FOREWORD INTRODUCTION

Sulfuryl chloride

CAS N°: 7791-25-5

SIDS Initial Assessment Report

For

SIAM 15

Boston, USA, 22-25 October 2002

1.	**Chemical Name:**	Sulfuryl chloride
2.	**CAS Number:**	7791-25-5
3.	**Sponsor Country:**	Germany Contact Point: BMU (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit) Contact person: Prof. Dr. Ulrich Schlottmann Postfach 12 06 29 D- 53048 Bonn-Bad Godesberg
4.	**Shared Partnership with:**	
5.	**Roles/Responsibilities of the Partners:**	
•	Name of industry sponsor /consortium	Bayer AG, Germany Contact person: Dr. Burkhardt Stock D-51368 Leverkusen Gebäude 9115
•	Process used	see next page
6.	**Sponsorship History**	
•	How was the chemical or category brought into the OECD HPV Chemicals Programme ?	by ICCA-Initiative
7.	**Review Process Prior to the SIAM:**	last literature search (update): 16 May 2002 (Human Health): databases medline, toxline; search profile CAS-No. and special search terms 15 May 2002 (Ecotoxicology): databases CA, biosis; search profile CAS-No. and special search terms
8.	**Quality check process:**	As basis for the SIDS-Dossier the IUCLID was used. All data have been checked and validated by BUA.
9.	**Date of Submission:**	20 August 2002
10.	**Date of last Update:**	

11. Comments:

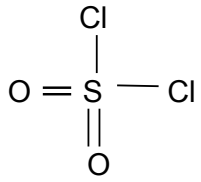
OECD/ICCA - The BUA* Peer Review Process

Qualified BUA personnel (toxicologists, ecotoxicologists) perform a quality control on the full SIDS dossier submitted by industry. This quality control process follows internal BUA guidelines/instructions for the OECD/ICCA peer review process and includes:

- a full (or update) literature search to verify completeness of data provided by industry in the IUCLID/HEDSET
- Review of data and assessment of the quality of data
- Review of data evaluation
- Check of adequacy of selection process for key studies for OECD endpoints, and, where relevant, for non-OECD endpoints by checking original reports/publications
- Review of key study description according robust summaries requirements; completeness and correctness is checked against original reports/publications (if original reports are missing: reliability (4), i.e. reliability not assignable)
- Review of validity of structure-activity relationships
- Review of full SIDS dossier (including SIAR, SIAP and proposal for conclusion and recommendation for further work)
- In case of data gaps, review of testing plan or rationale for not testing

* BUA (GDCh-Beratergremium für Altstoffe): Advisory Committee on Existing Chemicals of the Association of German Chemists (GDCh)

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	7791-25-5
Chemical Name	Sulfuryl chloride
Structural Formula	

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

The acute toxicity of sulfuryl chloride following inhalation is high. In male Sprague-Dawley rats with head-only exposure to vapor a 4 h-LC50 of 878 mg/m^3 was calculated. Clinical signs included nasal discharge and eye irritation.

In humans, pulmonary edema of delayed onset has been reported after inhalation of sulfuryl chloride vapor.

Sulfuryl chloride hydrolyzes slowly in moist air and reacts violently with water, forming chlorosulfonic acid, hydrochloric acid and sulfuric acid. Due to this hydrolytic reaction, sulfuryl chloride is corrosive to the skin, eyes and respiratory tract.

Studies with sulfuryl chloride concerning sensitizing properties are not available. The hydrolysis products sulfuric acid and hydrochloric acid gave no indication for a sensitizing potential in humans and experimental animals.

From a 14-day inhalation study with sulfuryl chloride in rats, a NOAEC could not be derived, since pneumonitis was still observed at the lowest exposure level of 17 mg/m^3. The reported effects are in line with all other evidence regarding the chemical and biological properties, i.e. corrosivity of sulfuryl chloride and its hydrolysis products hydrochloric acid, sulfuric acid, and chlorosulfonic acid. Studies performed with sulfuric acid gave LOAECs in the range of 0.3 mg/m^3, the LOAEC found in a 90-day study with hydrochloric acid was 15 mg/m³. All findings were confined to the site of first contact and can be explained by the irritating/corrosive properties of the acid.

Sulfuryl chloride as well as the hydrolysis products hydrochloric acid, sulfuric acid and chlorosulfonic acid are all classified as corrosive and hydrochloric acid and chlorosulfonic acid are classified as irritant to the respiratory tract. No primary systemic effects were reported.

Sulfuryl chloride did not show mutagenic activity in Ames tests with *Salmonella typhimurium*. A slight mutagenic activity was observed in only one tester strain without metabolic activation. However, this result was found to be not reproducible in further tests. As sulfuryl chloride decomposes to acids, the resulting change in pH may induce genotoxic effects such as chromosomal aberrations and other DNA damage *in vitro* and *in vivo* at the portal-of-entry.

No carcinogenicity studies with sulfuryl chloride were identified. The hydrolysis products hydrochloric acid and sulfuric acid gave no clear indications for an increased tumor incidence after life-time exposure in laboratory animals.

Studies with sulfuryl chloride concerning effects on fertility and development were not available and there were also no data on fertility effects for the hydrolysis products sulfuric acid and hydrochloric acid. Concerning developmental toxicity, the hydrolysis product sulfuric acid gave no indication for adverse effects in mice and rabbits after exposure via inhalation. Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and

because it is unlikely to reach the reproductive organs or the embryo/fetus, toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to sulfuryl chloride by any route.

In humans, several epidemiological studies have suggested a relationship between exposure to strong inorganic acid mists containing sulfuric acid and an increased incidence of laryngeal cancer. IARC (1992) has concluded that "occupational exposure to strong-inorganic-acid mists containing sulfuric acid is carcinogenic to humans" (Group 1). Concerns have been raised that confounding factors could not be fully excluded. The effects might be a secondary finding to be expected after prolonged exposure to strong acid due to the cytotoxicity and consequent stimulus to increased cell proliferation.

Environment

Sulfuryl chloride is a moisture/water sensitive fluid which hydrolyses completely and decomposes on heating above the boiling point (69°C) from 100°C on. It reacts violently with water. The vapor pressure is given with 148 hPa at 20°C, the log Kow cannot be determined due to hydrolysis.

If sulfuryl chloride is released to water, degradation occurs through hydrolysis to sulfuric and hydrochloric acid. A guideline test on hydrolysis at room temperature under stirring shows the substance to be completely hydrolyzed within 5 min. For assessment of the environmental impact of the hydrolysis products it is referred to the validated results of the hazard assessments on sulfuric acid (CAS-No. 7664-93-9) and hydrochloric acid (CAS-No. 7647-01-0) within the OECD HPV Chemicals Programme. Both acids are strong mineral acids, which dissociate readily in water to sulfate or chloride ions resp. and the hydrated protons, and they are miscible with water. The total ionization will imply also that both acids themselves, will not adsorb on particulate matters or surfaces, and will not accumulate in living tissues.

The hydrolysis products of sulfuryl chloride have been tested in a number of aquatic species. All effects are accounted to acidification.

Lepomis macrochirus showed an acute toxicity (96 h LC50) when a pH value of 3.5 to 3.25 was reached. Chronic testing with early life stages of fish gave NOECs at pH 6.0 (*Jordanella floridae*, exposure for 45 d) and 5.56 (*Salvelinus fontinalis* , exposure for 10 months).

Exposure

About 10,000 to 20,000 t/a sulfuryl chloride were produced by about 7 producers world wide in 2001. Sulfuryl chloride is a basic chemical which is processed chemically to other intermediates in different fields of application. A direct use besides in hermetically sealed batteries for special uses is not known. Due to the production and processing conditions, as well as the rapid hydrolysis property of sulfuryl chloride, no emission to the environment has been identified at the production site in the Sponsor country. There is no information about environmental emission at other production and processing sites.

Sulfuryl chloride is produced in closed systems. To protect workers from exposure during maintenance and repair work precautionary measures like engineering controls and personnel training is used. Sulfuryl chloride has a high vapour pressure and may react violently with water. Hence, workers may potentially be exposed through the inhalation of vapour or dermally by splashing from liquid.

There is no exposure of the general public in the Sponsor country.

RECOMMENDATION

The chemical is currently of low priority for further work.

RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED

Human Health: The corrosive properties indicate a hazard for human health. No further work is recommended, if sufficient control measures are in place to avoid significant human exposure, including prevention of accidental exposure. In situations where this is not the case, risk assessment and, if necessary, risk reduction measures are recommended.

Environment: The chemical is currently of low priority for further work as it hydrolyses very fast and therefore environmental releases of sulfuryl chloride are not likely to occur. The degradation products sulfuric acid and hydrochloric acid have already been assessed within the OECD SIDS-Program.

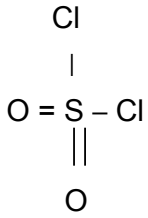
SIDS Initial Assessment Report

1 IDENTITY

1.1 Identification of the Substance

CAS Number: 7791-25-5
IUPAC Name: Sulfuryl chloride
Molecular Formula: $Cl_2 O_2 S$
Structural Formula:

:



Synonyms: Sulphuric oxychloride, Sulfonyl chloride

1.2 Purity/Impurities/Additives

The purity of the substance is given with ≥ 99.0 % w/w. Impurities may be sulfur dioxide with ≤ 0.5 % and chlorine with 0.1 % (Bayer AG, 2002c).

1.3 Physico-Chemical properties

Sulfuryl chloride is a colorless liquid with a pungent odor. On prolonged standing, sulfuryl chloride decomposes partly into the starting substances sulfur dioxide and chlorine, which gives the liquid a yellowish color (Römpp, 1999). Sulfuryl chloride is also decomposed slowly above the boiling point (69 °C) from 100 °C on (Bayer AG, 2002a). In air sulfuryl chloride will be affected by air humidity, which leads to hydrolysis products sulfuric acid and hydrochloric acid . In aqueous solution at room temperature under intense mixing or with hot water the substance reacts vigorously and completely, forming hydrochloric acid (HCl) and sulfuric acid (H_2SO_4), in buffered medium the corresponding salts (Bayer AG, 2002c). A hydrolysis test according to Guideline EWG 92/69 C.7 showed sulfuryl chloride to be completely hydrolyzed at room temperature after 5 minutes in buffered dest. water at pH 9, pH 7 and pH 4 respectively (Bayer AG, 2002b).

The vapor pressure of sulfuryl chloride is 148 hPa at 20 °C (Vdovenko and Kovaleva, 1958). A log K_{ow} is not determinable due to the reaction with water.

2 GENERAL INFORMATION ON EXPOSURE

The world wide (excluding East Europe) production of sulfuryl chloride is estimated to 10,000 to 20,000 metric tons in 2001. Thereof about 25 - 30 % are produced in West Europe, about 35 - 40 % in the USA, and about 35 - 40 % in Asia by presumably 7 producers. There is no information about production in East European countries (Bayer AG, 2002c).

Sulfuryl chloride is produced in a closed system by reaction of sulfur dioxide and chlorine in the presence of a catalyst e.g. activated carbon. The crude product is freed from excess SO_2 or Cl_2 by distillation (Bayer AG, 2002c).

Sulfuryl chloride is a basic chemical, used industrially as a chlorinating or sulfonating agent for manufacturing of further intermediates. By chlorination for example, chlorophenols or side-chain chlorinated aromatics are gained and by sulfonation, sulfonic acids are gained. These intermediates are further used in different areas as plant protection agents and biocides (about 49 %), pharmaceuticals (about 35 %), fine chemicals (about 10 %), coloring agents (about 5 %), and fragrances (about 1 %) (Bayer AG, 2002c).

Sulfuryl chloride is known to be used in hermetically sealed high power batteries for specialized commercial, aerospace, oil drilling, and military applications. A further direct use of sulfuryl chloride is not known (Bayer AG, 2002c).

