



Molten Sulfur

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sulfur (Molten) **Formula:** S **Molecular Weight:** 32.06
Chemical Name: Elemental Sulfur **Chemical Family:** Non-metallic element
Synonyms: Sulfur, Sulphur, Brimstone
Product Use: In manufacturing sulfuric acid, sulfur dioxide, carbon disulfide, plastics, enamels, in vulcanizing rubber, in synthesis of dyes, for bleaching wood pulp.

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2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Hazardous Ingredients</u>	<u>% by Wt.</u>	<u>CAS Number</u>
Sulfur	99-100%	7704-34-9
Hydrogen Sulfide	0-0.5%	7783-06-4

3. HAZARD INFORMATION

EMERGENCY OVERVIEW:

WARNING! Flammable Solid! Hot, Molten Sulfur will burn skin. Sulfur burns with a blue flame that may be difficult to see in daylight, and produces toxic sulfur dioxide gas. Vapour space of container may contain TOXIC concentrations of Hydrogen Sulfide, which could be fatal if inhaled or absorbed through skin. Hydrogen Sulfide is very flammable and even explosive under certain conditions.

National Fire Protection Association (NFPA) Rating
Hazardous Materials Identification System (HMIS) Rating

	NFPA		HMIS
HEALTH	2	HEALTH	2
FIRE	1	FIRE HAZARD	1
REACTIVITY	0	REACTIVITY	0
SPECIFIC HAZARD		PERSONAL PROTECTION	C

4 = Extreme/Severe
3 = High/Serious
2 = Moderate
1 = Slight
0 = Minimum

~~W~~ = Water Reactive



3. HAZARD INFORMATION (continued)

POTENTIAL HEALTH EFFECTS: HYDROGEN SULFIDE MAY CAUSE IRRITATION, BREATHING FAILURE, COMA, & DEATH, WITHOUT NECESSARILY ANY WARNING ODOUR BEING SENSED.

Exposure Limits:

	ACGIH (TLV)	OSHA (PEL)
Sulfur (Form: Nuisance dust)	10 mg/m ³ (TWA)	15 mg/m ³ (TWA)
Hydrogen Sulfide	10 ppm (TWA)	10 ppm (TWA)
	10 ppm Recommended Ceiling Value 10 min	
	15 ppm (STEL)	15 ppm (STEL)
	100 ppm (IDLH)	

Skin Contact: Direct contact with molten sulfur will cause thermal burns. Prolonged and repeated contact with cooled powder may cause irritation and possible sensitization.

Eye Contact: **Direct** contact with molten sulfur will cause immediate pain, severe burns and permanent corneal damage which may result in blindness. Mist and dusts may cause irritation, conjunctivitis, and possible corneal damage. Hydrogen sulfide in concentrations of 10 – 50 ppm irritates the eyes.

Inhalation: Dust and vapors are irritating to the eyes, nose, throat and respiratory tract, and may cause chronic bronchitis with chronic exposure. Hydrogen sulfide may not be sensed by smell at concentrations of 150 ppm or greater. Hydrogen sulfide is life threatening above 200 ppm. Inhalation at 200 - 250 ppm produces headache, dizziness, excitement, staggering, and vomiting. Prolonged exposure to hydrogen sulfide in this concentration range may cause lung damage and exposure for 4 to 8 hours can cause death. Concentrations of 300-500 ppm (of hydrogen sulfide) cause these same effects sooner and more severely. Death can occur in 1 to 4 hours. At 500 ppm respiratory failure can occur in 5 minutes to 1 hour. Exposures above 500 ppm rapidly cause unconsciousness and death.

Ingestion: Ingestion or direct contact with molten sulfur will cause severe thermal burns. Ingestion of large amount of dust may cause gastrointestinal upset, abdominal pain, nausea, vomiting, and diarrhea.

Long Term Exposure: Ingestion of large amounts of sulfur may lead to hydrogen sulfide poisoning due to the bacterial conversion of the sulfur in the colon.

Existing Medical Conditions Possibly Aggravated By Exposure: Breathing of dust, vapors or sprays (mists) may aggravate acute or chronic asthma and chronic pulmonary disease such as emphysema and bronchitis.

Carcinogenicity Data: Sulfur and hydrogen sulfide are not classified by NTP (National Toxicology Program), not regulated as carcinogenic by OSHA (Occupational Safety and Health Administration), and have not been evaluated by IARC (International Agency for Research on Cancer) or ACGIH (American Conference of Governmental Industrial Hygienists).

