

Material Safety Data Sheet

Molten Sulfur

1. Product and company identification

Product name	: Molten Sulfur
Material uses	: Manufacturing sulfuric acid, sulfur dioxide, fertilizer, carbon disulfide, plastics, enamels; vulcanizing rubber; synthesizing dyes; bleaching wood pulp.
Headquarters	: Marsulex Inc. 111 Gordon Baker Road Suite 300 North York, ON M2H 3R1 (416) 496-9655 www.marsulex.com
MSDS authored by	: KMK Regulatory Services inc.
<u>In case of emergency</u>	: Canada: CANUTEC +1-613-996-6666 US: CHEMTREC +1-800-424-9300
Product type	: Solid.

2. Hazards identification

Emergency overview

Color	: Yellow to red brown.
Physical state	: Molten solid. Yellow to reddish brown liquid at a temperature of about 140°C (284°F) with a characteristic rotten egg odor.
Odor	: Rotten eggs.
Signal word	: WARNING!
Hazard statements	: FLAMMABLE SOLID. CAUSES EYE AND SKIN IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. MAY BE HARMFUL IF SWALLOWED.
Precautions	: Keep away from heat, sparks and flame. Do not get on skin or clothing. Avoid contact with eyes. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.
OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Routes of entry	: Dermal contact. Eye contact. Inhalation. Ingestion.
<u>Potential acute health effects</u>	
Inhalation	: Vapors are irritating to the 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.
Skin	: Direct contact with molten sulfur may cause severe thermal burns. Prolonged and repeated contact with cooled powder may cause irritation and possible sensitization.
Eyes	: Direct contact with molten sulfur may cause severe burns and permanent corneal damage, which may result in blindness. Mist, vapors and dusts may cause irritation, conjunctivitis, and possible corneal damage. Hydrogen sulfide in concentrations of 10 - 50 ppm irritates the eyes.
<u>Potential chronic health effects</u>	
Chronic effects	: Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.

2. Hazards identification

- Carcinogenicity** : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Inhalation** : No specific data.
Ingestion : No specific data.
Skin : Adverse symptoms may include the following:
 irritation
 redness
Eyes : Adverse symptoms may include the following:
 pain or irritation
 watering
 redness
Medical conditions aggravated by over-exposure : Repeated exposure may cause chronic bronchitis.

See toxicological information (section 11)

3. Composition/information on ingredients

United States

Name	CAS number	%
Sulfur	7704-34-9	99.5 - 100
Hydrogen Sulfide	7783-06-4	0 - 0.5

Canada

Name	CAS number	%
Sulfur	7704-34-9	99.5 - 100
Hydrogen Sulfide	7783-06-4	0 - 0.5

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First aid measures

- Eye contact** : Immediately flush eyes with lukewarm running water for a minimum of 15 minutes. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY.
- Skin contact** : Flush skin with lukewarm running water for a minimum of 5 minutes or until the chemical is removed. Start flushing while removing contaminated clothing. If irritation persists, repeat flushing. Obtain medical attention if irritation remains.
- Inhalation** : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention.
- 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 center. Vomiting may need to be induced but should be directed by a physician or a poison control center. IMMEDIATELY transport victim to an emergency facility.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

4. First aid measures

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

5. Fire-fighting measures

Flammability of the product : Flammable solid.

Extinguishing media

- Suitable** : SMALL FIRE: Use dry chemical powder.
LARGE FIRE: Use water spray or fog. Cool sulfur containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion. 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.
- Not suitable** : Do not use water jet.
- Special exposure hazards** : Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
sulfur oxides
- Special protective equipment for fire-fighters** : Wear self-contained breathing apparatus and full protective clothing. Avoid straight streams of water, which can scatter dust. Small fires can be extinguished with sand. Fire will rekindle until mass is cooled below 154°C (310°F).
- Special remarks on fire hazards** : Slightly flammable to flammable in the presence of open flames, sparks and static discharge.
- Special remarks on explosion hazards** : Hazardous in contact with oxidizing materials, forming explosive mixtures. Sulfur burns with a pale blue flame that may be difficult to see in daylight.

6. Accidental release measures

- Personal precautions** : Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see section 8).
- Environmental precautions** : Hazardous to aquatic environment. May cause long-term adverse effects in the aquatic environment. Prevent leaking substances from running into the aquatic environment or the sewage system.
- Small spill** : With clean shovel place material into clean, dry container and cover loosely. Move containers from spill area.
- Large spill** : 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. Shovel solid sulfur into containers with covers (avoid dusting) for recovery or disposal. If removal is not immediate, 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. Consider initial downwind evacuation for at least 100 meters (330 feet).

7. Handling and storage

- Handling** : 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.

7. Handling and storage

- Storage** : Molten sulfur should be maintained at temperatures between 127°C and 149°C (260°F and 300°F).
Molten sulfur is stored in insulated storage tanks or storage pits that are heated with steam coils. Piping should be provided to permit steam to be used to smother any tank fires. Liquid sulfur tanks should be ventilated to prevent accumulation of toxic and explosive quantities of hydrogen sulfide. Separate from chlorates, nitrates and other oxidizers. Molten sulfur tanks should be kept dry.