There is no entry of sulfuryl chloride in the Swiss, Swedish, Norwegian and the Danish product register (Swiss Product Register, 2002; Swedish Product Register, 2002; Norwegian Product Register 2002, Danish Product Register, 2002).

Information on exposure from production and processing of sulfuryl chloride refers to the situation in Germany at Bayer AG:

There is no direct wastewater in connection with the sulfuryl chloride production process itself. The exhausts from the closed system production and processing of sulfuryl chloride are connected to central air washing units. Thus during normal operation no sulfuryl chloride is emitted to the air. Water from the air washing unit is led to the industrial biological waster water treatment plant (wwtp). Due the hydrolysis properties of sulfuryl chloride, no substance is emitted via the wwtp with the effluent or sewage sludge. Furthermore the outlet of the wwtp is monitored regularly with regard to the permitted pH value (Bayer AG, 2002c). There is no information available on environmental exposure of sulfuryl chloride from production and use as synthesis intermediate at other sites. Because of the hydrolyses property a relevant entry of sulfuryl chloride to the environment seems unrealistic.

There is no information available on the disposal of these special sulfuryl chloride containing batteries when they are exhausted.

An exposure of the terrestrial compartment could not be identified from the use pattern of this chemical. Besides, due to the rapid hydrolysis any emission to the terrestrial compartment would result in an exposure to the hydrolysis products.

2.1 Environmental Exposure and Fate

If sulfuryl chloride is released to water, degradation occurs through hydrolysis to sulfuric and hydrochloric acid. The hydrolysis half-life of sulfuryl chloride has been experimentally determined to be less than 5 minutes at pH 4, 7, and 9, respectively at 20 °C (Bayer AG, 2002b). Thus an environmental impact of sulfuryl chloride itself is not taken into account in the following.

For assessment of the environmental impact of the hydrolysis products, it is referred to the validated results of the hazard assessments on sulfuric acid and hydrochloric acid within the OECD SIDS-Program:

Sulfuric acid (CAS-No. 7664-93-9):

Sulfuric acid is a strong mineral acid that dissociates readily in water to sulfate ions and hydrated protons, and is miscible with water. At environmentally relevant concentrations, sulfuric acid is

practically totally dissociated, sulfate is at natural concentrations, and thus any possible effects are due to acidification. This total ionization will imply also that sulfuric acid, itself, will not adsorb on particulate matters or surfaces and will not accumulate in living tissues (OECD-SIAP Sulfuric Acid, 2001).

Hydrochloric acid (CAS-No. 7647-01-0):

Hydrochloric acid is a strong mineral acid as well, that dissociates readily in water to chloride ions and hydrated protons, and is miscible with water. Being diluted hydrochloric acid is practically totally dissociated (OECD SIAP Hydrochloric Acid 2002). This total ionization will imply also that like sulfuric acid, hydrochloric acid itself, will not adsorb on particulate matters or surfaces and will not accumulate in living tissues.

Estimation of the photodegradation of sulfuryl chloride is not applicable by current assessment models like AOPWIN due to the inorganic character of the substance. In air sulfuryl chloride will be affected by air humidity anyway, which leads to hydrolysis of the substance (see chapt. 1).

2.2 Human Exposure

2.2.1 Occupational Exposure

Sulfuryl chloride is a hazardous substance, but for Germany and the EU there is no workplace limit concentration laid down for the substance itself so far. Instead the workplace exposure must not exceed 8 mg/m³ for hydrochloric acid and 1 mg/m³ for sulfuric acid according to German TRGS 900.

Sulfuryl chloride has a high vapor pressure and may react violently with water. Hence, workers may potentially be exposed through the inhalation of vapor or dermally by splashing from liquid. Appropriate personal protection equipment is therefore prescribed in the material safety data sheet, which is also used to inform all down stream users.

Sulfuryl chloride is produced by reaction of sulfur dioxide and chlorine in closed systems. To protect workers from exposure to sulfuryl chloride at the production site several different precautionary and protective measures are taken These measures include engineering controls, periodical personnel training, and appropriate personal protection equipment prescribed in detail for different work situations (e.g. during maintenance and repair work) in order to exclude any exposure to the substance.

Sulfuryl chloride is transported in specially sealed tank wagons, special containers and / or special drums.

Workplace monitoring is carried out periodically at the production plant of Bayer. Due to the instability of sulfuryl chloride in ambient air, and the rapid decomposition into hydrochloric and sulfuric acid, the more volatile hydrochloric acid is measured as an indicator substance according to German TRGS 402 at different work places. All measurements were below 2 mg/m³ (Bayer AG, 2002c). No data on actual workplace concentrations at down stream user sites is readily available.

2.2.2 Consumer Exposure

Sulfuryl chloride is known to be used in hermetically sealed high power batteries for specialized commercial, aerospace, oil drilling, and military applications. There is no exposure of the general public from this use.

3 HUMAN HEALTH HAZARDS

In the presence of large quantities of water, sulfuryl chloride hydrolyses to hydrochloric acid and sulfuric acid, whereas with small amounts of water hydrolysis occurs via the intermediate chlorosulfonic acid, which then also decomposes immediately into hydrochloric acid and sulfuric acid. After contact with living tissues, sulfuryl chloride is hence expected to undergo immediate hydrolysis to chlorosulfonic acid, hydrochloric acid and sulfuric acid. The following assessment therefore includes available information on these compounds. A read-across was performed to fill data gaps, based on the assumption of a common mechanism, related to the ability of these compounds to reduce pH at the site of first contact. According to a recent review (BG Chemie 2000), the extreme irritation and corrosive effects of sulfuryl chloride are due to the reaction with water resulting in the formation of hydrochloric acid and sulfuric acid.

3.1 Effects on Human Health

3.1.1 Toxicokinetics, Metabolism and Distribution

Studies with sulfuryl chloride were not identified in the available literature.

At concentrations not exceeding the buffer capacity of body fluids, the free acids resulting from the hydrolysis of sulfuryl chloride will be neutralized quickly by body fluids. The resulting sulfate and chloride ions are natural components of food and ubiquitously found in living tissues, and are therefore not expected to pose a hazard. At concentrations, which exceed the buffer capacity of body fluids the acids will damage the tissue at the portal of entry dependent upon concentration and duration of exposure. Due to the hydrolysis at the site of first contact, a systemic availability of sulfuryl chloride or the free acids is hence not expected.

3.1.2 Acute Toxicity

Inhalation

There are no studies available performed according to current OECD guidelines. However, the available study with male Sprague-Dawley rats is considered to be sufficient to evaluate this endpoint. Ten animals per group were exposed to 84.4, 134, 155, 207, or 273 ppm (460, 740, 850, 1140, or 1500 mg/m^3) sulfuryl chloride vapor (purity ca. 100 %) by head-only exposure for 4 hours. All exposed animals showed reddish exudates from nose and eyes, and in surviving animals reduced body weights were observed 1 - 2 days after exposure. Macroscopical and histological findings were not reported. The 4 h-LC_{50} was calculated to be 878 mg/m^3 (Du Pont, 1982; Kelly and Stula, 1983; BG Chemie, 2000).

Comparable LC_{50} values have been found in studies with aerosols of sulfuric acid (OECD-SIDS Sulfuric Acid, 2001). Depending on the duration of exposure, the LC_{50} values for sulfuric acid range from 370 to 510 mg/m³ in rats, 320 to 850 mg/m³ in mice and 1470 to 1610 mg/m³ in rabbits.

In humans, vapors of sulfuryl chloride may cause pulmonary edema of delayed onset (Gerbis, 1931).

Conclusion: For rats the 4 h-LC_{50} of sulfuryl chloride is 878 mg/m^3. Clinical signs included nasal discharge and eye irritation.

In humans, pulmonary edema of delayed onset has been reported after inhalation of sulfuryl chloride vapor.

Dermal

Studies with sulfuryl chloride were not identified in the available literature.

The performance of meaningful studies is not considered possible due to the corrosive nature of sulfuryl chloride. At the low concentrations necessary to avoid irritation or corrosion, sulfuryl chloride will hydrolyze completely before it can even be administered to the skin. This would result in exposure to physiologic ions, which do not penetrate the skin in relevant quantities and are considered completely innocuous at these concentrations.

Oral

Studies with sulfuryl chloride were not identified in the available literature.

The hydrolysis products of sulfuryl chloride are strongly acidic, corrosive substances that are acutely toxic to all human tissue. The extent of tissue damage is dependent upon concentration and duration of exposure, and can range from mild, transient irritation to corrosion, and can in extreme cases cause death (TNO BIBRA International Ltd, 1990).

For sulfuric acid an oral LD_{50} value for rats is given with 2140 mg/kg (OECD-SIDS Sulfuric Acid, 2001). 900 mg/kg of hydrochloric acid were lethal for rabbits (Loewy and Munzer, 1923).

3.1.3 Irritation

Skin Irritation

Studies in Animals

Studies with experimental animals dealing specifically with this endpoint are not available.

Studies in Humans

The hydrolysis products of sulfuryl chloride are strongly acidic, corrosive substances that are acutely toxic to all human tissue. The extent of tissue damage is dependent upon concentration and duration of exposure, and can range from mild, transient irritation to corrosion.

Sulfuric acid is corrosive to the skin, while 10 % solutions of sulfuric acid appear not to be irritating to the skin in different species (OECD-SIDS Sulfuric Acid, 2001). Hydrochloric acid causes, dependent on its concentration, irritation or corrosion to the skin of humans and laboratory animals (TNO BIBRA International Ltd, 1990).

Conclusion: Based on the chemical nature of the substance itself and based on information on its hydrolysis products hydrochloric acid and sulfuric acid, it can be concluded that sulfuryl chloride is corrosive to the skin.

Eye Irritation

Studies in Animals

Studies with experimental animals dealing specifically with this endpoint are not available.

Studies in Humans

The hydrolysis products of sulfuryl chloride are strongly acidic, corrosive substances that are acutely toxic to all human tissue. The extent of tissue damage is dependent upon concentration and duration of exposure, and can range from mild, transient irritation to corrosion.

For sulfuric acid conflicting results (not irritating or severely irritating) are observed in eye irritation studies using 10 % sulfuric acid (OECD-SIDS Sulfuric Acid, 2001).

Hydrochloric acid causes effects from mild irritation to corrosion in the eyes of humans and laboratory animals, dependent on its concentration (TNO BIBRA International Ltd, 1990).

Conclusion

Based on the chemical nature of the substance itself and on information regarding its hydrolysis products hydrochloric acid and sulfuric acid, it can be concluded that sulfuryl chloride is corrosive to the eyes. Depending on the duration of exposure and the concentration of the agent (liquid or vapor) slight burning with lacrimation to severe ulceration are to be expected.

3.1.4 Sensitisation

Studies in Animals

Studies with sulfuryl chloride in experimental animals were not identified in the available literature.

The hydrolysis product hydrochloric acid was tested in a Guinea Pig Maximization Test (concentration of 1 %) and also in a Mouse Ear Swelling Test (concentrations of up to 5 %). Both tests gave no indication for a sensitizing potential (Gad et al., 1986).

Studies in Humans

Sulfuric acid is not considered as an allergen by skin contact in humans (OECD-SIDS Sulfuric Acid, 2001).

Conclusion

Data for sulfuryl chloride were not identified. The hydrolysis products sulfuric acid and hydrochloric acid gave no indication for a sensitizing potential in humans and experimental animals.

3.1.5 Repeated Dose Toxicity

There are no studies available performed according to current OECD guidelines.