Molten Sulfur

4. FIRST AID MEASURES

Precaution: Hydrogen sulfide gas build-up may occur leading to high exposures when container is first opened.

Skin Contact: Flush skin with running water for a **minimum** of 20 minutes. Start flushing while removing contaminated clothing. If irritation persists, repeat flushing. Obtain medical attention if irritation remains. Removal of solidified molten material from skin requires medical assistance.

Eye Contact: Immediately flush eyes with running water for a **minimum** of 20 minutes. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY.

Inhalation: Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give Cardiopulmonary Resuscitation (CPR) only if there is no pulse AND no breathing. Obtain medical attention IMMEDIATELY.

Ingestion: DO NOT INDUCE VOMITING. If victim is alert and not convulsing, rinse mouth and give ½ to 1 glass of water to dilute material. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in of vomitus, rinse mouth and administer more water. IMMEDIATELY contact local poison control centre. Vomiting may need to be induced but should be directed by a physician or a poison control centre. IMMEDIATELY transport victim to an emergency facility.

Note to Physician: All treatments should be based on observed signs and symptoms of distress in the patient.

5. FIRE FIGHTING MEASURES

Flash Point (method): 207°C (404.6 °F) (NFP 1986)

Autoignition Temperature: 232°C (449.6 °F) (solid)

Flammability Limits in air: UEL: 1400 g/m³ LEL: 35 g/m³ (as dust in air)

△ **Combustion and Thermal Decomposition Products:** Sulfur dioxide and Sulfur Trioxide.

Fire Extinguishing Media: Water fog, saturated stream, Carbon Dioxide. Small fires may be extinguished with sand.

Special Fire Fighting Procedures: Avoid straight streams of water, which can scatter molten, sulfur and dust. Small fires can be extinguished with sand. Wear self-contained breathing apparatus and full protective clothing.

Other Fire or Explosion Hazards: Easily ignitable, combustible solid. Dust or vapour forms explosive mixtures with air. Hazardous in contact with oxidizing materials, forming explosive mixtures. Sulfur burns with a pale blue flame that may be difficult to see in daylight. Hydrogen sulfide is heavier than air and may travel considerable distance to source of ignition and flashback. Hydrogen sulfide has a LEL of 4.3% and a UEL of 45% by volume.

Evacuation: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.



6. ACCIDENTAL RELEASE MEASURES

Steps to be taken in the event of a spill or leak: Stop discharge and contain if safe to do so. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch or walk through spilled material. Do not allow material to enter water sources or sewers.

- Small dry spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area
- Large spills: When spilled in a molten form, contain if possible by forming barriers and let it solidify. Shovel solid sulfur into containers with covers (avoid dusting) for recovery or disposal. If removal is not possible, let it solidify and apply a cover material, preferably inert and basic (limestone), to the spilled area until recovery procedures begin. This will reduce the possible release of sulfuric acid in the water. Collect product and contaminated soil and water for recovery or disposal.
- Evacuation: Large spill: Consider initial downwind evacuation for at least 100 meters (330 feet).

Deactivating Chemicals: Limestone

Waste Disposal Methods: Dispose of waste material at an approved waste treatment/disposal facility, in accordance with applicable regulations. Do not dispose of waste with normal garbage or to sewer systems.

Note - Clean-up material may be a RCRA Hazardous Waste on disposal.

- Spills are subject to CERCLA reporting requirements: RQ = 1000 lbs.

7. HANDLING AND STORAGE

Precautions: Smoking should be prohibited in storage areas. Wear appropriate Personal Protection Equipment. Do not breathe dusts or mists. Do not ingest. Do not get in eyes, on skin or on clothing.

Handling Procedures and Equipment: Liquid sulfur should not be put into any tank, rail car or truck that contains trace quantities of hydrocarbons, or more than a trace of moisture. When unloading tank cars or trucks, workers should wear suitable protective equipment and stand to one side, upwind of the path of the escaping gas. The dome cover bolts should be loosened slowly to vent the gas pressure. Care should be taken against possible dangerous concentrations of hydrogen sulfide in the vicinity of the tank during steaming and during tank ventilating after loading.

Storage Temperature: Molten sulfur should be maintained at temperatures between 127°C and 149°C (260°F and 300°F)

Storage Requirements: Store in a cool, well-ventilated area. Separate from chlorates, nitrates and other oxidizers. External tank bottoms should be kept dry. Liquid sulfur tanks should be ventilated to prevent accumulation of toxic and explosive quantities of hydrogen sulfide.