8. Exposure controls/personal protection

United States

Ingredient	Exposure limits
Particulates Not Otherwise Specified	ACGIH TLV (United States). TWA: 10 mg/m ³ Form: Inhalable
Sulfur	OSHA PEL (United States). TWA: 15 mg/m ³ 8 hour(s). Form: Total ACGIH TLV (United States). TWA: 10 mg/m ³ 8 hour(s). Form: Nuisance dust.
Hydrogen sulfide	OSHA PEL (United States). TWA: 15 mg/m ³ 8 hour(s). Form: Nuisance dust. ACGIH TLV (United States, 1/2009). STEL: 21 mg/m ³ 15 minute(s). STEL: 15 ppm 15 minute(s). TWA: 14 mg/m ³ 8 hour(s). TWA: 10 ppm 8 hour(s). NIOSH REL (United States, 6/2008). CEIL: 15 mg/m ³ 10 minute(s). CEIL: 10 ppm 10 minute(s). OSHA PEL Z2 (United States, 11/2006). AMP: 50 ppm 10 minute(s). CEIL: 20 ppm

Canada

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			Notations
Ingredient	List name	ppm	mg/m ³	Other	ppm	mg/m ³	Other	ppm	mg/m ³	Other	
Sulfur	US ACGIH	-	10	-	-	-	-	-	-	-	[a]
	AB 6/2008	-	10	-	-	-	-	-	-	-	
Hydrogen sulfide	US ACGIH 1/2009	10	14	-	15	21	-	-	-	-	
	AB 6/2008	10	14	-	-	-	-	15	21	-	
	BC 6/2008	-	-	-	10	-	-	-	-	-	
	ON 6/2008	10	14	-	15	21	-	-	-	-	
	QC 6/2008	10	14	-	15	21	-	-	-	-	

Form: [a]Nuisance dust.

Consult local authorities for acceptable exposure limits.

- Recommended monitoring procedures** : Personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.
- Engineering measures** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

8. Exposure controls/personal protection

Personal protection

Respiratory

- : NIOSH recommendations for hydrogen sulfide concentrations in air.
Up to 100 ppm: Powered air-purifying respirator with cartridge(s) to protect against hydrogen sulfide; or gas mask with canister to protect against hydrogen sulfide; or SAR*; or full-facepiece SCBA.
- Emergency or planned entry into unknown concentrations or IDLH conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
- ESCAPE: Gas mask with canister to protect against hydrogen sulfide; or escape-type SCBA.
- NOTE: The IDLH concentration for hydrogen sulfide is 100 ppm.
- *NOTE: Substance reported to cause eye irritation or damage; may require eye protection.
- ABBREVIATIONS: SAR = supplied-air respirator; SCBA = self-contained breathing apparatus. IDLH = Immediately Dangerous to Life or Health.

Hands

- : Use gloves appropriate for work or task being performed. Recommended: Impervious, insulated gloves.

Eyes

- : Safety eyewear should be used when there is a likelihood of exposure. Recommended: Splash goggles.

Skin

- : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Recommended: Lab coat or coveralls.

Environmental exposure controls

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

9. Physical and chemical properties

Physical state

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

Flash point

- : Closed cup: 207°C (404.6°F) [Pensky-Martens.]

Auto-ignition temperature

- : 232°C (449.6°F)

Flammable limits

- : Lower: 4%
- Upper: 44%

Color

- : Yellow to red brown.

Odor

- : Rotten eggs.

Boiling/condensation point

- : 444.6°C (832.3°F)

Melting/freezing point

- : 114 to 119°C (237.2 to 246.2°F)

Specific gravity

- : 1.79 g/cm³

Vapor pressure

- : 0.015 kPa (0.11 mm Hg)

Vapor density

- : 3.64 [Air = 1]

Solubility

- : Insoluble in the following materials: cold water, hot water. Soluble in carbon disulfide, benzene, toluene, chloroform, ether, warm aniline, carbon tetrachloride and liquid ammonia.

10. Stability and reactivity

Chemical stability

- : The product is stable.

Conditions to avoid

- : Avoid all possible sources of ignition (spark or flame).

Materials to avoid

- : Alkalis and oxidizing agents such as chlorine and fluorine. 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.

10. Stability and reactivity

- Hazardous decomposition products** : Produces oxides of sulfur on combustion.
- Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.
- Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

11. Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Sulfur	LD50 Oral	Rat	>8437 mg/kg	-

- Chronic toxicity** : No specific data.

12. Ecological information

- Environmental effects** : Very toxic to aquatic organisms.

Aquatic ecotoxicity

Product/ingredient name	Result	Species	Exposure
Sulfur	Acute EC50 >5000 ppm Fresh water Acute LC50 <14 ppm Fresh water	Daphnia - Daphnia magna - <24 hours Fish - Lepomis macrochirus	48 hours 96 hours

- 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.
- Toxicity of the products of biodegradation** : 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.
- Products of degradation** : Products of degradation: sulfur oxides (SO₂, SO₃ etc.).







