

Safety Data Sheet (US)

1. Identification

Product Identifier: Sulfur, molten

Other Means of Identification: Sulphur, Molten Sulphur, Liquid Sulfur, Liquid Sulphur

Product use: As raw material in the manufacture of sulfuric acid, fertilizers, in rubber vulcanization, and other chemical processes

Restrictions on use: Do not use for non-industrial purpose

Manufacturer: Keyera and Affiliates





Address: Suite 600, Sunlife Plaza West
144 – 4th Avenue SW
Calgary, AB, T2P 3N4


SDS Information: 1-780-449-7910

Emergency Contact (24 hours): 1-613-996-6666 (CANUTEC, Canada)
1-800-424-9300 (CHEMTREC, U.S.)

2. Hazards Identification

GHS Hazards

Pictogram	Classification	Hazard Statements
	Flammable Solids – Category 2 (if molten sulfur solidifies)	Flammable solid
	Acute Toxicity – Inhalation – Category 2	Fatal if inhaled
	Eye Damage/Irritation – Category 2A Skin Corrosion/Irritation – Category 2	Causes serious eye irritation Causes skin irritation.
	Specific Target Organ Toxicity – Single Exposure – Category 1 Specific Target Organ Toxicity – Repeated Exposure – Category 1 & Category 2	Causes damage to cardiovascular system, central nervous system, respiratory system. Causes damage to blood system, respiratory system through proplonged or repeated exposure. May cause damage to respiratory system and skin through proplonged or repeated exposure.

	Sensitization – Respiratory – Category 1	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
	Toxic to Reproduction – Category 2	Suspected of damaging fertility or the unborn child.
	Hazardous to the Aquatic Environment – Acute Hazard – Category 3	Harmful to aquatic life.

Other Hazards

- Contact with the hot molten sulfur will cause severe thermal skin burns and eye damage.

Signal Word: Danger

Precautionary Statements:

Prevention

- Keep away from heat/sparks/open flames/hot surfaces – No smoking.
- Ground/Bond container and receiving equipment.
- Use explosion-proof ventilation equipment.
- Do not breathe fume/mist/spray.
- Wash skin thoroughly after handling.
- Do not eat, drink or smoke when using this product.
- Use only outdoors or in a well-ventilated area.
- In case of inadequate ventilation, wear respiratory protection.
- Wear respiratory protection/protective gloves/ protective clothing/ eye protection/ face protection.
- Obtain special instructions before use.
- Do not handle until all safety precautions have been read and understood.
- Avoid release to the environment.

Response

- In case of fire: use dry chemical, CO₂, water spray or fire-fighting foam to extinguish.
- If inhaled: If breathing is difficult, remove person to fresh air and keep comfortable for breathing.
- If experiencing respiratory symptoms: Call a doctor/physician.
- If exposed: Call a doctor/physician.
- Get medical attention if you feel unwell.
- If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do so. Continue rinsing.
- If eye irritation persists: Get medical advice/attention.
- If on skin: Wash with plenty of water/shower.
- If skin irritation occurs: get medical advice/attention.
- Take off contaminated clothing and wash before reuse.

Storage

- Store locked up.
- Store in a well-ventilated place. Keep container tightly closed.

Disposal

- Dispose of contents/container in accordance with applicable local, provincial/state, and federal regulations.

3. Composition/Information on Ingredients

Chemical Name: Sulfur, molten
Common Name/Synonyms: Sulphur, Molten Sulphur, Liquid Sulfur, Liquid Sulphur

Ingredient Name	wt %	CAS No.
Sulfur molten	99.9 – 100.0%	7704-34-9
Hydrogen sulfide	0 – 0.1%	7783-06-4
Sulfur dioxide	0 – 0.1%	7446-09-5

4. First Aid Measures

Immediate Medical Attention and Special Treatment:
 Treat symptomatically and supportively. Refer also to Table below.

First Aid:	
Inhalation:	If breathing is difficult, remove person to fresh air and keep comfortable for breathing. If experiencing respiratory symptoms: Call a doctor/physician.
Skin:	Do not remove solidified molten sulfur or clothing which are stuck to the skin, as underlying tissues can be torn away during such attempts. Take off contaminated clothing. Wash with plenty of water/shower. If skin irritation occurs: get medical advice/ attention. If burnt: Cover skin with clean, dry dressings and do not apply burn ointments! Seek medical attention immediately.
Eyes:	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do so. Continue rinsing. If eye irritation persists: get medical advice/attention.
Ingestion:	Highly unlikely, but if ingested, rinse mouth with cold water. DO NOT induce vomiting unless directed by medical professional. DO NOT attempt to give anything by mouth to an unconscious person. Get medical attention immediately.

Most Important Effects and Symptoms, Acute or Delayed:
 Contact with the hot molten sulfur will cause severe thermal skin burns and eye damage.

Exposure Route	Health Effects	Symptoms of Exposure
Skin	Burn and tissue damage.	From redness/pain to blisters. Severe burn: no pain and dry skin if nerve endings and sweat glands are damaged.
Eyes	Burn and tissue damage.	Eye damage to blindness.