Other Precautions: Avoid excessive dust generation, sparks or open flames. Avoid breathing fumes of molten sulfur, use normal good industrial hygiene. Tanks should be filled from the bottom or through discharge pipes that extend the bottom of the tank, since the dielectric constant of sulfur promotes the build-up of static electricity. The H₂S level in the vapor space in a storage vessel should be checked periodically for explosivity.



8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Recommendations listed in this section indicate the type of equipment, which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: Local exhaust ventilation required.

Respiratory Protection: For concentrations up to 100 ppm of Hydrogen Sulfide: A NIOSH/MSHA approved air-purifying respirator equipped with acid gas/fume, dust, mist cartridges or air-purifying, full-facepiece respirator with a chin-style, front or back mounted canister. An air-supplied respirator if concentrations are higher or unknown.

Skin Protection: Use insulated/heat-resistant impervious gloves.

Eye Protection: Use tight fitting chemical safety goggles when there is potential for eye contact.

Other Personal Protective Equipment: A hard hat and a face shield should be worn. Shirts should have long sleeves. Gloves made of fabric or heat resistant material that is long enough to overlap shirt cuffs should be worn. High-top safety shoes with trouser legs long enough to cover shoe tops should be worn. Clothing should be loose fitting to protect against burns.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Molten solid.

Appearance and Odor: Yellow to reddish brown liquid at a temperature of about 140°C (284°F) with a characteristic rotten egg odor.

Odor Threshold: Not available.

Boiling Point: 444.6°C (832°F).

Melting/Freezing Point: 114-119°C (236°F-246°F).

Vapor Pressure at 140°C (284°F): 0.11 mmHg.

Specific Gravity at 130°C (266°F): 1.8

Vapor Density at 445°C (832°F): 3.64

Bulk Density: Not applicable.

Evaporation Rate: Not applicable.

Δ **Solubility:** Not soluble in water. Slightly soluble in carbon disulfide. Soluble in benzene, toluene, chloroform, ether, warm aniline, carbon tetrachloride and liquid ammonia.

pH: Not applicable.



10. STABILITY AND REACTIVITY

Stability:

Under Normal Conditions: Stable.

Under Fire Conditions: Flammable.

Conditions to Avoid: Avoid excessive dust production. Avoid sparks and open flame sources. Store in a well ventilated area.

Materials to Avoid: Oxidizing agents such as chlorine and fluorine and alkalis. May react explosively with ammonia, ammonium nitrate, chlorine dioxide (bromates, chlorates, and iodates of barium, calcium, magnesium, potassium, sodium or zinc), chlorate in presence of copper), chromic anhydride, silver bromate, lead dioxide, mercuric nitrate, all inorganic perchlorates, phosphorus trioxide, sodium nitrate, and zinc. Hydrocarbons in contact with molten sulfur generate hydrogen sulfide and carbon disulfide, which may accumulate in explosive concentrations.

Hazardous Decomposition or Combustion Products: Produces oxides of sulfur on combustion.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data: Molten Sulfur: oral rat LD₅₀ >8437 mg/kg
LDLo oral rabbit 175 mg/kg
Hydrogen Sulfide: LC₅₀ (rats): 444 ppm (4 hrs exposure)

Carcinogenicity Data: Sulfur and hydrogen sulfide are not classified by NTP (National Toxicology Program), not regulated as carcinogenic by OSHA (Occupational Safety and Health Administration), and have not been evaluated by IARC (International Agency for Research on Cancer) or ACGIH (American Conference of Governmental Industrial Hygienists).

Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.

Mutagenicity Data: No information is available and no mutagenic effects are anticipated.

Teratogenicity Data: No information is available and no adverse teratogenic effects are anticipated.

Synergistic Materials: None known

Molten Sulfur**12. ECOLOGICAL INFORMATION**

Ingredient Name	Species	Period	Result
Δ Sulfur	Daphnia magna (EC50)	48 hour(s)	>5000 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	<14 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	>180 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	>180 mg/l

Mobility: Sulfur is insoluble in water at 20°C. Over long-term exposure, sulfur can oxidize under certain conditions to yield acidic runoff. Harmful to aquatic life at high concentrations.

Products of Degradation: These products are sulfur oxides (SO₂, SO₃).

