.

Immediately Dangerous to Life or Health

IDLH	15 mg/m^3

(NIOSH, 2016)

Occupational Exposure Limits
TLV: 0.2 mg/m^3, as TWA; A2 (suspected human carcinogen).
MAK: (inhalable fraction): 0.1 mg/m^3; peak limitation category: I(1); carcinogen category: 4; pregnancy risk group: C.
EU-OEL: 0.05 mg/m^3 as TWA

Appropriate engineering controls

Recommended monitoring procedures:
If this product contains ingredients with exposure limits, personal,workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

Technical measures:
If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene measures:
Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Environmental exposure controls
Technical measures:
Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

The selection of PPE is dependent on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors. Recommendations below is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Eye/face protection
Tightly fitting safety glasses with side shields or safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166 (EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact Material:	Fluorinated rubber
Minimum layer thickness:	0,7 mm
Break through time:	480 min
Material tested:	Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact	
Material:	Nitrile rubber
Minimum layer thickness:	0,4 mm
Break through time:	30 min
Material tested:	Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

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 selfcontained breathing apparatus (SCBA).

NIOSH/OSHA Respirator Guidelines

Up to 15 mg/m3

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter

(APF = 50) Any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with an N100, R100, or P100 filter.

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter.

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

Escape

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter.

Any appropriate escape-type, self-contained breathing apparatus

9 Physical and chemical properties

Physical and chemical properties

Appearance (physical state, colour etc):	Colourless to brown, viscous liquid
Odour:	Odourless
Odour threshold:	Threshold for odor= 1.0 mg/cu m, Irritating concn= 1.1 mg/cu m
pH:	1,2 at 5 g/l
Melting/Freezing Point:	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)
Initial boiling point and boiling range:	310-335°C (98% sulphuric acid)
Density:	1.8144-1.8305 kg/L (90-100% sulphuric acid)
Flash point:	Do not flash
Evaporation rate:	No test data available
Flammability (solid, gas):	No test data available
Upper/lower flammability or explosive limits:	Not flammable or explosive
Vapour pressure:	214 Pa (65% sulphuric acid) 6 Pa (90% sulphuric acid)
Vapour density:	3.4 (Air = 1)
Relative density:	1,84 g/cm3 at 25 °C
Solubility(ies):	Miscible with water, with generation of much heat, also with ethanol
Partition coefficient:	Not relevant for ionisable substances
Autoflammability/Auto-ignition temperature:	No test data available
Decomposition temperature:	340°C
Viscosity:	A viscosity of 22.5 cP (0.0025 PaS; 22.5 mPaS) is reported for 95% sulphuric acid at 20 degrees Celsius.
Corrosivity:	Corrosion data for ASTM Grade 2 Titanium: Boiling sulfuric acid at a concentration of 1% by weight had a corrosion rate of 2.5 mm/yr
Dissociation Constants:	pKa = 1.92 at 25 deg C

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10 Stability and reactivity

Reactivity

Air and Water Reactions

Reaction with water is negligible unless acid strength is above 80-90% then heat from hydrolysis is extreme, may cause severe burns [Merck, 11th ed. 1989]. During sulfonation of mononitrobenzene by fuming sulfuric acid, a leak from an internal cooling coil permitted water to enter the reaction tank. A violent eruption occurred due to the heat of solution [MCA Case History 944 1963].

Soluble in water. Dissolution generates heat, which is slightly unless acid concentration is above 80-90% when the heat may cause severe burns [Merck 11th ed. 1989] and lead to localized boiling and spattering.

Reactive Group

Acids, Strong Oxidizing.

Reactivity Alerts

Strong Oxidizing Agent.

Known Catalytic Activity

Water-Reactive.

Chemical stability

Stable under normal conditions of use.

Possibility of hazardous reactions

SULFURIC ACID is strongly acidic. Reacts violently with bromine pentafluoride [Mellor 2 Supp. 1:172 1956]. Exploded with para-nitrotoluene at 80°C [Chem. Eng. News 27:2504]. An explosion occurred when concentrated sulfuric acid was mixed with crystalline potassium permanganate in a vessel containing moisture. Manganese heptoxide was formed, which explodes at 70°C [Delhez 1967]. A mixture of acrylonitrile with concentrated sulfuric acid must be kept well chilled, otherwise a vigorous exothermic reaction occurs [Chem. Safety Data Sheet SD-31:8. 1949]. Mixing sulfuric acid (96%) in equal portions with any of the following substances in a closed container caused the temperature and pressure to increase: acetonitrile, acrolein, 2-aminoethanol, ammonium hydroxide (28%), aniline, n-butyraldehyde, chlorosulfonic acid, ethylene diamine, ethyleneimine, epichlorohydrin, ethylene cyanohydrin, hydrochloric acid (36%), hydrofluoric acid (48.7%), propiolactone, propylene oxide, sodium hydroxide, styrene monomer [NFPA 1991]. Sulfuric acid (concentrated) is extremely hazardous in contact with carbides, bromates, chlorates, fulminates, picrates, and powdered metals [Haz. Chem. Data 1966]. Allyl chloride may polymerize violently under conditions involving an acid catalyst, such as sulfuric acid [Ventrone 1971]. React exothermically with sodium hypochlorite to produce chlorine gas. Mixing chlorosulfuric acid and 98% sulfuric acid may evolve HCl [Subref: Anon, Loss Prev. Bull. 1977, (013), 2-3]. Zinc iodide reacts violently with H2SO4.

SULFURIC ACID, [SPENT] is diluted and partly neutralized sulfuric acid recovered from industrial use. Likely to contain multiple impurities. Reacts an an acid and as a weak oxidizing agent. Chars wood and most other organic matter, but is unlikely to cause a fire. Zinc iodide reacts violently with H2SO4.

Conditions to avoid

Highly reactive with water and alkalis.

Incompatible materials

Bases, Halides, Organic materials, Carbides, Chlorates, fulminates, Nitrates, picrates, Cyanides, Reacts violently with:, cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phosphorous(III) oxide, Powdered metals. Alkalis. Attacks many metals producing extremely flammable hydrogen gas which can form explosive mixtures with air. Reactive or incompatible with the following materials: alkalis.

Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. Other decomposition products - No data available. In the event of fire: see section 5.