One 14 d-study with exposure by inhalation was done with 10 male Sprague-Dawley rats per test group. The rats were exposed 6 hours per day and 5 days per week to sulfuryl chloride (as vapor) at concentrations of 17, 55 or 166 mg/m3. The highest concentration was reduced to 110 mg/m3 after 2 exposures due to excessive weight loss and was terminated after 8 exposures due to the death of 2 rats. Animals exhibited labored breathing, red discharge from nose, swollen nose and reduced body temperature. Body weight was reduced also at low and mid dose levels, but developed normally during recovery Immediately after exposure a concentration-dependent increase of red blood cells and hemoglobin levels, as well as of relative lung weights was observed in rats treated with 55 mg/m^3 or more. Clinical chemistry showed increased blood urea nitrogen in all treated groups and increased levels of serum cholesterol in mid and high dose groups. Histopathologically these rats showed a fibrino-necrotic bronchopneumonia. Additionally, the rats of the high-dose group revealed a fibrino-purulent rhinitis and lymphoid atrophy in thymus. Marked recovery from these symptoms and return to normal weight gain was observed after the 2-week post exposure observation period. There was a decrease of monocytes in all treated groups at the end of the recovery period. In the low-dose group the only effect was an apparent exacerbation of naturally occurring murine pneumonitis (Kelly and Stula, 1983).

In numerous repeated dose inhalation studies with sulfuric acid aerosol, toxicity was confined to changes in the structure and function of the respiratory tract, suggesting that it has a local effect and no systemic effects. The observed changes are related to the irritant properties of sulfuric acid and are most likely due to the H+ ion. In a 28-day inhalation study in the rat exposed to sulfuric acid aerosol, minimal squamous metaplasia was observed in the laryngeal epithelium following exposure to the lowest concentration used (0.3 mg/m3). This effect was fully reversible. Exposure to 1.38 mg/m3 caused more severe metaplasia accompanied by cell proliferation (OECD-SIDS Sulfuric Acid, 2001).

In a 90-day inhalation study using B6C3F1 mice, Sprague-Dawley, and Fisher 344 rats groups of 31 males and 31 females of each species and strain were exposed to hydrogen chloride at 10, 20 or 50 ppm (15, 30, or 75 mg/m3), 6 h/day, 5 days/week for 90 days. Several animals died during the study; however, the deaths did not appear to be exposure related. There was a slight, but significant decrease in body weight gain in male and female mice and male Fisher 344 rats in the high dose groups. There was no effect on hematology, clinical chemistry, and urinalysis. Histologic examination showed minimum to mild rhinitis in both strains of rats. Lesions occurred in the anterior portion of the nasal cavity and were concentration and time related. In mice exposed to 50 ppm, there was cheilitis and accumulation of macrophages in the peripheral tissues after 90 days. Mice in all exposure groups developed eosinophilic globules in the epithelial lining of the nasal tissues (US EPA, 1995).

All findings were confined to the site of first contact and can be explained by the irritating/corrosive properties of the acid. No signs of systemic effects were reported. Therefore systemic availability is unlikely. The local LOAEC is 10 ppm (15 mg/m³). No statement is possible about a systemic LOAEC because of the severe irritation/corrosion effect occurring at the site of entry. Potential systemic effects are considered as consequences of these local effects.

Conclusion

From a 14-day inhalation study with sulfuryl chloride in rats, a NOAEC could not be derived, since pneumonitis was still observed at the lowest exposure level of 17 mg/m3. The reported effects are in line with all other evidence regarding the chemical and biological properties, i.e. corrosivity of sulfuryl chloride and its hydrolysis products hydrochloric acid, sulfuric acid, and chlorosulfonic acid. Studies performed with sulfuric acid gave LOAECs in the range of 0.3 mg/m3, the LOAEC found in a 90-day study with hydrochloric acid was 15 mg/m³. All findings were confined to the site of first contact and can be explained by the irritating/corrosive properties of the acid. Sulfuryl chloride as well as the hydrolysis products hydrochloric, sulfuric and chlorosulfonic acid are all classified as corrosive, and hydrochloric acid and chlorosulfonic acid are classified as irritant to the respiratory tract. No primary systemic effects were reported.

3.1.6 Mutagenicity

Studies in Animals

In vitro Studies

There is one Ames test available performed according to OECD Guideline 471 (1983), and two other Ames tests, each performed in TA100.

In one study sulfuryl chloride induced a significant and reproducible dose-dependent increase in the number of revertants in Salmonella typhimurium TA 100 in the absence of metabolic activation, while no mutagenicity was reported in this strain in the presence of metabolic activation and in tester strains TA 98, TA 1535, and TA 1537 both with and without metabolic activation (concentrations up to 5000 µg/plate, and including cytotoxic exposures) (Bayer AG, 1989).

In the second study Salmonella typhimurium TA 100 was tested negative with and without metabolic activation (concentrations up to 4000 µg/plate; 4000 µg/plate were slightly cytotoxic) (Bayer AG, 1993).

Also a third Ames test gave no indication for mutagenicity in TA 100 when tested with and without metabolic activation, and including cytotoxic concentrations (standard plate test: up to 5000 µg/plate; preincubation assay: up to 250 µg/plate). However, the reliability of this study is not assignable (secondary literature) (BASF AG, 1991).

Hydrochloric acid was not mutagenic in an Ames test, both with and without metabolic activation and did not cause DNA damage in the rec-assay with Escherichia coli and Bacillus subtilis (Isquith et al., 1988; McCarroll et al., 1981a, 1981b)

Sulfuric acid has been shown to be without effect in gene mutation studies in vitro (bacterial tests). It has been shown to cause chromosomal aberrations in a non-bacterial test in vitro (OECD-SIDS Sulfuric Acid, 2001).

The chromosomal effects are well known to be a consequence of low pH, and are seen with any strong acid (Morita et al., 1989; Scott et al., 1991).

The performance of an in vitro chromosomal aberration test with sulfuryl chloride is not considered necessary, because it can be predicted that sulfuryl chloride decomposes into acids in aqueous media and that the resulting change in pH may induce chromosomal aberrations as well as other DNA damage. Sulfuryl chloride hydrolyses in aqueous media resulting in acidic solutions. The cytotoxic effects of unphysiologically low pH-values are well known and standard in vitro test systems are buffered thoroughly to avoid such effects. The exhaustion of the buffer capacity is regarded as an invalidation of the test systems. At low concentrations physiologic anions (chloride and sulfate) are formed, which are not-mutagenic.

In vivo Studies

Studies with sulfuryl chloride were not identified in the available literature.

There are no *in vivo* mutagenicity studies available with sulfuric acid (OECD-SIDS Sulfuric Acid, 2001) and no reliable in vivo mutagenicity studies on hydrochloric acid were located in the available literature.

The performance of in vivo studies is not considered useful, because the result can easily be predicted. In vivo, sulfuryl chloride hydrolyses to produce acidic solutions. The cytotoxic effects of unphysiologically low pH-values are well known. The exhaustion of the physiologic buffer capacity will result in cytotoxicity and irritation / corrosion at the site of first contact. No systemic availability is to be expected. At low, non-irritating concentrations, physiologic anions (chloride and sulfate) are formed which are non-mutagenic.

Conclusion

Sulfuryl chloride did not show mutagenic activity in Ames tests with Salmonella typhimurium. A slight mutagenic activity was observed in only one tester strain without metabolic activation. However, this result was found to be not reproducible in further tests. As sulfuryl chloride decomposes to acids in aqueous media the resulting change in pH may induce chromosomal aberrations and other DNA damage.

In vivo, reduced pH levels could lead to local genotoxic effects such as chromosomal changes and DNA damage at the portal-of-entry of sulfuryl chloride. However, it is unlikely that systemic

changes in pH would occur after exposure to sulfuryl chloride, that are sufficient in magnitude to induce this effect in distant tissues or organs.

3.1.7 Carcinogenicity

No carcinogenicity studies with sulfuryl chloride in experimental animals were identified in the available literature.

Albert et al. (1982) reported data from a chronic inhalation exposure study with HCl in rats, discussed in detail by Sellakumar et al. (1985). One hundred male Sprague-Dawley rats were exposed to 10 ppm hydrogen chloride (HCl) for 6 hours/day, 5 days/week (duration-adjusted concentration = 2.5 mg/m^3) for their lifetimes. All animals were observed daily, weighed monthly, and allowed to die naturally or killed when moribund. Complete necropsy was performed on all animals, with particular attention given to the respiratory tract. Histological sections were prepared from the nasal cavity (one lateral section from each side of the head), lung (one section from each lobe), trachea, larynx, liver, kidneys, testes, and other organs where gross pathological signs were present. However, Sellakumar et al. (1985) did not discuss histopathological events in organs other than the respiratory tract. HCl-exposed animals showed no differences in body weights or survival when compared with air controls. The data indicated 62/99 exposed animals with epithelial or squamous hyperplasia in the nasal mucosa (location not specified) vs. 51/99 in the concurrent control group. Incidence of squamous metaplasia was 9 and 5 in the exposed and control rats, respectively. There was a 24 % incidence of hyperplasia of laryngeal-tracheal segments in HCl-exposed rats (larynx 2/22, trachea 6/26) vs. 6 % in the controls. The authors did not make any comments concerning the severity of these changes.

The repeated oral application of hydrochloric acid in mice gave no indication for an increased tumor incidence and also did not promote the activity of a known carcinogen. However, possibly only the gastro-intestinal tract was examined (TNO BIBRA International Ltd, 1990).

No carcinogenic effect was observed in carcinogenicity studies conducted by inhalation with sulfuric acid aerosol using 3 different animal species. Small increases in tumour incidence were reported in rats and mice after chronic gastric intubation or intratracheal instillation of sulfuric acid solution, but no clear conclusion can be drawn from these studies (OECD-SIDS Sulfuric Acid, 2001).

Conclusion

No carcinogenicity studies with sulfuryl chloride were identified. The hydrolysis products hydrochloric acid and sulfuric acid gave no clear indications for an increased tumor incidence after life-time exposure. A likely mechanism for tumor induction could be the constant stimulus to cell proliferation produced by prolonged local irritation at the site of entry.

3.1.8 Toxicity for Reproduction

Toxicity to Reproduction / Fertility

Studies in experimental animals performed with sulfuryl chloride were not identified in the available literature.

There were also no studies identified for the hydrolysis products hydrochloric acid and sulfuric acid.

Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs, effects on reproduction are not likely to occur following exposure to sulfuryl chloride by any route.

Developmental Toxicity / Teratogenicity

Studies in experimental animals performed with sulfuryl chloride were not identified in the available literature.

Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs or the embryo/fetus, developmental effects in mammals are not likely to occur following exposure by any route.

In a developmental toxicity/teratogenicity study conducted by inhalation with sulfuric acid aerosol, the NOAEL for maternal toxicity appears to be 20 mg/m3 in mice and rabbits. No evidence of fetotoxicity or teratogenicity was seen in either species (OECD-SIDS Sulfuric Acid, 2001).

Valid studies for the hydrolysis product hydrochloric acid were not identified in the available literature.

Conclusion

Data for sulfuryl chloride were not identified. The hydrolysis product sulfuric acid gave no indication for adverse effects concerning developmental toxicity or teratogenicity in mice and rabbits after exposure via inhalation (NOAEL: 20 mg/m^3). Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs or the embryo/fetus, toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to sulfuryl chloride by any route.

3.1.9 Experience with human exposure

The vapors of sulfuryl chloride are corrosive to the skin, eyes and mucous membranes (BASF AG, 1992; Grant and Schuman, 1993; Budavari et al., 1996), and extremely irritating and toxic to the respiratory tract (Gerbis, 1931; Goldblatt, 1955; Reichel, 1984; Schnurrenberger, 1987; BASF AG, 1992).

Several epidemiological studies have suggested a relationship between exposure to strong inorganic acid mists containing sulfuric acid and an increased incidence of laryngeal cancer. IARC (1992) has concluded that ”occupational exposure to strong-inorganic-acid mists containing sulfuric acid is carcinogenic to humans” (Group 1). In the TLV list (ACGIH, 2002) and the German MAK list (Greim, 2001) sulfuric acid is listed as human carcinogen. Concerns have been raised that confounding factors could not be fully excluded (OECD-SIDS Sulfuric Acid, 2001). The effects might be a secondary finding to be expected after prolonged exposure to strong acid due to the cytotoxicity and consequent stimulus to increased cell proliferation.

