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# SULFURIC ACID FACTS

TEXAS Department of State Health Services

## *Hazardous Substances Emergency Events Surveillance (HSEES) System*

**Synonyms:** sulfuric acid, battery acid, hydrogen sulfate, oil of vitriol, $H_2SO_4$

**CAS Number:** 7664-93-9

**DOT Numbers:** UN1830

**RTECS Number:** WS5600000

| Hazard rating | NFPA |
|---|---|
| **HEALTH** | 3 = Extreme danger |
| **FLAMMABILITY** | 0 = Minimal |
| **REACTIVITY** | 2 = Violent chemical change |
| USE NO WATER!<br>CORROSIVE<br>POISONOUS GASES ARE PRODUCED IN FIRE<br>CONTAINERS MAY EXPLODE IN FIRE | |


**Characteristics:**

- Clear to dark-brown, odorless, viscous, heavy liquid.
- A strongly corrosive agent that reacts violently with combustibles and reducing materials.
- In concentrated form (or solutions), it is a strong acid and reacts violently with bases and many aqueous solutions.
- It reacts with most light metals to generate HYDROGEN, a flammable/explosive gas.
- Reacts violently (explosively) with many organic materials.
- When heated, it forms irritating TOXIC gases (SULFUR OXIDES).
- Incompatibilities and reactivities:
  *Organics* – like cyclopentadine; cyclopentanone; fulminates, nitroarylamines, oxime, picrates.
  *Oxidizing agents* – like perchlorates, peroxides, permanganates, chlorates, chromates, nitrates, chlorine, bromine, or fluorine.

*Miscellaneous inorganics* – like carbides, cyanides, halides, hexalithium disilicide, phosphorus oxide, or powdered light metals (phosphorus, sodium, potassium, lithium, or zinc).

**Uses and Potential Exposures:**

- Used in the production of other chemicals, fertilizers, dyes, and petroleum refining.
- Used in making iron, steel, and industrial explosives.
- Used in etching and analytical chemistry.
- Used in printing, publishing, and photography.
- Used in lead acid batteries.
- Used in dilute or neutralized forms of household cleaning products.

**Exposure Routes:**

- Inhalation
- Ingestion (solutions)
- Skin and/or eye contact

**PREVENT GENERATION OF AEROSOLS, MISTS, AND GASEOUS BY PRODUCTS! AVOID ALL CONTACT!**

**Sulfuric acid exposure levels and associated health impact in acute (< 15 minutes) exposure situations:**

| Concentration | Health Effects |
|---|---|
| <1.0 mg/m$^3$ | No acute effects expected |
| 1.0-2.0 mg/m$^3$ | Eye, nose, and throat irritation expected |
| 2.0-5.0 mg/m$^3$ | Severe eye, nose, and throat irritation, burning sensation, cough, labored breathing, shortness of breath. |
| >5.0 mg/m$^3$ | Inhalation may result in pulmonary edema. Symptoms may be delayed and may not become apparent until a few hours after exposure. Medical observation is needed. |
| **15 mg/m$^3$** | **Immediately dangerous to life and health (IDLH)** |

**Recommended and permissible occupational exposure limits for sulfuric acid:**

| Concentration | Recommendations |
|---|---|
| 0.2 mg/m$^3$ | *Threshold Limit Value – Time Weighted Average (TLV-TWA®)** the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. |
| 1 mg/m$^3$ | *Permissible Exposure Limit (PEL)†* The permissible airborne contaminant concentration weighted over an 8-hour work day, as determined from breathing-zone air samples, over which the employee may not be exposed. |

*American Conference of Governmental Industrial Hygienists (ACGIH) guidelines
†Occupational Safety and Health Administration (OSHA) standard

**Personal Protective Equipment (PPE) Guidelines:**
***Note: Effective workplace controls and practices are preferred to PPE.***

**Respiratory Protection**

**NIOSH respirator recommendations**

| Purpose | Recommendations |
|---|---|
| Emergency or planned entry into unknown concentrations (At IDLH or >15 mg/m$^3$) | ►Self-contained breathing apparatus with full facepiece operated in a pressure-demand or other positive-pressure mode. |
| Escape | ►Escape-type, self-contained breathing apparatus.<br>►Full-face negative air-purifying respirator (gas mask) with chin-style, front- or back-mounted acid cartridge gas canisters and high-efficiency particulate filters (HEPA or P100). |
| Work environments ≤ 15 mg/m$^3$ | ►Self-contained breathing apparatus or supplied-air respirators.<br>► Powered, air-purifying respirators with full facepiece, acid gas cartridge(s), and HEPA or P100.<br>►Full-face negative air-purifying respirators (gas mask) with chin-style, front- or back-mounted acid cartridge gas canisters and HEPA or P100 . |

**Clothing**

- Avoid skin contact. Wear durable, acid-resistant gloves, and clothing. Glove manufacturers recommend polyvinyl chloride, nitrile, or neoprene for adequate chemical resistance.
- All protective clothing (suits, gloves, footwear, headgear) should be clean and put on before work.
- Structural firefighter protective clothing provides limited protection in fire situations, ONLY; not effective in spill situations.