11 Toxicological information

Toxicological (health) effects

Acute oral toxicity
The single available acute oral toxicity study (Smyth et al, 1969) performed with sulphuric acid reports an LD50 value of 2140 (1540 -2990) mg/kg bw. The study is reported in summary form only but the protocol design is comparable to OECD 401. The results of this study indicate that sulphuric acid is of low acute systemic toxicity when administered by gastric intubation. However it should be noted that the route of administration used in this study eliminates the potential for local corrosive effects of the test material on the upper gastrointestinal tract (mouth, pharynx and oesophagus). Following accidental/intentional oral ingestion of sulphuric acid by humans, the local effects on the upper gastrointestinal tract are likely to dominate the clinical presentation and the potential for systemic toxicity is likely to be low. Further testing of sulphuric acid for acute oral toxicity in animals (i.e. in a guideline- and GLP-compliant study) is not proposed for acute oral toxicity and for reasons of animal welfare, due to the corrosivity of the substance.

Acute dermal toxicity
No data on acute dermal toxicity in animals are available. Although this is a potential route of exposure for workers, testing is not justified for scientific reasons and on animal welfare grounds. The effects of acute dermal exposure to sulphuric acid on animals can be readily predicted, and the data from human exposure are sufficient to characterise the effects.

Acute inhalation toxicity
A number of acute inhalation toxicity studies have been performed with sulphuric acid, using various species and exposure times. In all tested species (rats, mice, rabbits and guinea pigs) the concentration of acid aerosol, the length of exposure and particle size are important factors in determining lethality by inhalation. Among the different species tested, the guinea pig appears to be the most sensitive to the acute inhalation toxicity of sulphuric acid mist/aerosols. In the guinea pig, the apparent LC50 for an 8 hour-exposure period to sulphuric acid mist/aerosol with a particle size of approximately 1 um ranges from 0.018-0.050 mg/l depending on the age of the animals, with younger guinea pigs apparently more sensitive to than older animals. In the more reliable studies performed in other species, LC50 values vary with exposure

duration and are in the range 0.375-0.425 mg/l in the rat, 0.600-0.850 mg/l in the mouse and 1.47-1.61 mg/l in the rabbit. The sensitivity of the guinea pig may be caused by its tendency to bronchoconstriction and laryngeal spasm compared with the other tested species. The main macroscopic and or microscopic alterations observed in respiratory tract following acute inhalation exposure were haemorrhage, oedema, atelectasis and thickening of the alveolar wall in the guinea pig lung; haemorrhage and oedema of the lungs, ulceration of the nasal turbinates, trachea and larynx in rats and mice. These lesions are directly related to the corrosive/irritant effects of sulphuric acid and there is no indication of systemic toxicity following acute inhalation exposure.

Based on the results of the acute oral toxicity study, no classification for acute oral toxicity is proposed according to current EU criteria.

No classification is proposed for acute dermal toxicity in the absence of an appropriate study; the acute dermal toxicity of sulphuric acid is dominated by local corrosivity and irritancy and is therefore sufficiently addressed by the current R35 classification of the substance.

Although the LC50 values from the various inhalation toxicity studies performed with sulphuric acid theoretically trigger Classification with (R23) 'Toxic by inhalation', classification is not proposed. The effects of sulphuric acid following inhalation are entirely due to local irritation / corrosivity of the respiratory tract: there is no evidence for the systemic toxicity of sulphuric acid in any study as effects are limited to the site of contact. As the substance already carries classification for its corrosive effects, classification for acute inhalation toxicity is not considered to be appropriate.

Skin irritation / corrosion
Endpoint conclusion: adverse effect observed (corrosive)
Skin - Rabbit (Sulfuric acid) Result: Extremely corrosive and destructive to tissue.

Eye irritation
Endpoint conclusion: adverse effect observed (irritating)
Eyes - Rabbit (Sulfuric acid) Result: Corrosive to eyes.

Respiratory irritation
Endpoint conclusion: adverse effect observed (irritating)

Sulphuric acid is listed on Annex I of Directive 67/548/EEC with classification as 'CORROSIVE' (R35). Specific concentration limits are R35 for concentrations of >=15%; 'IRRITANT' (R36/38) 'Irritating to eyes and skin' for concentrations of >=5% to 15%.

Skin sensitisation
Endpoint conclusion: no adverse effect observed (not sensitising)

Additional information:
Sulphuric acid has been in industrial use for many decades, and skin burns resulting from accidental occupational dermal contact with concentrated sulphuric acid are well documented. However, skin sensitisation secondary to skin irritation or burns has never been described, despite the fact that severe chemical irritation and burns are known to create favourable conditions for the induction of contact allergy: this strategy is, in fact, employed in routine skin sensitisation testing protocols such as the Magnusson and Kligman maximisation test. Repeated contact with more diluted sulphuric acid is known to cause skin desiccation, ulceration and chronic purulent inflammation around the fingernails, however these symptoms are quite different from those seen in acute or chronic allergic dermatitis. Skin contact with weak solutions of sulphuric acid (~10%) has been quite common in the viscose rayon industry for nearly a century, however sulphuric acid allergy has never been reported. Sulphate ions are considered to be highly unlikely to cause allergy, since the body contains large amounts of sulphate ions (~0.33 mmol/l in serum and about 50 times higher concentration intracellularly). Various metal sulphates (e.g. nickel sulphate, cobalt sulphate) are used in routine allergy testing, but positive reactions are related to the metal ion, not to the sulphate, as can be deduced from the definitely non-allergenic zinc sulphate. Similarly, the hydrogen ion has no potential to cause skin sensitisation, therefore protein binding and hapten formation is considered to be highly unlikely.

Based on the information discussed above, it can be concluded that sulphuric acid has no potential to cause delayed contact hypersensitivity (skin sensitisation in humans) is not an allergen in humans.

Animal testing for sensitisation potential is not scientifically justifiable as it would not provide any information relevant for the human risk assessment and, additionally, testing with a corrosive substance is not required and cannot be justified on animal welfare grounds.

Respiratory sensitisation

Endpoint conclusion: no adverse effect observed (not sensitising)

Additional information:
Exposure of laboratory animals to sulphuric acid aerosols has been associated with non-specific airway hyper-responsivity, including bronchial constriction. However these effects do not have an immunological mechanism and therefore do not represent respiratory sensitisation.

Similar effects following the inhalation of sulphuric acid aerosols/mists have been seen in exposed humans and asthmatic subjects have proved to be more sensitive than non-asthmatics to effects including bronchoconstriction. It is thought that findings may be due to the lower pH of the respiratory mucus in asthmatics (pH 5.3 -7.6) compared to non-asthmatics (pH 7.4 -8.2). This has the consequence that the buffering capacity of respiratory mucus is lower and also that the mucus is more viscous, thus reducing the efficacy of mucociliary clearance. Asthmatic subjects (and also non-asthmatics with hyper-responsive airways) are therefore inherently more sensitive to the local effects of sulphuric acid (and other acid) inhalation on the respiratory tract, however the effects do not have an immunological basis and therefore do not represent respiratory sensitisation (occupational asthma).