In several case-control studies there was no evidence that the hydrolysis product hydrogen chloride / hydrochloric acid is a human carcinogen (Bond et al., 1983; 1985; 1986; 1991).

3.2 Initial Assessment for Human Health

The acute toxicity of sulfuryl chloride following inhalation is high. In male Sprague-Dawley rats with head-only exposure to vapor a 4 h-LC_{50} of 878 mg/m^3 was calculated. Clinical signs included nasal discharge and eye irritation.

In humans, pulmonary edema of delayed onset has been reported after inhalation of sulfuryl chloride vapor.

Sulfuryl chloride hydrolyzes slowly in moist air and reacts violently with water, forming chlorosulfonic acid, hydrochloric acid and sulfuric acid. Due to this hydrolytic reaction, sulfuryl chloride is corrosive to the skin, eyes and respiratory tract.

Studies with sulfuryl chloride concerning sensitizing properties are not available. The hydrolysis products sulfuric acid and hydrochloric acid gave no indication for a sensitizing potential in humans and experimental animals.

From a 14-day inhalation study with sulfuryl chloride in rats, a NOAEC could not be derived, since pneumonitis was still observed at the lowest exposure level of 17 mg/m^3. The reported effects are in line with all other evidence regarding the chemical and biological properties, i.e. corrosivity of sulfuryl chloride and its hydrolysis products hydrochloric acid, sulfuric acid, and chlorosulfonic acid. Studies performed with sulfuric acid gave LOAECs in the range of 0.3 mg/m^3, the LOAEC found in a 90-day study with hydrochloric acid was 15 mg/m³. All findings were confined to the site of first contact and can be explained by the irritating/corrosive properties of the acid.

Sulfuryl chloride as well as the hydrolysis products hydrochloric acid, sulfuric acid and chlorosulfonic acid are all classified as corrosive and hydrochloric acid and chlorosulfonic acid are classified as irritant to the respiratory tract. No primary systemic effects were reported.

Sulfuryl chloride did not show mutagenic activity in Ames tests with *Salmonella typhimurium*. A slight mutagenic activity was observed in only one tester strain without metabolic activation. However, this result was found to be not reproducible in further tests. As sulfuryl chloride decomposes to acids, the resulting change in pH may induce genotoxic effects, such as chromosomal aberrations and other DNA damage *in vitro* and *in vivo* at the portal-of-entry.

No carcinogenicity studies with sulfuryl chloride were identified. The hydrolysis products hydrochloric acid and sulfuric acid gave no clear indications for an increased tumor incidence after life-time exposure in laboratory animals.

Studies with sulfuryl chloride concerning effects on fertility and development were not available and there were also no data on fertility effects for the hydrolysis products sulfuric acid and hydrochloric acid. Concerning developmental toxicity, the hydrolysis product sulfuric acid gave no indication for adverse effects in mice and rabbits after exposure via inhalation. Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs or the embryo/fetus, toxicity to reproduction or developmental toxicity in mammals are not likely to occur following exposure to sulfuryl chloride by any route.

In humans, several epidemiological studies have suggested a relationship between exposure to strong inorganic acid mists containing sulfuric acid and an increased incidence of laryngeal cancer. IARC (1992) has concluded that ”occupational exposure to strong-inorganic-acid mists containing sulfuric acid is carcinogenic to humans” (Group 1). Concerns have been raised that confounding factors could not be fully excluded. The effects might be a secondary finding to be expected after prolonged exposure to strong acid due to the cytotoxicity and consequent stimulus to increased cell proliferation.

4 HAZARDS TO THE ENVIRONMENT

4.1 Aquatic Effects

Sulfuryl chloride reacts with water completely, forming sulfuric and hydrochloric acid (see chapter 2.1.2), thus sulfuryl chloride itself indicates no hazard for the aquatic environment.

The hydrolysis products sulfuric and hydrochloric acid have been tested with aquatic species. Sulfuric and hydrochloric acid cause a pH displacement in water. It was the resulting pH that determined the impact on aquatic life as shown with buffered test substance solution. Thus toxic effects are not due to substance inherent properties but a function of the pH [OECD-SIDS on Sulfuric Acid (2001) and Hydrochloric Acid, (2002)]. Regarding natural systems, the impact of dissociated acids depends on the buffer capacity of the system. Buffer function is attributed to humic substances, alkaline earth carbonates, clay minerals, silicates, as well as sesquioxides.

Theoretical pH-values of sulfuric acid or hydrochloric acid in neutral water (pH = 7) with no buffer (e.g. dechlorinated tap water):

pH	sulfuric acid	hydrochloric acid
6	0.049 mg/l	0.036 mg/l
5	0.49 mg/l	0.36 mg/l
4	4.9 mg/l	3.6 mg/l
3	49 mg/l	36 mg/l

Natural waters, as well as reconstituted waters for testing purposes, stipulated within the OECD test guidelines, are normally composed of substances serving as buffers. However natural waters in boreal areas with subsurfaces consisting of granite or gneiss have low buffer capacities and are therefore susceptible to acidification.

The tolerance of water organisms towards pH margin and variation is diverse.

Recommended pH-values at OECD guidelines for testing issues are:

fish: 6.0 to 8.5 is preferable

daphnia: within the range of 6 to 9

algae: appr. 8

Ellgaard and Gilmore (1984) showed the acute toxicity (96 h-LC_{50}) of sulfuric and hydrochloric acid as well as other acids to be the same on *Lepomis macrochirus* as soon as a pH of 3.5 to 3.25 was reached. The authors state to have decreased the pH by addition of acid and needed an intermittent addition within the 96 hour treatment in order to maintain the pH level. In a second test the authors showed the pH to be the cause of the lethal effect by setting up a test with the lethal acid dosis of the first test but adding the needed concentration of NaOH to obtain a pH of 7. No effects were observed in this test.

Craig and Baski (1977) tested the effect of depressed pH on *Jordanella floridae* larvae on reproduction, growth, and survival with the result that after 45 days a LOEC (20 % effect on growth) at pH 6.0 and a NOEC at pH 6.5 was determined. Hurley et al. (1989) conducted early life stage tests with brook trout (45 d) in order to find an acid resistant strain for stocking purposes. *Salvelinus fontinalis* is known to be tolerant to low pH (Johansson et al. 1977). Strains, gathered

from an acid watershed (pH 4.7 to 5.3), a neutral watershed (pH 7) and a hatchery (pH 7), were investigated. Significant differences in mortality between the strains at low pH were observed and these suggested a genetic component to acid tolerance, according to the authors. The hatchery strain showed to be most sensitive towards low pH values; no statistically significant effect on survival and time for hatching at neither of the strains was observed down to pH 5.2. Tam and Payson (1986) showed the most sensitive endpoint with *Salvelinus fontinalis* was the weight of the young fish with a 10-month NOEC at pH 5.56.

There is no concentration of the added acid mentioned by any of the authors due to the infeasibility to transfer such a concentration to any other system.

4.2 Terrestrial Effects

No information available.

4.3 Other Environmental Effects

No information available.

4.4 Initial Assessment for the Environment

Sulfuryl chloride reacts with water within 5 minutes at 20 °C completely, forming sulfuric and hydrochloric acid.

The hydrolysis products are strong mineral acids that dissociate readily in water to the hydrated protons and sulfate respectively chloride ions. This total ionization will imply also, that the acids, themselves, will not adsorb on particulate matters or surfaces and will not accumulate in living tissues.

The hydrolysis products sulfuric and hydrochloric acid have been tested with aquatic species. Sulfuric and hydrochloric acid cause a pH displacement in water which determined the impact on aquatic life. The tolerance of water organisms towards pH margin and variation is diverse. Recommended pH values for test species listed in OECD guidelines are between 6.0 and almost 9. Acute testing with fish showed 96h-LC_{50} at about pH 3.5, chronic testing with early life stages of fish NOECs at pH 6.0 and 5.56. No concentration of the added acid is mentioned by any of the authors, due to the infeasibility to transfer such a concentration to any other water system with a different buffer system.

5 RECOMMENDATIONS

Environment:

The substance is currently of low priority for further work as it hydrolyses very fast and therefore environmental releases of sulfuryl chloride are not likely to occur. The degradation products sulfuric acid and hydrochloric acid have already been assessed within the OECD SIDS-Program.

Human Health:

The corrosive properties indicate a hazard for human health. No further work is recommended, if sufficient control measures are in place to avoid significant human exposure, including prevention of accidental exposure. In situations where this is not the case, risk assessment and, if necessary, risk reduction measures are recommended.

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I U C L I D

Data Set

Existing Chemical	:	ID: 7791-25-5
CAS No.	:	7791-25-5
EINECS Name	:	sulphuryl dichloride
EC No.	:	232-245-6
TSCA Name	:	Sulfuryl chloride
Molecular Formula	:	Cl2O2S

Producer related part

Company	:	Bayer AG
Creation date	:	10.08.1992

Substance related part

Company	:	Bayer AG
Creation date	:	10.08.1992
Status	:	
Memo	:	X AKTUELL EG / ICCA
Printing date	:	13.02.2004
Revision date	:	04.06.1994
Date of last update	:	28.11.2003
Number of pages	:	42
Chapter (profile)	:	Chapter: 1, 2, 3, 4, 5, 6, 7, 8, 10
Reliability (profile)	:	Reliability: without reliability, 1, 2, 3, 4
Flags (profile)	:	Flags: without flag, non confidential, WGK (DE), TA-Luft (DE), Material Safety Dataset, Risk Assessment, Directive 67/548/EEC, SIDS

1.0.1 APPLICANT AND COMPANY INFORMATION

1.0.2 LOCATION OF PRODUCTION SITE, IMPORTER OR FORMULATOR

1.0.3 IDENTITY OF RECIPIENTS

1.0.4 DETAILS ON CATEGORY/TEMPLATE

1.1.0 SUBSTANCE IDENTIFICATION

1.1.1 GENERAL SUBSTANCE INFORMATION

Purity type :
Substance type : inorganic
Physical status : liquid
Purity : >= 99 % w/w
Colour :
Odour :

Flag : Critical study for SIDS endpoint
04.04.2002

1.1.2 SPECTRA

1.2 SYNONYMS AND TRADENAMES

SULFURYLCHLORID

22.03.2002

SULFURYL CHLORIDE

22.03.2002

SULFONYL CHLORIDE

22.03.2002

CHLOROSULPHURIC ACID

22.03.2002

SULPHURIC OXYCHLORIDE

Flag : Critical study for SIDS endpoint
22.03.2002

1.3 IMPURITIES

Purity :
CAS-No : 7446-09-5
EC-No : 231-195-2
EINECS-Name : sulfur dioxide
Molecular formula :
Value : <= .5 % w/w

Remark : Data apply to Bayer AG product
Flag : Critical study for SIDS endpoint
19.06.2002

Purity :
CAS-No : 7782-50-5
EC-No :
EINECS-Name : Chlorine
Molecular formula :
Value : <= .1 % w/w

Remark : Data apply to Bayer AG product
Flag : Critical study for SIDS endpoint
19.06.2002

1.4 ADDITIVES

1.5 TOTAL QUANTITY

Quantity : 10000 - 20000 tonnes produced in 2001

Remark : Production estimation worldwide
Flag : Critical study for SIDS endpoint
22.03.2002

1.6.1 LABELLING

Labelling : as in Directive 67/548/EEC
Specific limits :
Symbols : C, , ,
Nota : , ,
R-Phrases : (14) Reacts violently with water
(34) Causes burns
(37) Irritating to respiratory system
S-Phrases : (26) In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
(45) In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

Remark : EG-Index-No. 016-016-00-6
Flag : Critical study for SIDS endpoint

1.6.2 CLASSIFICATION

Classified : as in Directive 67/548/EEC
Class of danger :
R-Phrases : (14) Reacts violently with water
Specific limits :