13. Disposal considerations

- Waste disposal** : The generation of waste should be avoided or minimized wherever possible. This material and its container must be disposed of in a safe way. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Empty containers or liners may retain some product residues. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
DOT Classification	UN2448	SULFUR, MOLTEN	4.1	III		Special provisions 30, IB8, IP2
TDG Classification	UN2448	SULFUR, MOLTEN	4.1	III		Special provisions 33
IMDG Class	UN2448	SULFUR, MOLTEN. Marine pollutant (Hydrogen sulfide)	4.1	III	 	-
IATA-DGR Class	UN2448	SULFUR, MOLTEN	4.1	III	 	Passenger and Cargo Aircraft Quantity limitation: 20 kg Cargo Aircraft Only Quantity limitation: 100 kg Limited Quantities - Passenger Aircraft Quantity limitation: 10 kg

PG* : Packing group

Exemption to the above classification may apply.

AERG : 133

15 . Regulatory information

United States

HCS Classification : Flammable solid
Irritating material
Sensitizing material

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.
SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Sulfur
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Sulfur: Fire hazard
Clean Water Act (CWA) 307: No products were found.
Clean Water Act (CWA) 311: No products were found.
Clean Air Act (CAA) 112 accidental release prevention: Hydrogen sulfide
Clean Air Act (CAA) 112 regulated flammable substances: No products were found.
Clean Air Act (CAA) 112 regulated toxic substances: Hydrogen sulfide

Clean Air Act Section 112(b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

15 . Regulatory information

DEA List I Chemicals (Precursor Chemicals)

: Not listed

DEA List II Chemicals (Essential Chemicals)

: Not listed

State regulations

Connecticut Carcinogen Reporting: None of the components are listed.
Connecticut Hazardous Material Survey: None of the components are listed.
Florida substances: None of the components are listed.
Illinois Chemical Safety Act: None of the components are listed.
Illinois Toxic Substances Disclosure to Employee Act: None of the components are listed.
Louisiana Reporting: None of the components are listed.
Louisiana Spill: None of the components are listed.
Massachusetts Spill: None of the components are listed.
Massachusetts Substances: The following components are listed: Sulfur
Michigan Critical Material: None of the components are listed.
Minnesota Hazardous Substances: None of the components are listed.
New Jersey Hazardous Substances: The following components are listed: Sulfur
New Jersey Spill: None of the components are listed.
New Jersey Toxic Catastrophe Prevention Act: None of the components are listed.
New York Acutely Hazardous Substances: None of the components are listed.
New York Toxic Chemical Release Reporting: None of the components are listed.
Pennsylvania RTK Hazardous Substances: The following components are listed: Sulfur
Rhode Island Hazardous Substances: None of the components are listed.

California Prop. 65

No products were found.

Canada

WHMIS (Canada)

: Class B-4: Flammable solid.
 Class D-2B: Material causing other toxic effects (Toxic).

Canadian lists

: **CEPA Toxic substances:** None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: None of the components are listed.
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Canada inventory

: All components are listed or exempted.

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

International regulations

International lists

: **Australia inventory (AICS):** All components are listed or exempted.
China inventory (IECSC): All components are listed or exempted.
Japan inventory: Not determined.
Korea inventory: All components are listed or exempted.
New Zealand Inventory of Chemicals (NZIoC): All components are listed or exempted.
Philippines inventory (PICCS): All components are listed or exempted.

Chemical Weapons Convention List Schedule I Chemicals

: Not listed

Chemical Weapons Convention List Schedule II Chemicals

: Not listed

Chemical Weapons Convention List Schedule III Chemicals

: Not listed

16 . Other information

United States

Label requirements : FLAMMABLE SOLID. CAUSES EYE AND SKIN IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. MAY BE HARMFUL IF SWALLOWED.

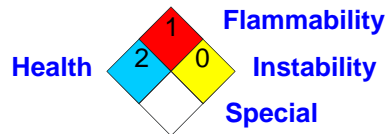
Hazardous Material Information System (U.S.A.) :

Health	2
Flammability	1
Physical hazards	0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

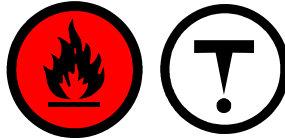
The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.) :



Canada

WHMIS (Canada) :



References

: - 29CFR Part1910.1200 OSHA MSDS Requirements. - 49CFR Table List of Hazardous Materials, UN#, Proper Shipping Names, PG. ANSI Z400.1, MSDS Standard, 2004. - Canada Gazette Part II, Vol. 122, No. 2. Registration SOR/88-64, 31 December 1987. Hazardous Products Act "Ingredient Disclosure List" - Canadian Transport of Dangerous Goods, Regulations and Schedules, Clear Language version 2005. - Manufacturer's Material Safety Data Sheet.

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Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.