Repeated dose toxicity: inhalation - systemic effects

Classification for severe effects after repeated or prolonged exposure (R48) is not proposed.

While the studies performed with sulphuric acid clearly show the potential for toxicity following repeated/prolonged exposure to low concentrations, there is clearly no potential for systemic toxicity and the effects seen in these studies are essentially a consequence of the local corrosivity/irritancy. Given the R35 classification, additional classification with R48 is not considered to be necessary or appropriate.

Genetic toxicity

No classification is proposed for genotoxicity. An absence of mutagenicity has been demonstrated in Ames tests; positive results in studies with mammalian cells are attributable to the artefactual effects of low pH. No in vivo studies are available, however the absence of systemic exposure to the substance and the lack of genotoxicity of the hydrogen and sulphate ions means that no genotoxicity is predicted and testing is not required.

Carcinogenicity

The available animal data do not support the classification of sulphuric acid for carcinogenicity. Weak evidence of a local carcinogenic effect on the forestomach/oesophagus was seen following lifetime oral gavage of rats with sulphuric acid at the MTD. Similarly, some evidence of a local carcinogenic effect on the respiratory tract was seen in rats treated with sulphuric acid by intratracheal instillation over a lifetime. A synergistic effect was seen in animals instilled with sulphuric acid and benzo(a)pyrene. A weak local carcinogenic effect was also seen in mice gavaged with sulphuric acid at the MTD over a lifetime. In all cases, findings were associated with chronic irritation at the site of contact. Although a number of epidemiological studies report a link between exposure to sulphuric acid mists and laryngeal cancer, the individual studies are imprecise and often do not take sufficient account of confounding factors such as smoking and occupational exposure to other chemicals, a number of studies (using various animal species) have not demonstrated any carcinogenic effect of inhalation exposure to sulphuric acid mists.

Reproductive toxicity

No classification is proposed for reproductive or developmental toxicity. The existing data and the absence of systemic exposure do not indicate that classification is required.

Neurotoxicity

The toxicology of sulphuric acid has been adequately described. The hazards associated with its corrosive or irritant nature (depending on the dilution) are known, and appropriate risk and safety phrases are in place. The immediate dissociation to hydrogen and sulphate ions in water, and the ubiquitous nature of both of those ions in physiological processes render further testing unnecessary.

Immunotoxicity

The toxicology of sulphuric acid has been adequately described. The hazards associated with its corrosive or irritant nature (depending on the dilution) are known, and appropriate risk and safety phrases are in place. The immediate dissociation to hydrogen and sulphate ions in water, and the ubiquitous nature of both of those ions in physiological processes render further testing unnecessary.

Health surveillance data
Conclusions:
Inhalation exposure to sulphuric acid is known to cause effects on the respiratory tract and teeth.

Executive summary:
Acute inhalation exposure to sulphuric acid aerosols causes a range of effects in the respiratory system including decrease in particle clearance rates at lower concentrations (1.0 mg/m33) to changes in lung function (>1.0 mg/m3). Asthmatics and those with hyper-reactive airways appear more sensitive to the broncho-constrictive effects of the aerosol. Repeated exposure to higher concentrations of aerosol (>3.0 mg/m3) has been reported to cause damage to the incisors.

Epidemiological data
Conclusions:
The authors conclude that sulfuric-acid at low concentrations does not irritate the upper respiratory tract. The sulfuric-acid may cause dental changes, even when it is at a concentration below what is considered the recommended standard.

Executive summary:
The chronic effects of sulfuric-acid on teeth and the respiratory system of workers in lead acid battery factories were examined. Workers exposed to sulfuric-acid mist were given questionnaires. Chest radiograms were taken and teeth were examined for evidence of etching or erosion. Respiratory symptoms such as cough, phlegm, dyspnea, and wheezing showed no significant differences between factories or by amount of sulfuric-acid exposure. Teeth etching and erosion showed a very strong association with acid exposure. Etching developed in 4 months with an average daily exposure of 0.23 milligram per cubic meter. High sulfuric-acid exposure groups had reduced forced vital capacity. Mean pulmonary function was not related to average exposure. Those with respiratory symptoms tended to have reduced pulmonary function. There was no excess of industrial bronchitis in the sulfuric-acid exposed workers. The authors conclude that sulfuric-acid at low concentrations does not irritate the upper respiratory tract. The sulfuric-acid may cause dental changes, even when it is at a concentration below what is considered the recommended standard

Direct observations: clinical cases, poisoning incidents and other
Conclusions:
The authors note that sulfuric-acid mists having concentrations below 3mg/m3 are not normally detectable. They conclude that respiratory changes induced by inhaling sulfuric-acid mists at concentrations on the order of 0.35mg/m3 are purely reflexive in nature. The more shallow, more rapid breathing may be a reflex protective mechanism to decrease the retention of acid mist particles.

Executive summary:
The effects of inhaling sulfuric acid mist were studied in humans. An unspecified number of normal male subjects inhaled sulfuric-acid aerosols at concentrations ranging from 0.35 to 5 milligrams per cubic meter (mg/m3). The subjects were at rest during the exposures and breathed through a face mask. Exposure times ranged from 5 to 15 minutes. Lung retention of sulfuric-acid was determined. The effect of the acid mist on respiration was measured by means of a pneumotachograph. Lung retention of sulfuric-acid averaged 77 percent. Exposures to the lower concentrations of mist caused more shallow and more rapid breathing. The period of expiration was prolonged, averaging 69.3 percent of the breathing cycle versus 59.6 percent of the cycle when the subjects breathed air. At sulfuric-acid concentrations of 5mg/m3, the effects of the mist on respiration were more varied. The major response was a decrease in minute volume. The authors note that sulfuric-acid mists having concentrations below 3mg/m3 are not normally detectable. They conclude that respiratory changes induced by inhaling sulfuric-acid mists at concentrations on the order of 0.35mg/m3 are purely reflexive in nature. The more shallow, more rapid breathing may be a reflex protective mechanism to decrease the retention of acid mist particles.

Aspiration hazard
No data available (Sulfuric acid).

Toxic effects on livestock and pets
No data are available and none are required.

Additional toxicological data
Executive summary:

Exposure of guinea pigs to sulphuric acid aerosols by inhalation revealed an all-or-none response, with increased resistance and reduced compliance seen in a proportion of animals. It is postulated by the authors that sensitivity may be linked to pre-exposure.

Additional Information:
RTECS: WS5600000.