Flag : Critical study for SIDS endpoint
18.05.2000

Classified : as in Directive 67/548/EEC
Class of danger : corrosive
R-Phrases : (34) Causes burns
Specific limits :

Flag : Critical study for SIDS endpoint
18.05.2000

Classified : as in Directive 67/548/EEC
Class of danger : irritating
R-Phrases : (37) Irritating to respiratory system
Specific limits :

Flag : Critical study for SIDS endpoint
18.05.2000

1.6.3 PACKAGING

1.7 USE PATTERN

Type of use : type
Category : Use in closed system

Flag : Critical study for SIDS endpoint
12.06.2002

Type of use : industrial
Category : Chemical industry: used in synthesis

Flag : Critical study for SIDS endpoint
12.06.2002

Type of use : use
Category : Intermediates

Flag : Critical study for SIDS endpoint
12.06.2002

Type of use : type
Category : Non dispersive use

Remark : Industrial: Electrical/electronical engineering

Use: Conductive agent in hermeticaly sealed special batteries.
Flag : Critical study for SIDS endpoint

12.06.2002

1.7.1 DETAILED USE PATTERN

1.7.2 METHODS OF MANUFACTURE

1.8 REGULATORY MEASURES

1.8.1 OCCUPATIONAL EXPOSURE LIMIT VALUES

Type of limit : other: no limit established
Limit value :

12.03.2002

1.8.2 ACCEPTABLE RESIDUES LEVELS

1.8.3 WATER POLLUTION

Classified by : other: VwVwS (DE)
Labelled by :
Class of danger : 1 (weakly water polluting)

Remark : Kenn-Nr. 2423
22.03.2002

1.8.4 MAJOR ACCIDENT HAZARDS

Legislation : Stoerfallverordnung (DE)
Substance listed : yes
No. in Seveso directive :

Remark : Stoerfallst.-No. 277.00

1.8.5 AIR POLLUTION

Classified by : TA-Luft (DE)
Labelled by :
Number : 3.1.6 (gaseous inorganic substances)
Class of danger : III

Remark : as HCl

1.8.6 LISTINGS E.G. CHEMICAL INVENTORIES

1.9.1 DEGRADATION/TRANSFORMATION PRODUCTS

1.9.2 COMPONENTS

1.10 SOURCE OF EXPOSURE

1.11 ADDITIONAL REMARKS

1.12 LAST LITERATURE SEARCH

Type of search : Internal and External
Chapters covered :
Date of search :

Remark : Toxicology, environmental aspects and ecotoxicology: February 2002
CAS number search in external and internal databases, e.g. HSDB, Aquire, Biosis, Embase, Toxline, Scisearch.
Flag : Critical study for SIDS endpoint
16.07.2002

1.13 REVIEWS

2.1 MELTING POINT

Value : -54 °C

Remark : in The Merck Index besides the main entry of -54.1 °C, also cited with "(also given as -46 °C)"
Reliability : (2) valid with restrictions
Data from handbook
Flag : Critical study for SIDS endpoint
21.06.2002 (1) (2) (3) (4)

2.2 BOILING POINT

Value : 69 °C at 1013 hPa

Remark : Handbook Gmelin states values from 69.1 to 69.9 °C
Reliability : (2) valid with restrictions
Data from handbook
Flag : Critical study for SIDS endpoint
21.06.2002 (1) (2) (3) (4)

2.3 DENSITY

Type : density
Value : 1.67 g/cm³ at 20 °C

Remark : Gmelin (1963): 1.667 g/cm3 at 20 °C
Reliability : (2) valid with restrictions
Data from handbook
Flag : Critical study for SIDS endpoint
21.06.2002 (1) (2) (3) (4)

2.3.1 GRANULOMETRY

2.4 VAPOUR PRESSURE

Value : 148 hPa at 20 °C

Method : experimental data via ebullioscope
Reliability : (2) valid with restrictions
Acceptable, well-documented publication/study report which meets basic scientific principles
Flag : Critical study for SIDS endpoint
21.06.2002 (1) (5)

Value : 511 hPa at 50 °C

(1)

2.5 PARTITION COEFFICIENT

Remark : not applicable (hydrolysis)
Flag : Critical study for SIDS endpoint

2.6.1 SOLUBILITY IN DIFFERENT MEDIA

Solubility in : Water
Value : at °C
pH value :
concentration : at °C
Temperature effects :
Examine different pol. :
pKa : at 25 °C
Description :
Stable :

Remark : Hydrolysis, see chapt. 3.1.2
Flag : Critical study for SIDS endpoint
25.03.2002

2.6.2 SURFACE TENSION

2.7 FLASH POINT

Remark : not applicable, decomposition beginning at 100 °C
Flag : Critical study for SIDS endpoint
25.03.2002 (1)

2.8 AUTO FLAMMABILITY

2.9 FLAMMABILITY

2.10 EXPLOSIVE PROPERTIES

2.11 OXIDIZING PROPERTIES

2.12 DISSOCIATION CONSTANT

2.13 VISCOSITY

2.14 ADDITIONAL REMARKS

3.1.1 PHOTODEGRADATION

Remark : Photodegradation not calculable with SRC-AOPWIN v1.90 (2000)
Flag : Critical study for SIDS endpoint
04.04.2002

3.1.2 STABILITY IN WATER

Type : abiotic
t1/2 pH4 : < 5 minute(s) at 20 °C
t1/2 pH7 : < 5 minute(s) at 20 °C
t1/2 pH9 : < 5 minute(s) at 20 °C
Deg. product : yes
Method : Directive 92/69/EEC, C.7
Year : 2002
GLP : yes
Test substance : other TS: Fa. Aldrich, Batch no.: LOT 28700-61
Deg. products : 7647-01-0 231-595-7 hydrogen chloride
7664-93-9 231-639-5 sulphuric acid

Remark : Sulfuryl chloride hydrolyses in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

After 5 min. sulfuryl chloride was completely hydrolysed at different pH-values (4, 7, 9). Absence of sulfuryl chloride has been shown with FT-IR
Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
16.07.2002 (6)

Remark : When standing still at room temperature sulfuryl chloride decomposes very slowly with water.
While stirring the mixture the reaction starts quickly and becomes so vigorous that sulfuryl chloride is boiling.
The decomposition takes place only at the contact surface between water and sulfuryl chloride.
The results are not relevant for the SIAR, because this tests do not reflect to environmental conditions.
Reliability : (2) valid with restrictions
data from handbook
15.07.2002 (2)

3.1.3 STABILITY IN SOIL

Remark : Not stable, hydrolysis with moisture
Flag : Critical study for SIDS endpoint
11.06.2002

3.2.1 MONITORING DATA

Remark : Due to the rapid hydrolysis (see 3.1.2) an occurence of sulfuryl chloride in the environment is not expected.
Flag : Critical study for SIDS endpoint
05.04.2002

3.2.2 FIELD STUDIES

3.3.1 TRANSPORT BETWEEN ENVIRONMENTAL COMPARTMENTS

Remark : not assignable (hydrolysis)
Flag : Critical study for SIDS endpoint
25.03.2002

3.3.2 DISTRIBUTION

Remark : not assignable (hydrolysis)
Flag : Critical study for SIDS endpoint
04.02.2002

3.4 MODE OF DEGRADATION IN ACTUAL USE

3.5 BIODEGRADATION

Remark : not assignable for inorganic compounds; hydrolysis
Flag : Critical study for SIDS endpoint
05.04.2002

3.6 BOD5, COD OR BOD5/COD RATIO

3.7 BIOACCUMULATION

Remark : not assignable (hydrolysis)
Flag : Critical study for SIDS endpoint
04.02.2002

3.8 ADDITIONAL REMARKS

4.1 ACUTE/PROLONGED TOXICITY TO FISH

Remark : There are no data available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
28.11.2003 (7) (8)

4.2 ACUTE TOXICITY TO AQUATIC INVERTEBRATES

Remark : There are no data on sulfuryl chloride available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
28.11.2003 (7) (8)

4.3 TOXICITY TO AQUATIC PLANTS E.G. ALGAE

Remark : There are no data on sulfuryl chloride available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
28.11.2003 (7) (8)

4.4 TOXICITY TO MICROORGANISMS E.G. BACTERIA

Remark : There are no data on sulfuryl chloride available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
28.11.2003 (7) (8)

4.5.1 CHRONIC TOXICITY TO FISH

Remark : There are no data on sulfuryl chloride available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
04.04.2002 (8)

4.5.2 CHRONIC TOXICITY TO AQUATIC INVERTEBRATES

Remark : There are no data on sulfuryl chloride available.

Sulfuryl chloride hydrolizes in water to H2SO4 and HCl,
in the buffered medium the respective salts are formed.

The hydrolysis products have been tested in a number of aquatic species.
Effects are accounted to acidification.

Flag : Critical study for SIDS endpoint
04.04.2002 (8)

4.6.1 TOXICITY TO SEDIMENT DWELLING ORGANISMS

4.6.2 TOXICITY TO TERRESTRIAL PLANTS

4.6.3 TOXICITY TO SOIL DWELLING ORGANISMS

4.6.4 TOX. TO OTHER NON MAMM. TERR. SPECIES

4.7 BIOLOGICAL EFFECTS MONITORING

4.8 BIOTRANSFORMATION AND KINETICS

4.9 ADDITIONAL REMARKS

5.0 TOXICOKINETICS, METABOLISM AND DISTRIBUTION

5.1.1 ACUTE ORAL TOXICITY

Type	:	LD50
Value	:	= 900 mg/kg bw
Species	:	rabbit
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrochloric acid
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

19.07.2002 (9)

Type	:	LD100
Value	:	900 mg/kg bw
Species	:	rabbit
Strain	:	
Sex	:	
Number of animals	:	3
Vehicle	:	
Doses	:	
Method	:	
Year	:	1923
GLP	:	
Test substance	:	other TS: Hydrochloric acid
Result	:	2 rabbits treated with hydrochloric acid (900 mg/kg, gavage) died quickly afterwards. 1 additional rabbit received twice 450 mg/kg on two consecutive days and died after the second dose
Reliability	:	(4) not assignable early study, few animals, few details given

08.08.2002 (10)

5.1.2 ACUTE INHALATION TOXICITY

Type	:	LC50
Value	:	= 878 mg/m³
Species	:	rat
Strain	:	Sprague-Dawley
Sex	:	male
Number of animals	:	10
Vehicle	:	other: no
Doses	:	84.4, 134, 155, 207, or 273 ppm (0.46, 0.74, 0.85, 1.14, or 1.50 mg/l)
Exposure time	:	4 hour(s)
Method	:	other: no data
Year	:	1982

GLP : no data
Test substance : other TS: purity ca. 100 %

Remark : LC50: 159 ppm (original value)
exposure to sulfuryl chloride vapours
Result : MORTALITY:
0.46 mg/l: 0/10
0.74 mg/l: 2/10 (1 death during exposure, 1 death within 24 hours)
0.85 mg/l: 8/10 (6 deaths during exposure, 2 deaths within 24 hours)
1.14 mg/l: 7/10 (7 deaths during exposure)
1.50 mg/l: 10/10 (10 deaths during exposure)

CLINICAL SIGNS:
During exposure all rats showed red nasal and ocular discharge. At >= 0.85 mg/l a foamy nasal discharge was noted. In surviving animals reduced body weights were observed 1-2 days following exposure. Also pallor, dry red ocular discharge, wet perineum, dry red nasal discharge and dried wetness around the mouth lasting for 1-2 days after exposure were described.