Toxicity (Products of Degradation): The products of biodegradation are toxic but are not typically released to the atmosphere as a result of this degradation. They are instead incorporated into new compounds or combined with water to form a sulfur acid

13. DISPOSAL CONSIDERATIONS

- Responsibility for proper waste disposal is with the owner of the waste. Work with the appropriate regulatory bodies to ensure compliance with regulations.
 - Consider the collection of residual material into containers for reclamation or disposal only if the container is suitable to withstand the material.
 - Clean-up material may be a RCRA Hazardous Waste on disposal.
 - Provincial/State or local regulations or restrictions are complex and may differ from Federal regulations.
 - The information applies to the material as manufactured; processing, neutralizing, use or contamination may make the information inappropriate, inaccurate or incomplete.
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14. TRANSPORT INFORMATION

U.S. (Under DOT)

Shipping Name: Sulfur, molten
Hazard Class or Division: 9
Identification No.: NA2448
Packing Group: III

Δ ER Guide 133

Canada (Under TDG)

Shipping Name: Sulphur, molten
Classification(s): Class 4.1
Product Identification No. (PIN): UN2448
Packing Group: III



15. REGULATORY INFORMATION

U.S.A.

SARA Title III HAZARD CATEGORIES AND LISTS

Product Hazard Categories

Acute (Immediate) Health: No
Chronic (Delayed) Health: No
Fire: No
Reactivity: No
Sudden Release of Pressure: No

Lists

Extremely Hazardous Substance No
(40 CFR 355, SARA Title III Section 302)
CERCLA Hazardous Substance No
(40 CFR 302.4)
Toxic Chemical No
(40 CFR 372.65, SARA Title III Section 313)

Reportable Quantity (RQ) under U.S. EPA CERCLA: Not listed

TSCA Inventory Status: Reported/Included

Right-To-Know: Massachusetts, New Jersey, Pennsylvania

California proposition 65: No products were found

CANADA

Workplace Hazardous Materials Information System (WHMIS)

WHMIS Classification(s): Class B4- Flammable Solid
Class D-2B – Material causing other toxic effects (TOXIC)

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CEPA DSL: Sulfur

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WHMIS Ingredient Disclosure List: Confirmed A; Meets criteria for disclosure at 1% or greater.

Reportable Quantity (RQ) under Transport Canada - TDG: Not listed

European:

EEC CLASSIFICATION: 4.1

EINECS: 231-722-6

16. OTHER INFORMATION

Additional Information and References

Δ REFERENCES:

1. RTECS-Registry of Toxic Effects of Chemical Substances, On-line search, Canadian Centre for Occupational Health and Safety RTECS database, Doris V. Sweet, Ed., National Institute for Occupational Safety and Health, U.S. Dept. of Health and Human Services, Cincinnati, Entry Update/Oct1997/Dec1997.
2. "CHEMINFO", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (December, 1998).
3. CESARS: CHEMICAL EVALUATION SEARCH AND RETRIEVAL SYSTEM, Ontario Ministry of the Environment and Michigan Department of Natural Resources, CCOHS Issue : 98-4 (November, 1998)
4. Chemlist, STN Database, Chemical Abstract Service, 1999
5. HSDB-Hazardous Substances Data Bank , through "CCINFO disc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (November, 1998).
6. DOSE, Royal Society of Chemistry, 1998/S2
7. NIOSH POCKET GUIDE TO CHEMICAL HAZARDS, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, June 1997
8. Sax, N.I., "Dangerous Properties of Industrial Materials", 7th Edition, 1989
9. Merck, 11th Edition, 1989
10. Supplier's Material Safety Data Sheets.



16. OTHER INFORMATION (continued)

Revision Indicators:

Δ in the left margin indicates a revision or addition of information since the previous issue.

Legend:

CAS #	- Chemical Abstracts Service Registry Number
CERCLA	- Comprehensive Environmental Response, Compensation, and Liability Act
CFR	- Code of Federal Regulations
DOT	- Department of Transportation
EPA	- Environmental Protection Agency
LC ₅₀	- The concentration of material in air expected to kill 50% of a group of test animals
LD ₅₀	- Lethal Dose expected to kill 50% of a group of test animals
LEL	- Lower Explosive Limit
MSHA	- Mine Safety and Health Administration
NIOSH	- National Institute for Occupational Safety and Health
PEL	- Permissible Exposure Limit
PVC	- Polyvinyl chloride
RCRA	- Resource Conservation and Recovery Act
SARA	- Superfund Amendments and Reauthorization Act of the U.S. EPA
STEL	- Short Term Exposure Limit
TC	- Transport Canada
TDG	- Transportation of Dangerous Goods Act/Regulations
TLV	- Threshold Limit Value
TSCA	- Toxic Substances Control Act
TWA	- Time-Weighted Average
UEL	- Upper Explosive Limit

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