Information on the likely routes of exposure

Data for WORKERS

INHALATION Exposure	**Threshold**	**Most sensitive study**
Systemic Effects		
Long-term:	-	-
Acute /short term:	-	-
Local Effects		
Long-term:	(DNEL) 50 µg/m³	irritation (respiratory tract)
Acute /short term:	(DNEL) 100 µg/m³	irritation (respiratory tract)

DERMAL Exposure	**Threshold**	**Most sensitive study**
Systemic Effects		
Long-term:	-	-
Acute /short term:	-	-
Local Effects		
Long-term:	-	-
Acute /short term:	-	-
EYE Exposure	-	

Data for the GENERAL POPULATION

INHALATION Exposure	**Threshold**	**Most sensitive study**
Systemic Effects		
Long-term:	-	-
Acute /short term:	-	-
Local Effects		
Long-term:	-	-
Acute /short term:	-	-

DERMAL Exposure	**Threshold**	**Most sensitive study**
Systemic Effects		
Long-term:	-	-
Acute /short term:	-	-
Local Effects		
Long-term:	-	-
Acute /short term:	-	-

ORAL Exposure	**Threshold**	**Most sensitive study**
Systemic Effects		
Long-term:	-	-
Acute /short term:	-	-
EYE Exposure	-	

Symptoms related to the physical, chemical and toxicological characteristics

Irritation eyes, skin, nose, throat; pulmonary edema, bronchitis; emphysema; conjunctivitis; stomatis; dental erosion; eye, skin burns; dermatitis.

Inhalation Symptoms
Cough. Sore throat. Burning sensation. Shortness of breath. Laboured breathing.

Skin Symptoms
Redness. Pain. Blisters. Serious skin burns.

Eye Symptoms
Redness. Pain. Severe burns.

Ingestion Symptoms
Burns in mouth and throat. Burning sensation behind the breastbone. Abdominal pain. Vomiting. Shock or collapse.

Target Organs
Eyes, skin, respiratory system, teeth.

Delayed and immediate effects and also chronic effects from short and long term exposure

Inhalation:
Corrosive. Burning sensation. Sore throat. Cough. Labored breathing. Shortness of breath. Symptoms may be delayed.

Skin:
Corrosive. Redness. Pain. Blisters. Serious skin burns.

Eyes:
Corrosive. Redness. Pain. Severe deep burns.

The results of inhalation exposure of human subjects to sulfuric acid mist at concn ranging from 0.35 to 5 mg/cu m for 5 to 15 min. Concn < 1 mg/cu m could be detected by odor, taste, or irritation. For two subjects, the threshold was 1 mg/cu m, a concn of 3 mg/cu m was noticed by all, and 5 mg/cu m was considered very objectionable to some but less so to others. Inhalation at the last concn usually produced coughing.

Extremely irritating, corrosive, and toxic to tissue, resulting in rapid destruction of tissue, causing severe burns. If much of the skin is involved, exposure is accompanied by shock, collapse, and symptoms similar to those seen in severe burns. Repeated contact with dilute solutions can cause a dermatitis, and repeated or prolonged inhalation of a mist of sulfuric acid can cause inflammation of the upper repiratory tract, leading to chronic bronchitis. Inhalation of concentrated vapor or mists from hot acid or oleum can cause rapid loss of consciousness with serious damage to lung tissue. Severe exposure may cause a chemical pneumonitis; erosion of the teeth due to exposure to strong acid fumes has been recognized in industry.

SYMPTOMATOLOGY (after ingestion or skin contact):
Corrosion of mucous membranes of mouth, throat, and esophagus, with immediate pain and dysphagia. The necrotic areas are at first grayish white but soon acquire a blackish discoloration and sometimes a shrunken or wrinkled texture; the process is described as a "coagulation necrosis." Epigastric pain, which may be associated with nausea and the vomiting of mucoid and "coffee-ground" material. At times, gastric hemorrhage may be intense, and the vomitus then contains fresh blood. Profound thirst. Ulceration of all membranes and tissues with which the acid comes in contact. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine. Circulatory shock is often the immediate cause of death. Asphyxial death due to glottic edema. Late esophageal, gastric and pyloric strictures and stenoses, which may require major surgical repair, should be anticipated. Signs of obstruction commonly appear within a few weeks but may be delayed for month and even year. Permanent scars may also appear in the cornea, skin and oropharynx. Uncorrected circulatory collapse of several hours duration may lead to renal failure and ischemic lesions in the liver and heart.

The symptoms of lung edema often do not become manifest until a few hours have passed, and they are aggravated by physical effort. Rest and medical observation are therefore essential.

Lungs may be affected by repeated or prolonged exposure to an aerosol of this substance. Risk of tooth erosion upon repeated or prolonged exposure to an aerosol of this substance. Strong inorganic acid mists containing this substance are carcinogenic to humans.

Occupational exposures to strong inorganic acid mists containing sulfuric acid are specifically associated with laryngeal and lung cancer in humans.

Sulfuric acid is corrosive and irritating and causes direct local effects on the skin, eyes and gastrointestinal tracts after direct exposure to sufficient concentrations. Small droplets of sulfuric acid (aerosol/mist) can also be inhaled and cause direct local effects on respiratory tract. The effects of inhaled sulfuric acid aerosols will depend on many factors: exposure concentrations; exposure time; particle size of the aerosol, which determines the location in the respiratory tract where sulfuric acids aerosols will deposit; humidity, both in the environment and in the respiratory tract, which determines the particle size; endogenous ammonia that can neutralize sulfuric acid; pattern of respiration and the inhalation route (oral or nasal); buffering capacity of the airways; species studied (e.g. respiratory tract dimension and architecture).

Toxic signs of oral exposure in human are of irritation/corrosion of the gastrointestinal tract.

Skin sensitization secondary to skin irritation or burns has never been described, despite the fact that severe chemical irritation and burns are known to create favorable conditions for the induction of contact allergy (this is a strategy employed in routine skin sensitization testing such with the Magnusson-Kligmann test).

Repeated contact with more diluted sulfuric acid is known to cause skin dessication, ulceration and chronic purulent inflammation around the nails.

Acute inhalation exposure to sulfuric acid aerosols causes a range of effects in the respiratory system including decrease in particle clearance rates at lower concentrations (< 1.0 mg/cu m) to changes in lung function (>1.0 mg/cu m). Asthmatics and those with hyper-reactive airways appear more sensitive to the broncho-constrictive effects of the aerosol. Repeated exposure to higher concentrations of aerosol (>3.0 mg/cu m) has been reported to cause damage to the incisors.

A review of 31 patients with chemical injuries admitted to the Tasmanian Burns Unit at the Royal Hobart Hospital (RHH) was carried out for the years 1989-1999. The majority of patients were men aged 20-49 years (mean age: 32 years). Fifty-one per cent of injuries occurred in a domestic and 38% in an industrial setting. The more common etiological agents were cement (25%), sulfuric acid (16%) and hydrofluoric acid (16%). The upper and lower extremities were involved in all but four patients and the mean total body surface area affected was 3.4%. The mean length of hospital stay was 9 days with a range of 1-30 days. Management of injuries consisted of either surgical or conservative treatment. The former included debridement and split-thickness skin grafting or primary closure and the latter of topical treatment with 1% silver sulfadiazine cream and appropriate dressings.