NECROPSY FINDINGS:
no data
Test condition : TEST ORGANISMS:
-Age: 7-8 weeks
-Weight at study initiation: 233-274 g
-Exposure: head only to vapour
-Post exposure period: 14 days

Chamber atmosphere was analyzed. LC50 calculated according to Finney (1971).
Reliability : (2) valid with restrictions
Although the documentation is limited, this study meets generally accepted scientific principles and is acceptable for assessment.
Flag : Critical study for SIDS endpoint
08.05.2003 (11) (12) (13)

Type : LC50
Value : 723 - 1336 mg/m³
Species : rat
Strain : no data
Sex : male/female
Number of animals :
Vehicle : no data
Doses : no data
Exposure time : 1 hour(s)
Method : other: no data
Year : 1985
GLP : no data
Test substance : other TS: purity not given

Remark : males:
LC50: 723 mg/m3 (original value = 131 ppm)

females:
LC50: 1336 mg/m3 (original value = 242 ppm)
Reliability : (4) not assignable
Data from handbook or collection of data

Flag : Critical study for SIDS endpoint
19.07.2002 (14)

Type : LC50
Value : = 330 mg/m³
Species : rat
Strain : no data
Sex : male/female
Number of animals : 10
Vehicle : other: atmosphere
Doses : 174, 346 or 695 mg/m³
Exposure time : 1 hour(s)
Method : other: no data
Year : 1970
GLP : no
Test substance : other TS: purity ca. 100 %

Remark : At necropsy only effects on the respiratory tract were reported.
Result : MORTALITY:
-Time of death / Number of deaths at each dose
174 mg/m3: none
346 mg/m3: 16 - 72 hrs / 6 of 10
695 mg/m3: 8 - 12 hrs / 10 of 10

CLINICAL SIGNS:
All concentrations tested resulted in concentration dependent salivation and dyspnea. Local reactions were lacrimation and chemosis with erythema of the skin around the ears and the nose.

NECROPSY FINDINGS:
Histological examinations revealed hemorrhagic lungs in died and surviving animals. Furthermore, strong erythema of the gastrointestinal tract was observed in animals died during the study.
Reliability : (4) not assignable
The CAS no is given correct with 7791-25-5, but the structure of the chemical with FCCl2CCl2SCl
Flag : Critical study for SIDS endpoint
24.07.2002 (15)

Type : LC50
Value : = 8300 mg/m³
Species : rat
Strain : no data
Sex : no data
Number of animals :
Vehicle : no data
Doses : no data
Exposure time : 30 minute(s)
Method : other: no data
Year :
GLP : no
Test substance : other TS: hydrochloric acid

Result : The respiratory tract showed obvious damage at necropsy.
Reliability : (4) not assignable
Secondary literature
Flag : Critical study for SIDS endpoint
24.07.2002 (16)

Type : LC50
Value : = 38.5 mg/m³
Species : rat
Strain : no data
Sex : no data
Number of animals :
Vehicle :
Doses : no data
Exposure time : 4 hour(s)
Method : other: no data
Year :
GLP : no
Test substance : other TS: chlorosulfonic acid

Reliability : (4) not assignable
Methodological details are missing (e.g. no data about analytics)
Flag : Critical study for SIDS endpoint
24.07.2002 (17)

Type : LC50
Value : > 1765 - 4749 mg/m³
Species : rat
Strain : other: Crl:CD BR
Sex : male/female
Number of animals : 10
Vehicle : no data
Doses : 0, 1765, 2768 or 5864 mg/m3
Exposure time : 4 hour(s)
Method : other: no data
Year :
GLP : no data
Test substance : other TS: chlorosulfonic acid

Reliability : (4) not assignable
Secondary literature
19.07.2002 (18)

Type : LC50
Value : = 25 mg/m³
Species : mouse
Strain : no data
Sex : no data
Number of animals :
Vehicle :
Doses : no data
Exposure time : 2 hour(s)
Method : other: no data
Year :
GLP : no
Test substance : other TS: chlorosulfonic acid

Reliability : (4) not assignable
Methodological details are missing (e.g. no data about analytics)
24.07.2002 (17)

Type : LC50
Value : = 3150 mg/m³
Species : mouse

Strain	:	no data
Sex	:	no data
Number of animals	:	
Vehicle	:	no data
Doses	:	no data
Exposure time	:	30 minute(s)
Method	:	other: no data
Year	:	
GLP	:	no
Test substance	:	other TS: hydrochloric acid

Result	:	The respiratory tract showed obvious damage at necropsy.
Reliability	:	(4) not assignable Secondary literature
Flag	:	Critical study for SIDS endpoint

24.07.2002 (16)

Type	:	other: detailed information concerning tested species and LC50 values is given in the attached document "Acute Inhalation Toxicity studies with animals exposed to sulfuric acid aerosol/mist or oleum"
Value	:	320 - 1610 mg/m³
Species	:	other: rats, mice and rabbits
Strain	:	
Sex	:	
Number of animals	:	
Vehicle	:	
Doses	:	
Exposure time	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid

Attached document	:	Acute Inhalation Toxicity studies with animals exposed to sulfuric acid aerosol/mist or oleum
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint

19.07.2002 (19)

Remark	:	One additional study for sulfuryl chloride was identified: ICI Americas Inc. (1992) Initial Submission: Letter from ICI Americas Inc. to USEPA regarding sulfonyl chloride Acute Inhalation Test with Attachment. OTS0543908. Doc#: 88-920006977 However, the quality of the reprint of this study is very poor, so that no information can be taken from here.

17.07.2002

5.1.3 ACUTE DERMAL TOXICITY

5.1.4 ACUTE TOXICITY, OTHER ROUTES

5.2.1 SKIN IRRITATION

Species	:	human
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	corrosive
Classification	:	
Method	:	other: no data
Year	:	
GLP	:	
Test substance	:	
Remark	:	no further information available
Result	:	Liquid sulfuryl chloride as well as vapours of sulfuryl chloride are corrosive to skin and mucous membranes.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

16.07.2002 (20) (21)

Species	:	other: human and experimental animals
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	corrosive
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	Sulfuric acid is corrosive to the skin, while 10 % solutions of sulfuric acid appear not to be irritating to the skin in different species.
Attached document	:	Skin irritation testing with sulfuric acid
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint

17.07.2002 (19)

Species	:	other: human and experimental animals
Concentration	:	
Exposure	:	
Exposure time	:	
Number of animals	:	
Vehicle	:	
PDII	:	
Result	:	corrosive
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrochloric acid

Result	:	Hydrochloric acid causes irritation and damage to the skin of humans and laboratoy animals.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint
16.07.2002		(9)

5.2.2 EYE IRRITATION

Species	:	human
Concentration	:	
Dose	:	
Exposure time	:	
Comment	:	
Number of animals	:	
Vehicle	:	
Result	:	highly corrosive
Classification	:	
Method	:	other: no data
Year	:	
GLP	:	
Test substance	:	
Remark	:	no further information available
Result	:	Sulfuryl chloride is highly corrosive to the eyes. Depending on the duration of exposure and the concentration of the agent (liquid or vapor) slight burning with lacrimation to severe ulceration are to be expected.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint
17.07.2002		(21)

Species	:	rabbit
Concentration	:	
Dose	:	
Exposure time	:	
Comment	:	
Number of animals	:	
Vehicle	:	
Result	:	
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	Conflicting results (not irritating or severely irritating) are observed in eye irritation studies using 10 % sulfuric acid, depending on the protocol used (OECD/EU or US).
Attached document	:	Eye irritation testing with sulfuric acid
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint
17.07.2002		(19)

Species	:	other: human and experimental animals
Concentration	:	

Dose	:	
Exposure time	:	
Comment	:	
Number of animals	:	
Vehicle	:	
Result	:	corrosive
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrochloric acid
Result	:	Hydrochloric acid causes irritation and damage to the eyes.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

16.07.2002 (9)

5.3 SENSITIZATION

Type	:	Guinea pig maximization test
Species	:	guinea pig
Concentration	:	1st: Induction 1 % intracutaneous 2nd: Induction 1 % occlusive epicutaneous 3rd: Challenge 1 % occlusive epicutaneous
Number of animals	:	15
Vehicle	:	other: ethanol
Result	:	not sensitizing
Classification	:	
Method	:	other: no data
Year	:	1986
GLP	:	no data
Test substance	:	other TS: hydrochloric acid (purity not given)
Remark	:	Studies with sulfuryl chloride were not identified in the available literature. However, information can be taken from valid studies performed with the hydrolysis product.
Test condition	:	Hartley guinea pigs (test group: 15 animals; control group: 6 animals). Induction: intradermal injection on day 0, closed 48-hour patch at day 7. Challenge: closed 24-hour patch to a naive skin site at day 21.
Reliability	:	(2) valid with restrictions Study presented only in tabular form (no further data)
Flag	:	Critical study for SIDS endpoint

15.07.2002 (22)

Type	:	Mouse ear swelling test
Species	:	mouse
Concentration	:	1st: Induction 1 % occlusive epicutaneous 2nd: Challenge 5 % occlusive epicutaneous 3rd:
Number of animals	:	
Vehicle	:	other: 70 % ethanol
Result	:	not sensitizing
Classification	:	
Method	:	other: no data
Year	:	1986

GLP	:	no data
Test substance	:	other TS: hydrochloric acid (purity not given)
Remark	:	Studies with sulfuryl chloride were not identified in the available literature. However, information can be taken from valid studies performed with the hydrolysis product.
Test condition	:	Test animals: female CF-1 mice, 10-15 per group. Induction: topical application on four consecutive days. Challenge: topical application at 7 days after the final induction.
Reliability	:	(2) valid with restrictions Study presented only in tabular form (no further data)
Flag	:	Critical study for SIDS endpoint
15.07.2002		(22)

Type	:	
Species	:	human
Number of animals	:	
Vehicle	:	
Result	:	
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	Sulfuric acid is not considered as an allergen by skin contact in humans.
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint
16.07.2002		(19)

Type	:	
Species	:	human
Number of animals	:	
Vehicle	:	
Result	:	
Classification	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrochloric acid
Result	:	There is no evidence that hydrochloric acid has a sensitizing potential.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint
16.07.2002		(9)

5.4 REPEATED DOSE TOXICITY

Type	:	Sub-acute
Species	:	rat
Sex	:	male
Strain	:	Sprague-Dawley
Route of admin.	:	inhalation
Exposure period	:	2 weeks

Frequency of treatm.	:	6 hours/day and 5 days/week
Post exposure period	:	up to 2 weeks
Doses	:	0, 3, 10 or 30 [20] pmm (0, 17, 55, or 166 [110] mg/m3)(measured: 0,0; 3,1; 9,8; 22,3 ppm)
Control group	:	yes
LOAEL	:	= 17 mg/m³
Method	:	other: no data
Year	:	1983
GLP	:	no data
Test substance	:	other TS: purity approx. 100% (specially distilled batch)
Method	:	ANIMALS: 10 male CD rats/ group PARAMETERS: observation, mortality, body weights, hematology, clinical chemistry, urinalysis, necropsy, histopathology,
Result	:	-Mortality and time to death: The highest exposure concentration (30 ppm) was reduced to 20 ppm after 2 exposures due to excessive weight loss and terminated after 8 exposures due to the death of 2 rats. No mortalities in other exposure groups. -Clinical signs: labored breathing, red discharge from nose, swollen nose, reduced body temperature -Body weight gain: excessive weight loss after 30 ppm, reduced body weight at low and mid dose levels; normal weight gain during reovery -Food/water consumption: no data -Ophthalmoscopic examination: no data -Clinical chemistry: increased blood urea nitrogen in all treated groups; increased chloesterol in mid and high dose groups -Haematology: Immediately after exposure there was a dose-dependent increase in blood RBC's, hematocrit, and haemoglobin levels in the mid and high dose groups; WBC and neutrophils increased after the high dose -Urinalysis: no data -Organ weights: Immediately after exposure there was a dose-dependent increase in lung-to-body weight ratio in the mid and high dose groups. -Gross pathology: lungs not collapsed in mid and high dose animals -Histopathology: Mid and high dosed rats showed a fibrino-necrotic bronchopneumonia; in addition, the high-level rats showed a fibrino-purulent rhinitis. lympgoid atrophy in thymus, In the 3 ppm group the only effects were an apparent exacerbation of naturally occurring murine pneumonitis. There was marked recovery from these lesions and a return to normal weight-gains two weeks later. There was a decrease of monocytes in all treated groups at the end of the recovery period. STATISTICAL RESULTS: no data
Reliability	:	(2) valid with restrictions Documentation incomplete (method, clinical observations, hematology results, histopathology results described) Although the study documentation is incomplete, the results described are nevertheless reliable, as the data were produced and published by recognized institutions. Furthermore the results are plausible and in line with all other evidence regarding the chemical and biological properties, i.e. corrosivity, of sulfuryl chloride and its hydrolysis products hydrochloric acid, sulfuric acid, and chlorosulfonic acid.
Flag	:	Critical study for SIDS endpoint