**Eye Protection**

- When working with acid gases, aerosols, or vapors, wear non-vented, impact resistant goggles and face shields.
- When working with liquids, wear indirect-vent, impact and splash resistant goggles and face shields.
- Avoid wearing contact lenses when working with this substance.

**Sulfuric Acid Handling and Storage:**

- Avoid contact with combustible and reducing substances, strong oxidants, strong bases, or metals.
- NEVER pour water into concentrated sulfuric acid; when diluting always add acid slowly into water stored in a suitable container. Glass is the most suitable. When adding acid to water it produces considerable heat and often melts plastic containers.
- Store in a cool, dry, well-ventilated area away from sunlight and combustibles in an area with an acid resistant cement floor.

**Disposal Methods:**

Dilute, neutralize, and/or absorb sulfuric acid-containing waste; store in appropriate waste containers. Dispose of wastes in accordance with facility hazardous waste generation and characterization policies.

**Spills and Emergencies:**

***NOTE: Instructions below are dependent on spill size and concentration of acid.***

- ✓ Evacuate endangered area 160 to 330 feet in all directions. If there is a fire/explosion threat, consider an evacuation in all directions within ½ mile.
- ✓ Stay up wind. Ventilate area.
- ✓ Stop the leak, if you can do it without risk.
- ✓ Cover spills with dry lime, sand, or soda ash, and place into loosely covered plastic containers for proper disposal.
- ✓ Do NOT use organic materials like sawdust or paper towels.
- ✓ Do NOT wash down a spill of concentrated sulfuric acid with water. In most cases when sulfuric acid is a 10% solution or less, water wash maybe appropriate. Water spray may be used to reduce vapors.

- ✓ Keep out of confined spaces such as sewers, basements, or confined areas to prevent build-up of toxic explosive byproducts.

**Emergency First Aid Measures:**

*Eye Contact*

1. Immediately flush eyes with large amounts of water. Continue for at least 30 minutes, lifting upper and lower eye lids.
2. Seek medical attention immediately.

*Skin Contact*

1. Quickly remove and isolate contaminated clothing.
2. Immediately wash skin with large amounts of mild soap and water for at least 20 minutes.
3. Seek medical attention immediately.

*Respiratory*

1. Remove the victim from the site of the release to fresh air.
2. If breathing has stopped, begin rescue breathing using universal precautions, and CPR if heart activity has stopped.
3. Transfer the victim promptly to a medical facility.
4. Observation is recommended for up to 48 hours, as swelling and fluid in the lungs (pulmonary edema) may have delayed onset.

**Fire Extinguishing and Explosion Hazards:**

- ✓ In case of fire, use carbon dioxide, dry chemical, dry sand, AFFF, or foam. Do NOT use water.
- ✓ To prevent explosion or corrosion of the container, do NOT spray straight streams of water on or into a leaking container, use a water spray or fog.
- ✓ Fight the fire from the maximum distance or use unmanned hose holders or monitor nozzles.
- ✓ Dike the fire control water for later disposal; do not scatter the material. Isolate the area for ½ mile in all directions.
- ✓ Contact with some metals may produce HYDROGEN, a FLAMMABLE/EXPLOSIVE gas.
- ✓ TOXIC GASES may accumulate in confined areas (basements, tanks, tank cars).

**TxHSEES Facts**

The Texas Department of State Health Services (DSHS) has participated in this surveillance system since 1993. HSEES collects and analyzes information about releases of hazardous substances (excluding petroleum) that need to be cleaned up or neutralized, as well as threatened releases that result in a public health actions such as an evacuations. The goal of HSEES is to reduce the morbidity (injury) and mortality (death) that may result from hazardous substance events.

From 1993 to 2002, TxHSEES investigated 23,139 events meeting the HSEES case definition. Due to the large number of spills and air releases in Texas, TxHSEES requires that spills or releases must be greater than one gallon or 10 pounds, unless the CERCLA reportable quantity is one pound.

HSEES categorizes chemicals into 16 substance categories. The substance category, acids, ranked as the fourth most frequently occurring event (1,497, 6%). Sulfuric acid releases accounted for 37% of the acid releases and included sulfuric acid, sulfuric acid not otherwise specified (NOS), and battery acid NOS. Sulfuric acid was involved in 553 actual or threatened events: 429 fixed-facility events and 124 transportation events (Table 1). A total of 107 people were injured during 32 events involving sulfuric acid releases (Table 1).