There have been multiple case reports of chemical colitis resulting from unintentional administration of caustic chemicals. Intentional administration of corrosive enemas has been implicated in sexual practices, bowel cleansing, or in suicide attempts. Patients present with nonspecific symptoms including abdominal pain, rectal bleeding, and/or diarrhea. As chemical colitis remains rare, the literature consists of scattered case reports and small series. Agents implicated in chemical colitis include alcohol, radiocontrast agents, glutaraldehyde, formalin, ergotamine, hydrofluoric acid, sulfuric acid, acetic acid, ammonia, soap, sodium hydroxide, hydrogen peroxide, herbal medicines, chloro-m-xylenol, and potassium permanganate. Clinical, endoscopic, and histologic features are outlined for each agent in addition to the existing literature. Given the nonspecific presentation of many cases of chemically induced colitis, the diagnosis can be challenging if the pertinent history is not obtained. Most patients demonstrate the resolution of chemical-induced colitis after conservative or medical therapy. Depending on the depth and extent of injury, patients rarely require colectomy for ischemic colitis and/or peritonitis. Other postingestion complications include colonic strictures and rectovaginal fistulae. The benefits of medical therapy compared with conservative therapy are not known, as comparative clinical management trials have not been performed.

Sulfuric acid is a direct irritant that results in adverse effects at the site of contact. The concentration of sulfuric acid is important in determining effects. For example, a small amount of concentrated sulfuric acid will erode and possibly cause perforation of the gastrointestinal tract if swallowed. The same amount of acid diluted sufficiently will have no effects. The effects of sulfuric acid are thought to be a result of pH change rather than a result of sulfate. If there is enough acid-neutralizing capacity at the site of contact with sulfuric acid, there will be no effects.

Numerical measures of toxicity (such as acute toxicity estimates)

Acute toxicity	
LD_{50} Oral (rat)	2.140 mg/kg bw
LD_{50} Dermal	No data
LC_{50} Inhalation (mouse)	(8h) 600 mg/m^3 air (4h) 850 mg/m^3 air

Repeated Dose toxicity	
LOAEC (rat)	300 µg/m^3 air

Interactive effects

The effects of a combination of sulfuric acid mist at 8 mg/cu m and sulfur dioxide at 89 ppm on growth, lung pathology, and respiratory response were reported. In 8 pigs exposed for 8 hr, weight had decreased the day following exposure and growth was slower to resume than was observed for either agent administered separately. Two guinea pigs were exposed 72 hr following the initial exposure to the same concn for another 8 hr. In these reexposed animals, growth ceased entirely during the period of observation following reexposure. Pathologic lung changes were also more extensive than that observed for either agent alone, consisting of large areas of complete consolidation and hepatization involving entire lobes in all cases. In the reexposed animals, extensive hemorrhage and consolidation were present. It was commented that the general ill health of the animals was very likely related to the presence of the extensive lung damage. Labored breathing was very pronounced, continuing for 24 to 48 hr after exposure. In contrast, there were no noticeable respiratory effects in guinea pigs exposed to 8 mg/cu m sulfuric acid mist alone. Restlessness and annoyance initially appeared in animals exposed to 89 ppm sulfur dioxide alone, but disappeared after approximately 5 to 10 min exposure. It was therefore concluded that effects on growth, lung changes, and respiration were much more marked than would have been predicted from the use of either agent alone.

Where specific chemical data are not available

No additional data.

Mixtures

No additional data.

Mixture versus ingredient information

No additional data.

Other information

No additional data.

12 Ecological information

Toxicity

Hazard for aquatic organisms

Freshwater	
Hazard assessment conclusion:	PNEC aqua (freshwater)
PNEC value:	0.003 mg/L
Assessment factor:	10
Marine water	
Hazard assessment conclusion:	PNEC aqua (marine water)
PNEC value:	0 mg/L
STP	
Hazard assessment conclusion:	PNEC STP
PNEC value:	8.8 mg/L
Assessment factor:	10
Sediment (freshwater)	
Hazard assessment conclusion:	PNEC sediment (freshwater)
PNEC value:	0.002 mg/kg sediment dw
Extrapolation method:	equilibrium partitioning method
Sediment (marine water)	
Hazard assessment conclusion:	PNEC sediment (marine water)
PNEC value:	0.002 mg/kg sediment dw

Additional information

Sulphuric acid is a strong mineral acid that dissociates readily in water to hydrogen ions and sulphate ions (at environmentally relevant pH) totally dissociates and and is totally miscible with water. The hydrogen ions, although not degraded as such due to their elemental nature, contribute to the pH of the local environment. The sulphate ions are incorporated into the various mineral species present in the environment. The total dissociation of sulphuric acid at environmental pH implies that it will not, per se, adsorb onto particulates or accumulate in living tissues.

Conclusion on classification

Sulphuric acid is listed on Annex I with no classification for environmental effects. No change to this classification is proposed based on the information presented in this dossier.

Short-term toxicity to fish
An acute toxicity study performed with bluegill sunfish (Lepomis macrochirus) was conducted, in which fish were exposed to series of pH values decreasing from 7.5 to 3.25. There was no mortality at pH values of 7.5, 5.0, 4.5, 4.0 or 3.5 and 100% mortality at 3.25. The 96 hour LC50 for sulphuric acid to bluegill sunfish was determined to be between pH 3.25 and 3.5, equivalent to 16 to 28 mg/L.

Long-term toxicity to fish
The first study is a chronic toxicity study with the brook trout (Salvelinus fontinalis). Fertilised eggs from three sources (wild strain, acidic watershed, pH 4.7 to 5.3, wild strain from neutral watershed , pH 7.0, and a hatchery strain, pH 7.0) were exposed to a series of test media, with pH adjustment using sulphuric acid to varying pHs (3.9, 4.3, 4.7, 5.2 and 7.0) under flow-through conditions. At pH 3.9, most embryos were dead within a few degree-days. Significant differences in mortality between the strains at low pH were observed and these suggested a genetic component to acid tolerance. Mortality in the strain from the acidic watershed was the lowest, followed by the second wild strain. Survival of both wild strains at low pH was much better than that of the hatchery embryos. These differences in survival at sublethal acidity (pH 4.7 to 7.0) were principally the result of high mortality shortly after fertilisation; after this period, mortality stabilised. Only at pH 4.3 did substantial mortality occur at hatching. The early embryonic strain therefore appears to be the most susceptible to sublethal acid stress in brook trout. Hatchery strain embryos were also introduced at the eyed stage at 213 degree days. Subsequent survival of this group was better at low pH than that of hatchery embryos introduced at fertilisation. Higher acidity retarded hatch in all cases. The no-observed effect concentration (NOEC) for brook trout (based on survival) exposed to sulphuric acid was observed to be pH 5.2, equivalent to 0.31 mg/L.