28.11.2003 (23) (24) (25) (26)

Type	:	
Species	:	other: detailed information concerning tested species, concentrations and end-points is given in the attached documents "Repeated dose toxicity studies by inhalation conducted with sulfuric acid aerosol"
Sex	:	
Strain	:	
Route of admin.	:	inhalation
Exposure period	:	
Frequency of treatm.	:	
Post exposure period	:	
Doses	:	
Control group	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	In numerous repeated dose inhalation studies with sulfuric acid aerosol, toxicity was confined to changes in the structure and function of the respiratory tract, suggesting that it has a local effect and no systemic effects. The observed changes are related to the irritant properties of sulfuric acid and are most likely due to the H+ ion. In a 28-day inhalation study in the rat exposed to sulfuric acid aerosol, minimal squamous metaplasia was observed in the laryngeal epithelium following exposure to the lowest concentration used (0.3 mg/m3). This effect was fully reversible. Exposure to 1.38 mg/m3 caused more severe metaplasia accompanied by cell proliferation.
Attached document	:	Repeated dose toxicity studies by inhalation conducted with sulfuric acid aerosol (part 1) Repeated dose toxicity studies by inhalation conducted with sulfuric acid aerosol (part 2) Repeated dose toxicity studies by inhalation conducted with sulfuric acid aerosol (part 3) Repeated dose toxicity studies by inhalation conducted with sulfuric acid aerosol (part 4)
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint

19.07.2002 (19)

Type	:	
Species	:	mouse
Sex	:	
Strain	:	
Route of admin.	:	other: dermal or oral
Exposure period	:	
Frequency of treatm.	:	
Post exposure period	:	
Doses	:	
Control group	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrogen chloride
Result	:	Repeated dermal application of hydrochloric acid in mice has resulted in local tumours, but the repeated oral application of hydrochloric acid in mice gave no indication for an increased tumor incidence and did also not promote the

activity of a known carcinogen. However, possibly only the gastro-intestinal tract was examined. No other data are available on the possible effects after repeated administration.

Reliability : (4) not assignable
Data from handbook or collection of data
Flag : Critical study for SIDS endpoint
24.07.2002 (9)

Type : Sub-chronic
Species : other: rats and mice
Sex : male/female
Strain : other: B6C3F1, Sprague-Dawley, Fisher 344
Route of admin. : inhalation
Exposure period : 90 days
Frequency of treatm. : 6 hours/day and 5 days/week
Post exposure period :
Doses : 10, 20 or 50 ppm (15, 30, or 75 mg/m3)
Control group : yes
NOAEL : < 10 ppm
Method :
Year :
GLP :
Test substance : other TS: hydrogen chloride

Result : In a 90-day inhalation study using B6C3F1 mice, Sprague-Dawley, and Fisher 344 rats groups of 31 males and 31 females of each species and strain were exposed to HCl at 10, 20 or 50 ppm (15, 30, or 75 mg/m3), 6 h/day, 5 days/week for 90 days. Several animals died during the study; however, the deaths did not appear to be exposure related. There was a slight, but significant decrease in body weight gain in male and female mice and male Fisher 344 rats in the high dose groups. There was no effect on hematology, clinical chemistry, and urinalysis. Histologic examination showed minimum to mild rhinitis in both strains of rats. Lesions occurred in the anterior portion of the nasal cavity and were concentration and time related. In mice exposed to 50 ppm, there was cheilitis and accumulation of macrophages in the periferal tissues after 90 days. Mice in all exposure groups developed eosinophilic globules in the epithelial lining of the nasal tissues.
All findings were confined to the site of first contact and can be explained by the irritating/corrosive properties of the acid. No signs of direct sytemic effects were reported. Therefore systemic availability is unlikely. The local NOAEC is below 10 ppm. No statement is possible about a systemic NOAEL because of the severe irritation/corrosion effect occurring at the site of entry after higher doses. Potential systemic effects are considered as consequences of these local effects.
Reliability : (1) valid without restriction
Peer Reviewed Document
Flag : Critical study for SIDS endpoint
19.07.2002 (27)

5.5 GENETIC TOXICITY 'IN VITRO'

Type : Ames test
System of testing : Salmonella typhimurium TA 98, TA 100, TA 1535, TA 1537

Test concentration	:	trial 1 and 2: 10 - 1000 ug/plate trial 2a: 10 - 5000 ug/plate trial 2b: 100 - 3333 ug/plate (only with TA 98 / TA 100 without S9-mix)
Cycotoxic concentr.	:	>= 3333 ug/plate
Metabolic activation	:	with and without
Result	:	
Method	:	OECD Guide-line 471
Year	:	1983
GLP	:	yes
Test substance	:	other TS: purity "according to specification" (no further data)
Result	:	Significant and reproducible dose-dependent increase up to the highest investigated concentration only in TA 100 without S9-mix. Negative in TA 98, TA 1535 and TA 1537. PRECIPITATION CONCENTRATION: 5000 ug/plate
Test condition	:	vehicle: ethylene glycol dimethylether (EGDE) S9 liver microsomal fraction was obtained form livers of 8 - 12 weeks old male Wistar rats (single i.p. injection of 500 mg/kg Aroclor 1254) positive controls without metabolic activation: sodium azide (TA 100, TA 1535) and 4-nitro-o-phenylene-diamine (TA 98, TA 1537) positive controls with metabolic activation: 2-aminoanthracene (TA 98, TA 100, TA 1535, TA 1537) each concentration including controls was tested in triplicate no data on pH values given
Reliability	:	(1) valid without restriction Guideline study
Flag	:	Critical study for SIDS endpoint

15.07.2002 (28)

Type	:	Ames test
System of testing	:	Salmonella typhimurium TA 100
Test concentration	:	up to 4000 ug/plate
Cycotoxic concentr.	:	Doses up to 32 ug/plate revealed no bacteriotoxic effect. Doses up to 4000 ug/plate caused weak bacteriotoxic effects but could still be used for assessment purposes.
Metabolic activation	:	with and without
Result	:	negative
Method	:	
Year	:	
GLP	:	yes
Test substance	:	other TS: purity 99.8 %
Test condition	:	vehicle: ethylene glycol dimethylether (EGDE) S9 liver microsomal fraction was obtained form livers of male SD rats (single i.p. injection of 500 mg/kg Aroclor 1254) positive control without metabolic activation: nitrofurantoin positive control with metabolic activation: 2-aminoanthracene no data on pH values given
Reliability	:	(1) valid without restriction Comparable to Guideline study
Flag	:	Critical study for SIDS endpoint

19.07.2002 (29)

Type	:	Ames test
System of testing	:	Salmonella typhimurium TA 100
Test concentration	:	15 - 5000 ug/plate (standard plate test) 15 - 250 ug/plate (preincubation test)
Cycotoxic concentr.	:	100 - 500 ug/plate
Metabolic activation	:	with and without
Result	:	negative
Method	:	other: no data
Year	:	1991
GLP	:	no data
Test substance	:	other TS: purity not given
Test condition	:	vehicle: ethylene glycol dimethylether (EGDE)
Reliability	:	(4) not assignable Secondary literature
Flag	:	Critical study for SIDS endpoint

15.07.2002 (30)

Type	:	
System of testing	:	
Test concentration	:	
Cycotoxic concentr.	:	
Metabolic activation	:	
Result	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	Sulfuric acid has been shown to be without effect in genetic toxicity studies in vitro (bacterial test). It has been shown to cause chromosomal aberrations in a non-bacterial test in vitro. The chromosomal effects are well known to be a consequence of reduced pH, being seen using any strong acid.
Reliability	:	(1) valid without restriction Peer Reviewed Document
Flag	:	Critical study for SIDS endpoint

08.08.2002 (19)

Type	:	other: Ames test and rec-assay with Escherichia coli and Bacillus subtilis
System of testing	:	
Test concentration	:	
Cycotoxic concentr.	:	
Metabolic activation	:	with and without
Result	:	negative
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: hydrochloric acid
Result	:	Hydrochloric acid was not mutagenic in an Ames test, both with and without metabolic activation and did not cause DNA damage in the rec-assay with Escherichia coli and Bacillus subtilis.
Reliability	:	(2) valid with restrictions Studies well documented, meets generally accepted scientific principles, acceptable for assessment
Flag	:	Critical study for SIDS endpoint

30.07.2002 (31) (32) (33)

Type	:	other
System of testing	:	
Test concentration	:	
Cycotoxic concentr.	:	
Metabolic activation	:	
Result	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	

Remark : The performance of further in vitro studies is not considered useful, because the result can easily be predicted. Sulfuryl chloride hydrolyses in aqueous media resulting in acidic solutions. The cytotoxic effects of unphysiologically low pH-values are well known and standard in vitro test systems are buffered thoroughly to avoid such effects. The exhaustion of the buffer capacity is regarded as an invalidation of the test systems. At low concentrations physiologic anions (chloride and sulfate) are formed, which are not-mutagenic

Flag : Critical study for SIDS endpoint

08.08.2002

5.6 GENETIC TOXICITY 'IN VIVO'

Type	:	Drosophila SLRL test
Species	:	Drosophila melanogaster
Sex	:	male
Strain	:	other: Oregon-K
Route of admin.	:	inhalation
Exposure period	:	24 hours
Doses	:	0.01 %
Result	:	negative
Method	:	other: according to Demerec M (1948) Genetics 33, 337-348
Year	:	1948
GLP	:	no
Test substance	:	other TS: hydrochloric acid (purity not given)

Remark : Studies with sulfuryl chloride were not identified in the available literature. However, information can be taken from valid studies performed with the hydrolysis product.

Reliability : (3) invalid
Methodological deficiencies: only one dose level tested, no data about MTD

19.07.2002 (34)

Type	:	Drosophila SLRL test
Species	:	Drosophila melanogaster
Sex	:	male
Strain	:	other: Oregon-K
Route of admin.	:	oral feed
Exposure period	:	24 hours
Doses	:	0.01 %
Result	:	negative
Method	:	other: according to Demerec M (1948) Genetics 33, 337-348
Year	:	1948
GLP	:	no
Test substance	:	other TS: hydrochloric acid (purity not given)

Remark : Studies with sulfuryl chloride were not identified in the

available literature. However, information can be taken from valid studies performed with the hydrolysis product.

Reliability : (3) invalid
Methodological deficiencies: only one dose level tested, no data about MTD

19.07.2002 (34)

Type : other
Species :
Sex :
Strain :
Route of admin. :
Exposure period :
Doses :
Result :
Method :
Year :
GLP :
Test substance :

Remark : The performance of in vivo studies is not considered as usefull, because the result can easily be predicted. Sulfurylchloride hydrolyses in aqueous media to produce acidic solutions. The cytotoxic effects of unphysiologically low pH-values are well known. The exhaustion of the physiologic buffer capacity will result in cytotoxicity and irritation/ corrosion at the point of entry. No systemic availability is to be expected. At lower concentrations physiologic anions (chloride and sulfate) are formed, which are non-mutagenic.