**Table 1. Summary of sulfuric acid events reported to TxHSEES**

| | Fixed Facility No. % | Transportation No. % | Total |
|---|---|---|---|
| Events | 429 (78%) | 124 (22%) | 553 |
| Evacuations | 23 (77%) | 7 (23%) | 30 |
| Shelter-in-place | 4 (80%) | 1 (20%) | 5 |
| People receiving emergency decontaminations | 88 (67%) | 44 (33%) | 132 |
| Events with victims | 23 (72%) | 9 (28%) | 32 |
| Victims | 98 (92%) | 9 (8%) | 107 |

More than 685 people were evacuated in 30 sulfuric acid events. The number of people evacuated ranged from 1 to 150, with a median number of 8 people in each incident. The length of evacuation ranged from 1 to 65 hours, with a median number of 3 hours.

The industries most frequently associated with sulfuric acid releases were chemical manufacturing (210, 38%), transportation (128, 23%), and petroleum refining (59, 11%) (Table 2). Six percent of all sulfuric acid release events injured people; 61 people (57% of the total number of victims) injured were in the chemical manufacturing industry.

The transportation industry had the largest number of evacuations (9, 30% of all evacuations), followed by chemical manufacturing (5, 17% of all evacuations). Eighty-four people received emergency decontamination in 24 events.

**Table 2. Frequency of events, events with victims, and victims by selected industries**

| Industry Category | Events No. (%) | Events with victims No. (%) | Victims No. (%) |
|---|---|---|---|
| Chemical Mfg. | 210 (38%) | 10 (31%) | 61 (57%) |
| Transportation | 128 (23%) | 9 (28%) | 10 (9%) |
| Petroleum Refining | 59 (11%) | 2 (6%) | 5 (5%) |
| Durable and Nondurable Goods Mfg | 45 (8%) | 4 (13%) | 20 (19%) |
| Utilities | 41 (7%) | 2 (6%) | 6 (6%) |
| Wholesale | 20 (4%) | 2 (6%) | 2 (2%) |
| All other | 42 (8%) | 2 (6%) | 2 (2%) |
| Unknown | 8 (1%) | 1 (3%) | 1 (1%) |
| Total* | 553 (100%) | 32 (99%) | 107 (101%) |

* Percentages may not add to 100% due to rounding.

The majority of injured persons were employees (50, 47%) and their most frequent injuries were respiratory irritation and chemical burns. For the 46 injured members of the general public, respiratory irritation and gastrointestinal problems were the most frequently reported injuries. The 11 responders most frequently reported respiratory irritation. No deaths occurred in HSEES events associated with sulfuric acid releases; most people were treated on the scene or at a hospital and released.

**Case Study 1**

*Highlights: 10 victims and an evacuation*

At a copper refinery, piping containing sulfuric acid ruptured and sprayed 40 gallons into the air. There were 600 employees working at the time of the release. Ten employees reported symptoms of respiratory irritation. Six employees went to the plant's clinic for first aid. Four employees were taken to the hospital emergency room and were treated and released. They were 75 yards from the initial point of release. All were wearing the following personal protective equipment (PPE): plastic hard hat, safety glasses with side-shields, coveralls, and leather or rubberized gloves. Forty-five employees were evacuated from the area for two hours.

**Case Study 2**

*Highlights: 6 victims*

At a durable goods manufacturing facility, a suction line on a sulfuric acid tank ruptured and spilled 6,000 gallons into a concrete containment area. Six employees reported respiratory irritation. They were taken to the hospital emergency room and were treated and released. They were wearing Level D personal protective equipment that included coveralls and chemical-resistant boots and gloves. No orders were given to the surrounding community to evacuate or shelter-in-place. The material was absorbed and the cleanup materials were secured for proper disposal.

**Lessons Learned**

Engineering control measures, designed specifically to stop or contain process materials near their point of emission before the hazards reach workers or offsite residents, are the most effective means through which to prevent and mitigate the types of exposures experienced in these case studies. For instance, in case study 1, double wall pipes with cutoff valves could have prevented the release thereby eliminating the exposures. In case study 2, an automated cutoff system could have reduced the amount of material released mitigating the exposures.

In both case studies the use of properly fit-tested respiratory protection would have prevented the respiratory irritation experienced by the workers; however, at the time of the releases, the workers were not performing tasks that required respiratory protection. Since it would not be practical to require all workers to wear respiratory protection at all times, in both cases, improved engineering controls would be the primary approach in preventing future worker exposures.

**For more information about TxHSEES, call 512-458-7220.**



*Information for this fact sheet was obtained from the TxHSEES program, the Environmental Protection Agency (EPA); the Agency for Toxic Substances and Disease Registry (ATSDR) TOXFAQS; the Handbook of Toxic and Hazardous Chemicals and Carcinogens, Third Edition; American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values® and Biological Exposure Indices®, 2004; Federal OSHA Regulations: 29 CFR 1910.1000, 29 CFR 1910.111; National Institute for Occupational Safety and Health, NIOSH Pocket Guide to Chemical Hazards, 2003; NIOSH International Chemical Safety Cards; U.S. Department of Transportation, Emergency Response Guidebook 2004 (hazmat.dot.gov erg2000/g124.pdf); and National Library of Medicine's TOXNET Hazardous Substances Databank (toxnet.nlm.nih.gov).*

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