The second study reported is also a chronic toxicity study with the brook trout (Salvelinus fontinalis). Hatchery reared fish were maintained in the laboratory at mean pH values of 7.34, 5.56, 5.16 and 4.48 from early February to December 1984. At pH 4.8, the mean growth rates of males were uniformly lowered during the entire experimental period. Among females, growth was inhibited during the first 5 months, but their rate of weight gain recovered during the period of rapid oocyte development. At the end of the experiment, the body weights of both male and female fish in pH 5.16 and 4.48 were only 71 – 77% of the control fish at pH 7.34. Growth was not affected by exposure to pH 5.56. Rapid oocyte development occurred simultaneously over all pH groups in June, suggesting that the initiation of gametogenesis was not affected over the range of pH tested. The number of eggs produced was significantly correlated to body weight; consequently the number of eggs produced by the smaller ph 5.16 – 4.48 females was reduced. Ovulation was also significantly delayed in the acidic groups. The overall NOEC for this study was determined on the weight of juvenile trout produced in 10 months and was pH 5.56 (equivalent to 0.13 mg/L).

The third study investigated breeding communities of flagfish (Jordanella floridae) exposed to northern Ontario lake water (hardness 28 mg/L) adjusted to pH levels of 6.0, 5.5, 5.0 and 4.5. Control water (pH 6.8) received no acid treatment. Egg production, egg fertility and fry growth was significantly impaired ($P < 0.05$) at all exposure levels. Flagfish fry survival was also significantly reduced ($P < 0.05$) at pH 5.5 and 5.0, no fry survived at pH 4.5. Variability of hatching in all treatments precluded any identifiable hatching response to depressed pH. Reduction in the reproductive processes monitored indicated the following order of sensitivity: egg production > fry survival > fry growth > egg fertility. The LOEC 20% (lowest observed effect concentration) was pH 6.0 equivalent to 0.049 mg/L. and the NOEC (LOEC/2) was determined to be 0.025 mg/L.

Short-term toxicity to aquatic invertebrates
Weyers (2009) performed a study to assess the acute toxicity of sulphuric acid to Daphnia magna STRAUS under static conditions. The study was conducted in accordance with the Council Regulation (EC) No 440/2008, Method C.2 'Acute toxicity forDaphnia' (2008) which is equivalent to OECD Guideline for Testing of Chemicals No. 202 'Daphnia sp., Acute Immobilisation Test' (adopted April 13, 2004).Daphnia were exposed to a limit test concentration of nominally 100 mg/L sulphuric acid dissolved in water. Observations were made on the swimming ability and the immobilisation rate, respectively, after 24 and 48 hours of exposure. There were no observed toxic effects on Daphnia at the limit concentration of 100 mg/L after 48 hours. The EC50 for this study is therefore >100 mg/L.

Long-term toxicity to aquatic invertebrates
A chronic toxicity study with the midge Tanytarsus dissimilis was conducted. Midge larvae were exposed to a series of test media, carbon-filtered lake water with pH adjustment using sulphuric acid, to varying pHs. At pH 3.0 and 4.0 all of the larvae died within 10 days. At pH 5 larvae pupated but the adults were unable to escape from the pupal case. At pH 5.5 and 6.0 there were no effects on the initial larvae and three complete generations were obtained. The initial 15 larvae increased to between 500 and 550 larvae. The results from the control group (lake water with no adjustment pH 7.8) were

the same as in the pH 5.5 and 6.0.

The no-observed effect concentration (NOEC) for T. dissimilis (based on reproduction) exposed to sulphuric acid was observed to be pH 5.5, equivalent to 0.15 mg/L.

Toxicity to aquatic algae and cyanobacteria
Weyers (2009) performed a study to assess the adverse effects of sulphuric acid on the yield (biomass) and the growth rate of the planktonic freshwater algal species Desmodesmus subspicatus (former name: Scenedesmus subspicatus) over several generations.
The study was conducted in accordance with OECD Guideline for Testing of Chemicals No. 201 'Alga, Growth Inhibition Test' (2006). This method succeeded the previous OECD Guideline No. 201 'Alga, Growth Inhibition Test' (1984) and EU Method C.3 'Algal inhibition test' (1992). Exponentially growing algal cells were exposed for a period of 72 hours to a limit test concentration of nominally 100 mg/L of Sulfuric acid dissolved in water adjusted to pH 8.1 of the OECD growth medium. The cell densities were measured at 24 hour intervals. Inhibition of the algal population was measured as reduction in growth rate (index r), relative to control cultures grown under identical conditions. A NOEC of 100 mg/L was determined.

Toxicity to aquatic plants other than algae
No data available.

Toxicity to microorganisms
Sulphate is inherently non-toxic to bacteria and is used by strains of anaerobic bacteria as an energy source. Sulphate reducing bacteria are required for the anaerobic digestion of raw sewage sludge. Sulphate is included as a component of the synthetic sewage feed defined by OECD 209. The toxic effects of sulphuric acid will therefore be driven by pH. Available non-standard data for the read-across compound sodium sulphate report NOECs for bacteria in sewage sludge of 26 -30 g/L. Niederlehner & Cairns (1990) investigated the chronic effects of pH of protozoa, bacteria and algae in a microcosm study using sulphuric acid as a test substance. Bacterial abundance was shown to decrease at pH levels of <= 5.34 (100 mg/L sulphuric acid), with no effects seen at pH 6.61 (88 mg/L sulphuric acid). Bacteria were shown to be relatively insensitive to the effects of acid pH under the conditions of this study.

Toxicity to other aquatic organisms
No data available.

Sediment toxicity
No data are available. No testing is proposed as significant terrestrial exposure is not predicted. Sulphuric acid will rapidly dissociate in the environment to form the ubiquitous hydrogen (hydronium) and sulphate ions.

Terrestrial Toxicity
No data on terrestrial toxicity are available and no testing is proposed. Waivers are proposed for all endpoints based on the lack of exposure, however endpoints may have to be re-considered in light of more detailed exposure modelling for all uses in the CSR.

Persistence and degradability

No studies of biodegradation are available and none are required: waivers are therefore proposed.