Flag : Critical study for SIDS endpoint
08.08.2002

5.7 CARCINOGENICITY

Species : mouse
Sex : no data
Strain : other: F1 (C57B1 x CBA)
Route of admin. : dermal
Exposure period : not further specified
Frequency of treatm. : daily, 5 times per week (30 applications)
Post exposure period : one day
Doses : 4 % solution (vehicle: water)
Result : positive
Control group : no data specified
Method : other: no data
Year : 1982
GLP : no data
Test substance : other TS: 4 % solution of "sulfanol chloride" (purity not given), contaminated with benzo(a)pyrene (0.19-0.41 mg/kg)

Result : According to the authors, a chronic cutaneous exposure of mice to the test substance, and a single administration of benzo(a)pyrene followed by a cutaneous application of "sulfanol chloride" resulted in sebaceous adenoma in 2 animals and in squamous cell carcinoma in 1 animal (no further details given).
Based on these results the authors concluded that "sulfanol chloride" has a carcinogenic health hazard.
A reliable decrease in the quantity of sebaceous glands was observed in mice following short-term cutaneous exposure to

"sulfanol chloride" (no further data).

Reliability : (3) invalid
Due to the lack of important information on the experimental design, detailed results and for example details on tumor incidence in different test groups, doubtful identity of the test substance and furthermore due to the contamination of the test substance with the known carcinogen benzo(a)pyrene, this study is considered to be invalid and not suitable for the assessment of the carcinogenic potential of sulfuryl chloride.

03.04.2002 (11) (35)

Species : rat
Sex : male
Strain : Sprague-Dawley
Route of admin. : inhalation
Exposure period : lifetime
Frequency of treatm. : 6 hours/day and 5 days/week during tifetime
Post exposure period :
Doses : ca. 0.015 mg/l (10 ppm)
Result : negative
Control group : yes
Method : other: no data
Year : 1982
GLP : no data
Test substance : other TS: hydrogen chloride

Remark : Reliable studies with sulfuryl chloride were not identified in the available literature. However, information can be taken from valid studies performed with the hydrolysis product.

Result : -Mortality: 29 % after 588 days (control: 28 %).
-Body weight gain: No significant change when compared with controls.
-Histopathology: Totally, 19 and 25 tumours were found in treated and control rats, respectively. Type and incidence of tumours were not significantly different. No nasal tumours were observed in both treated and control animals.

The Albert et al. (1982) study, discussed in detail by Sellakumar et al. (1985), reported data from a chronic inhalation exposure study in rats. One hundred male Sprague-Dawley rats were exposed to 10 ppm hydrogen chloride (HCl) for 6 hours/day, 5 days/week (duration-adjusted concentration = 2.5 mg/m3) for their lifetimes. All animals were observed daily, weighed monthly, and allowed to die naturally or killed when moribund. Complete necropsy was performed on all animals, with particular attention given to the respiratory tract. Histological sections were prepared from the nasal cavity (one lateral section from each side of the head), lung (one section from each lobe), trachea, larynx, liver, kidneys, testes, and other organs where gross pathological signs were present. However, Sellakumar et al. (1985) did not discuss histopathological events in organs other than the respiratory tract. HCl-exposed animals showed no differences in body weights or survival when compared with air controls. The data indicated 62/99 exposed animals with epithelial or squamous hyperplasia in the nasal mucosa (location not specified) vs. 51/99 in the concurrent control group. Incidence of squamous metaplasia was 9 and 5 in the

exposed and control rats, respectively. There was a 24 % incidence of hyperplasia of laryngeal-tracheal segments in HCl-exposed rats (larynx 2/22, trachea 6/26) vs. 6 % in the controls. The authors did not make any comments concerning the severity of these changes. Based on these results, the US EPA (1995) gave 10 ppm as LOAEL [LOAEL(HEC) = 6.1 mg/m3).

Test condition : The aim of the study was to investigate the hydrogen chloride induction of nasal cancer. Groups of 99 rats were exposed to gaseous HCl (whole-body exposure). Two groups of control rats were either sham-treated or remained untreated. Complete necropsy was performed on all animals and particular attention was given to the respiratory tract.

Reliability : (2) valid with restrictions
Study well documented, meets generally accepted scientific principles, acceptable for assessment

Flag : Critical study for SIDS endpoint

19.07.2002 (36) (37) (27)

Species : other: detailed information concerning tested species, concentrations and end-points is given in the attached document "Carcinogenicity studies conducted with sulfuric acid"

Sex :
Strain :
Route of admin. :
Exposure period :
Frequency of treatm. :
Post exposure period :
Doses :
Result :
Control group :
Method :
Year :
GLP :
Test substance : other TS: sulfuric acid

Result : No carcinogenic effect was observed in limited carcinogenicity studies conducted by inhalation with sulfuric acid aerosol using 3 different animal species. Small increases in tumour incidence were reported in rats and mice after chronic gastric intubation or intratracheal instillation of sulfuric acid solution, but no clear conclusion can be drawn from these studies.

Attached document : Carcinogenicity studies conducted with sulfuric acid

Reliability : (1) valid without restriction
Peer Reviewed Document

Flag : Critical study for SIDS endpoint

19.07.2002 (19)

Species : mouse
Sex : no data
Strain : no data
Route of admin. : oral unspecified
Exposure period : 11 months
Frequency of treatm. : 5-10 times/week
Post exposure period : no data
Doses : 90 - 360 mg/kg bw
Result : negative
Control group : no data specified
Method : other: no data
Year :
GLP : no

Test substance	:	other TS: hydrogen chloride
Result	:	The repeated oral application of hydrochloric acid in mice gave no indication for an increased tumor incidence and also did not promote the activity of a known carcinogen. However, possibly only the GI tract was examined.
Reliability	:	(4) not assignable Data from handbook or collection of data
Flag	:	Critical study for SIDS endpoint

24.07.2002 (9)

5.8.1 TOXICITY TO FERTILITY

Remark	:	Studies in experimental animals performed with sulfuryl chloride or the hydrolysis products hydrochloric acid and sulfuric acid were not identified in the available literature. Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs, reproductive effects in mammals are not likely to occur following exposure to sulfuryl chloride by any route.
Flag	:	Critical study for SIDS endpoint

08.08.2002

5.8.2 DEVELOPMENTAL TOXICITY/TERATOGENICITY

Remark	:	Valid studies in experimental animals performed with sulfuryl chloride or the hydrolysis product hydrochloric acid were not identified in the available literature. Because sulfuryl chloride is a toxicant acting at the portal-of-entry, and because it is unlikely to reach the reproductive organs, reproductive effects in mammals are not likely to occur following exposure to sulfuryl chloride by any route.

08.08.2002

Species	:	other: detailed information concerning tested species, concentrations and end-points is given in the attached document "Developmental toxicity/teratogenicity studies conducted with sulfuric acid mist"
Sex	:	
Strain	:	
Route of admin.	:	
Exposure period	:	
Frequency of treatm.	:	
Duration of test	:	
Doses	:	
Control group	:	
Method	:	
Year	:	
GLP	:	
Test substance	:	other TS: sulfuric acid
Result	:	In a developmental toxicity/teratogenicity study conducted

by inhalation with sulfuric acid aerosol, the NOAEL for maternal toxicity appears to be 20 mg/m3 in mice and rabbits. No evidence of foetotoxicity or teratogenicity was seen in either species.

Attached document : Developmental toxicity/teratogenicity studies conducted with sulfuric acid mist

Reliability : (1) valid without restriction
Peer Reviewed Document

Flag : Critical study for SIDS endpoint

08.08.2002 (19)

Species : rat
Sex : female
Strain : no data
Route of admin. : inhalation
Exposure period : 1 hour/day
Frequency of treatm. : One group was exposed 12 days prior to mating, and the other group on day 9 of gestation
Duration of test : no data specified
Doses : 302 ppm (450 mg/m3)
Control group : no data specified
Method : other: no data
Year :
GLP : no
Test substance : other TS: hydrogen chloride

Result : In both groups, signs of severe dyspnea and cyanosis were noted, and mortality occurred in one-third of the animals. Fetal mortality was significantly higher in rats exposed during pregnancy. When the progeny were subjected to an additional exposure of 35 ppm (52 mg/m3) at the age of 2-3 months, functional abnormalities in the organs of the progeny were similar to those found in the mothers.

Reliability : (3) invalid
Only one concentration tested, no data about controls or duration of study given.

08.08.2002 (38) (27)

5.8.3 TOXICITY TO REPRODUCTION, OTHER STUDIES

5.9 SPECIFIC INVESTIGATIONS

5.10 EXPOSURE EXPERIENCE

Type of experience : Health records from industry

Remark : no further information available
information in tabulated format and no details reported

Result : A concentration of 10 ppm (56 mg/m3) for 1 minute caused severe toxic effects.
Prolonged exposure to 4 ppm (22 mg/m3) may cause unspecified symptoms of illness.

Reliability : (4) not assignable

Flag : Critical study for SIDS endpoint

19.07.2002 (39)

Type of experience : Health records from industry

Remark : no further information available
Result : In one worker irritation of the respiratory tract and burns of the lower legs were observed after accidental inhalative uptake and dermal contact.
Reliability : (4) not assignable
Flag : Critical study for SIDS endpoint
15.07.2002 (40)

Type of experience : Health records, other

Remark : no further information available
Result : Vapors of sulfuryl chloride may cause pulmonary edema which may be delayed in onset.
Reliability : (4) not assignable
Flag : Critical study for SIDS endpoint
15.07.2002 (41)

Type of experience : Health records from industry

Remark : no further information available
Result : The vapours of sulfuryl chloride are extremely irritating and toxic to the respiratory tract.
Reliability : (4) not assignable
Flag : Critical study for SIDS endpoint
15.07.2002 (42) (43)

Type of experience : Health records from industry

Remark : Co-exposure to other chemicals such as carbon disulphide, isopropanol, toluene, and acrylonitrile among others. The authors concluded that it is not possible to decide which chemical was responsible.
Result : Dossing (1986) described sulfuryl chloride as a possible agent causing hepatotoxicity and gave the source for this information with Dossing & Ranek (1984). However, in this publication no data for sulfuryl chloride were given.
Reliability : (3) invalid
15.07.2002 (44) (45)

Type of experience : Human

Result : An in-plant case-control study of 26 renal cancer deaths was conducted in a Texas Chemical Plant. There was no association between renal cancer and occupational exposure to hydrochloric acid.
Test substance : hydrochloric acid
Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
19.07.2002 (46)

Type of experience : Human

Result : A plant-based case-control study of brain tumour mortality (28 cases) was conducted in a Texas Chemical Plant. There was no statistically significant association between brain tumours and occupational exposure to hydrogen chloride.
Test substance : hydrogen chloride
Reliability : (1) valid without restriction

Flag : Critical study for SIDS endpoint
19.07.2002 (47)

Type of experience : Human

Result : A nested case-control study of lung cancer and hydrogen chloride exposure was conducted among a cohort of chemical manufacturing employees (308 lung cancer cases observed between 1940 and 1981, 616 comparison workers). There was no evidence that hydrogen chloride is a human carcinogen.
Test substance : hydrogen chloride
Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
19.07.2002 (48) (49)

Type of experience : Human

Result : Carcinogencity:
Evaluation of different case-control studies and cohort studies and consideration of other cancer risks (smoking, alcohol consumption, and exposure to other carcinogens) revealed an increased risk of laryngeal cancer induced by exposure to sulfuric acid.
Test substance : sulfuric acid
Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
15.07.2002 (50)

Type of experience : Human

Result : There is sufficient evidence that occupational exposure to strong-inorganic-acid mists containing sulfuric acid is carcinogenic to humans (Group 1).
Test substance : sulfuric acid
Reliability : (1) valid without restriction
Flag : Critical study for SIDS endpoint
16.07.2002 (51)

5.11 ADDITIONAL REMARKS

Type : other: Toxicity evaluation of degradation products: Hydrogen Chloride

28.11.2003 (7)

Type : other: Toxicity evaluation of degradation products: Sulfuric acid

28.11.2003 (8)

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