Sulphuric acid is a simple inorganic substance, which will not biodegrade. The substance dissociates readily in water to form hydrogen ions and sulphate ions (at environmentally relevant pH) and is totally miscible with water. The hydrogen ions, although not degraded as such due to their elemental nature will react with and be neutralised by (OH) to form water. The sulphate ions are incorporated into the various mineral species present in the environment. No further information is necessary.

Bioaccumulative potential

Sulphuric acid is a strong mineral acid (pKa =1.92) that dissociates readily in water to hydrogen ions and sulphate ions (at environmentally relevant pH) and is totally miscible with water. The resulting hydrogen ions and sulphate ions are naturally present in water/sediment and no bioaccumulation of these ions is predicted. The hydrogen ions will react with hydroxyl ions to form water. No further information is necessary. A waiver is therefore proposed based on the chemical nature and rapid dissociation of sulphuric acid to form environmentally ubiquitous ionic species. No bioaccumulation of these ions is predicted as they are ubiquitous in living organisms and subject to physiological homeostasis, therefore secondary poisoning is not relevant. No further information is necessary.

A waiver is proposed for this endpoint.

Mobility in soil

Sulphuric acid is a strong mineral acid that dissociates readily in water to hydrogen ions and sulphate ions (at environmentally relevant pH) and is totally miscible with water. The resulting hydrogen ions and sulphate ions are naturally present in water/sediment. The hydrogen ions will contribute to local pH and are potentially mobile; sulphate ions may be incorporated into naturally occurring mineral species. No further information is necessary.

No studies are available and none are proposed. A waiver is proposed based on the chemical nature and rapid dissociation of sulphuric acid to form environmentally ubiquitous ionic species.

Other adverse effects

Stability
Sulphuric acid is a strong mineral acid(pKa = 1.92)that dissociates readily in water to hydrogen ions and sulphate ions (at all environmentally relevant pH levels), and is totally miscible with water. Following dissociation, the hydrogen ion reacts with (OH) and yields water. At all environmentally relevant concentrations, the substance will therefore exist as the environmentally ubiquitous sulphate (SO4 -) anion and hydronium (H3O+) cation. No further studies on hydrolysis or additional information are required.

Hydrolysis
Sulphuric acid is a strong mineral acid (pKa = 1.92) that dissociates readily in water to hydrogen ions and sulphate ions (at all environmentally relevant pH levels), and is totally miscible with water. Following dissociation, the hydrogen ion reacts with (OH) and yields water. At all environmentally relevant concentrations, the substance will therefore exist as the environmentally ubiquitous sulphate (SO4 -) anion and hydronium (H3O+) cation. No further studies on hydrolysis or additional information are required.

Phototransformation in water
Sulphuric acid is a strong mineral acid that will react with minerals and other soil constituents e.g. carbonates, liberating carbon dioxide, and forming the corresponding sulphate. Phototransformation will not occur. No further information is necessary.

Phototransformation in soil
Sulphuric acid is a strong mineral acid that will react with minerals and other soil constituents e.g. carbonates, liberating carbon dioxide, and forming the corresponding sulphate. Phototransformation will not occur. No further information is necessary.

13 Disposal considerations

Disposal methods

Waste disposal recommendations
Avoid contact of spilled material and runoff with soil and surface waterways. Consult an environmental professional to determine if local, regional or national regulations would classify spilled or contaminated materials as hazardous waste. Use only approved transporters, recyclers, treatment, storage or disposal facilities. Dispose of in accordance with all applicable local and national regulations.

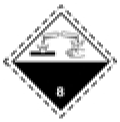
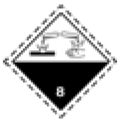
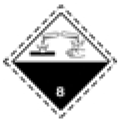
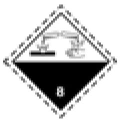
Ecology - waste materials
DO NOT release to the environment.

Empty Container
DO NOT reuse container. Rinse thoroughly before discarding in trash or return to supplier.

14 Transport information

UN Number

TRANSPORTATION CLASSIFICATION	DOT	TDG	IMDG	IATA
Identification Number	1830	1830	1830	1830
Proper Shipping Name	SULFURIC ACID with >51% acid	SULFURIC ACID with >51% acid	SULFURIC ACID with >51% acid	SULFURIC ACID with >51% acid

Transport Hazard Class(es)	8 	8 	8 	8 
Packing Group	II	II	II	II
Environmental Hazards	N/A	N/A	Refer below	Refer below
Emergency Response	ERG: 137/157	N/A	Refer below	Refer below
Additional Information	None	None	Refer below	Refer below
Special Provisions	None	None	Refer below	Refer below
Vessel Stowage	N/A	N/A	Refer below	On deck only
Quantity Limitations	Exempt Quantity 50Kg Factor 20	N/A	Refer below	Passenger/Rail 1 L Cargo 30L

IATA

The International Air Transport Association (IATA) Dangerous Goods Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials. Sulfuric acid with more than 51% acid; Sulfuric acid with 51% or less acid; and Sulfuric acid, spent are included on the dangerous goods list

IMDG

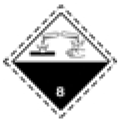
The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article. Sulfuric acid with more than 51% acid; Sulfuric acid, spent; Sulfuric acid with not more than 51% acid or battery fluid, acid are included on the dangerous goods list.

UN Proper Shipping Name

SULFURIC ACID with >51% acid

Transport hazard class(es)

8



Packing group, if applicable

II **Exempt quantity** 50Kg **Factor** 20

Environmental hazards

DO NOT discharge into the environment.

Special precautions for user

DO NOT load with Classes 1 and 2.3.
Cyanides must not be transported with acid.
May be loaded with Classes 2.1, 2.2, 5.2, 6.1 and 6.2 if kept at least 1 metre apart.
Concentrated acids and bases **must** be kept at least 1 metre apart.
Can be loaded with all other classes.
Goods of different classes **must** be segregated by an air space of at least 100mm or by an approved segregation device or non-dangerous goods.

P, B, L and O provisions as per SANS 10231:2006
None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable.

15 Regulatory information

Safety, health and environmental regulations specific for the product in question

SA NATIONAL LEGISLATION
Hazardous Substances Act 15 of 1973 and Regulations.
Occupational Health and Safety Act 85 of 1993 and Regulations.

SA NATIONAL STANDARDS
SANS 10228 : 2006 : Identification and Classification of Dangerous Goods for Transport by Road and Rail.
SANS 10231 : 2018 : Transport of dangerous goods - Operational requirements for road vehicles.
SANS 10234 : 2008 : Globally Harmonized System of classification and labelling of chemicals (GHS).
SANS 11014 : 2010 : Safety Data Sheets for chemical Products.

REACH Regulation (EC) No 1907/2006
This product contains only components that have been either pre-registered, registered, are exempt from registration, are regarded as registered or are not subject to registration according to Regulation (EC) No. 1907/2006 (REACH). The aforementioned indications of the REACH registration status are provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. It is the buyer´s/user´s responsibility to ensure that his/her understanding of the regulatory status of this product is correct.

Seveso III: Directive 2012/18/EU
Listed in Regulation: Not applicable

Clean Water Act Requirements
Sulfuric acid is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

CERCLA Reportable Quantities
Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1000 lb or 454 kg. The toll free number of the NRC is (800) 424-8802. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV.D.3.b).

Releases of CERCLA hazardous substances are subject to the release reporting requirement of CERCLA section 103, codified at 40 CFR part 302, in addition to the requirements of 40 CFR part 355. Sulfuric acid is an extremely hazardous substance (EHS) subject to reporting requirements when stored in amounts in excess of its threshold planning quantity (TPQ) of 1000 lbs.

FIFRA Requirements
(a) Residues of sulfuric acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice when used as a herbicide in the production of garlic and onions, and as a potato vine dessicant in the production of potatoes. (b) Residues of sulfuric acid are exempted from the requirement of a tolerance in cattle, meat; goat, meat; hog, meat; horse, meat; sheep, meat; poultry, fat; poultry, meat; poultry, meat, byproducts; egg; milk; fish, shellfish, and irrigated crops when it results from the use of sulfuric acid as an inert ingredient in a pesticide product used in irrigation conveyance systems and lakes, ponds, reservoirs, or bodies of water in which fish or shellfish are cultivated. The sulfuric acid is not to exceed 10% of the pesticide formulation (non-aerosol formulations only).

Residues of sulfuric acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Use: pH control agent. Limit: Not to exceed 10% of the pesticide formulation; non-aerosol formulations only.

Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. (a) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils. Sulfuric acid is included on this list. Limit: Food-contact surfaces in public eating places, dairy-processing equipment, and food-processing equipment and utensils in antimicrobial formulations. Not to exceed 600 ppm.

Based on the reviews of the generic data for the active ingredients mineral acids /hydrogen chloride, phosphoric acid, sodium bisulfate and sulfuric acid/, the Agency has sufficient information on the health effects of mineral acids and on its potential for causing adverse effects in fish and wildlife and the environment. Therefore, the Agency concludes that products, labeled and used as specified in this Reregistration Elegibility Decision, containing mineral acids for all uses except for the use of sulfuric acid on potato vines, are eligible for reregistration.

As the federal pesticide law FIFRA directs, EPA is conducting a comprehensive review of older pesticides to consider their health and environmental effects and make decisions about their continued use. Under this pesticide reregistration program, EPA examines newer health and safety data for pesticide active ingredients initially registered before November 1, 1984, and determines whether the use of the pesticide does not pose unreasonable risk in accordance to newer safety standards, such as those described in the Food Quality Protection Act of 1996. Pesticides for which EPA had not issued Registration Standards prior to the effective date of FIFRA '88 were divided into three lists based upon their potential for human exposure and other factors, with List B containing pesticides of greater concern than those on List C, and with List C containing pesticides of greater concern than those on List D. Sulfuric acid is found on List D. Case No: 4064; Pesticide type: fungicide, herbicide, antimicrobial; Case Status: RED Approved 2/94; OPP has made a decision that some/all uses of the pesticide are eligible for reregistration, as reflected in a Reregistration Eligibility Decision (RED) document.; Active ingredient (AI): sulfuric acid; Data Call-in (DCI) Date(s): 2/23/94, 10/13/95; AI Status: OPP has completed a Reregistration Eligibility Decision (RED) for the case/AI.

FDA Requirements

The ingredient is used as a pH control agent as defined in part 170.3(o)(23) of this chapter and processing aid as defined in part 170.3(o)(24) of this chapter. The ingredient is used in food at levels not to exceed good manufacturing practice in accordance with part 184.1(b)(1). Current good manufacturing practice results in a maximum level, as served, of 0.014% for alcoholic beverages as defined in part 170.3(n)(2) of this chapter and 0.0003% for cheeses as defined in part 170.3(n)(5) of this chapter.

Chemical safety assessment

Performed for this substance: YES

16 Other information

Other information

Full text of H & P - Statements referred to under section 2.

Hazard Statements

H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.

Precautionary Statements

P234	Keep only in original container.
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.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P404	Store in a closed container.
P405	Store locked up.
P501	Dispose of contents and container in accordance with local, regional, national, international

regulations.

Labelling REGULATION (EC) No 1272/2008
Signal Word
Danger
Pictograms Hazard to Human

GHS05	Corrosive Hazard

Pictogram Hazard during Transport

Class 8	Corrosive Substance

Acronyms:

CAS	Chemical Abstract Service
CEIL	Ceiling Limit
DNEL	Derived No-Effect Level
DMEL	Derived Minimal Effect Level
DTP/NCI	NCI Development Therapeutics Program
EINECS	European Inventory of Existing Commercial Chemicals
ICSC	International Chemical Safety Cards
NCI	National Cancer Institute
NSC	National Service Centre
PNEC	Predicted No-Effect Concentration
RTECS	Registry of Toxic Effects of Chemical Substances
TLV	Threshold Limit Value
TWA	Time Weighted AVerage

Training advice
Provide adequate information, instruction and training for operators.

Information Sources

1. ECHA
   https://echa.europa.eu/de/registration-dossier/-/registered-dossier/16122/9
2. National Center for Biotechnology Information. PubChem Database. Sulfuric acid, CID=1118, https://pubchem.ncbi.nlm.nih.gov/compound/1118 (accessed on Apr. 13, 2019)
3. INCHEM – International Program on Chemical Safety
   http://www.inchem.org/documents/icsc/icsc/eics0362.htm
4. CDC The National Institute for Occupational Safety and Health (NIOSH)
   https://www.cdc.gov/niosh-rtecs/WS557300.html
   https://www.cdc.gov/niosh/npg/npgd0577.html
5. Cameo Chemicals
   https://cameochemicals.noaa.gov/chemical/5193
   https://cameochemicals.noaa.gov/chris/SFA.pdf

Compiled Aquatrade Water Treatment Chemicals (Pty) Ltd, by R. van Rooyen, SHEQ Co-ordinator and E. Le Sar, Director

MANUFACTURER/SUPPLIER DISCLAIMER:

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Revision History

Revision:	Date:	Change:
1.0	2019/03/15	Preparation of the safety data sheet according to Regulation (EC) No 1907/2006 of the European Parliament and of the Council
2.0	2019/04/13	Sections 3 - 14. Updated with information from ECHA, Pubchem, INCHEM, CDC & Cameo Chemicals