5. Fire Fighting Measures

<p>Flammability: Both the sulfur liquid (molten) and vapor can be ignited easily by flame, sparks, or static electricity discharge.</p>	<p>Hazardous Combustion Products: May include carbon monoxide (CO), carbon dioxide (CO₂), and sulfur dioxide (SO₂).</p>
<p>Sensitive to impact: No.</p>	<p>Sensitive to static discharge: No.</p>
<p>Extinguishing Media: Small Fire: Dry chemical, CO₂, sand, earth, water spray or regular foam. Large Fire: Water spray, fog or regular foam.</p>	
<p>Unsuitable Extinguishing Media:</p> <ul style="list-style-type: none"> • Water or foam may cause frothing of molten sulfur, causing boil over. 	
<p>Special Protective Equipment for Firefighters:</p> <ul style="list-style-type: none"> • Wear full protective clothing and NIOSH-approved SCBA with full face-piece. 	
<p>Precautions for Firefighters:</p> <ul style="list-style-type: none"> • Contact with the hot molten sulfur will cause severe thermal skin burns and eye damage. • The molten sulfur can release ~100-300 ppm Hydrogen Sulfide H₂S and Sulfur Dioxide SO₂ into the atmosphere. • This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of ignition and heat. • Move container from fire area if you can do it without risk. • Apply cooling water to sides of containers that are exposed to flames until well after fire is out. • Stay away from ends of tanks. • For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. • Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. • Cool fire-exposed containers with flooding quantities of water applied from as far a distance as possible. • Consider evacuation of downwind area if material is leaking. • 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. • See Guide 133, Emergency Response Guidebook (Transp. Can/US Dept. of Transp). 	
<p>Unusual Fire and Explosion Hazards:</p> <ul style="list-style-type: none"> • The highly flammable vapors are heavier than air and may accumulate in low areas and /or spread along ground to distant ignition sources and flash back. • As molten sulfur may contain H₂S, the flammability of the headspace vapors containing H₂S will differ from that of pure sulfur. • In enclosed spaces above the molten sulfur, the concentration of H₂S may accumulate and exceed the LEL (4.3% by volume in air). • Can form explosive mixtures with oxidizers (e.g. acid, chlorine). • Sulfur burns with a blue flame which may be difficult to see in daylight. • Water or foam may cause frothing of molten sulfur, with further application leading to boil over. • Steam explosions may occur when mixing water with molten sulfur. 	

6. Accidental Release Measures

Protective Equipment:

Gloves: Recommended: rubber or neoprene gloves, and heat-resistant outerwear as well as fire retardant clothing and insulated protective gloves when handling molten sulfur. Not recommended: PVC, latex.

Clothing: Flame-retardant e.g. Nomex, Proban.

Respirator: A SABA (Supplied Air Breathing Apparatus) or SCBA (Self-Contained Breathing Apparatus) is required if there is a potential for uncontrolled release, exposure levels are unknown, or any other circumstance exists where an air-purifying respirator may not provide adequate protection. Where appropriate, a NIOSH/MSHA approved air-purifying respirator with dust cartridges and acid gas cartridges can be used. When assessing the proper type of respiratory protection, also consider the occupational exposure limits applicable to individual ingredients.

Eye: Chemical goggles and face shield unless full-face respiratory protection is being worn.

Precautions:

- Sulfur itself is relatively non-toxic to humans, causing mild local irritation to the eyes, nose, throat and upper airways. However, hot molten sulfur may cause severe thermal skin burns and eye damage.
- The molten sulfur can release ~100-300 ppm Hydrogen Sulfide H₂S and Sulfur Dioxide SO₂ into the atmosphere.
- Beware that water or foam may cause frothing of molten sulfur, with further application leading to boil over, and steam explosions may occur when mixing water with molten sulfur.

Emergency Procedures:

- Shut off leak/release source, if it can be done safely.
- Remove all sources of ignition.
- Isolate hazard area.
- Evacuate area of all unnecessary personnel.
 Small spill: consider downwind evacuation of at least 10-25 meters (30-80 feet)
 Large spill: consider downwind evacuation of at least 100 meters (330 feet)
 If tank, rail car or tank truck is involved in a fire, evacuate in all directions of at least 800 meters (1/2 mile).
- Keep unnecessary and unprotected personnel from entering.
- Emergency personnel must wear appropriate personal protective equipment.
- Ventilate area of leak or spill.

Containment and Clean-up:

- Use non-sparking tools and equipment.
- Use booms/pillows to prevent runoff into storm sewers and ditches that lead to waterways.
- If it can be done safely contain and recover the liquid/molten sulfur, which will turn into solid when cooled, into appropriate container (e.g. for chemical waste: Collect spillage or absorb with an inert material (e.g., vermiculite, dry sand, earth), and place in metal container which can be grounded.
- Do not use combustible materials, such as sawdust, as absorbent.
- Refer to Guide 133 of the Emergency Response Guidebook (Transport Canada/US Dept. of Transportation).

7. Handling and Storage

Handling Precautions :

- Use only in a well ventilated area.
- Keep away from heat/sparks/open flames/hot surfaces – No smoking.
- Avoid contact with eyes, skin, and clothing. Contact with the hot molten sulfur will cause severe thermal skin burns and eye damage.
- Avoid ingestion and inhalation
- Wear protective gloves/clothing and eye/face protection:
- Use only non-sparking tools and explosion-proof ventilation equipment.
- Take precautionary measures against static discharge.
- Ground/bond containers and equipment when transferring material.

Storage Precautions:

Locations

- Store in a cool, dry, well-ventilated location, away from any area of fire-hazard.
- Outside or detached storage is preferred.
- Storage and use areas should be No Smoking areas.
- Ventilation system must be explosion-proof.

Containers

- Containers should be grounded.
- Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.
- Do not attempt to clean empty containers since residue is difficult to remove.
- Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death

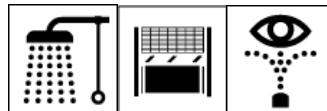
Other precautions

- Separate from incompatibles like oxidizers e.g. bromates, chlorates, chromates, hypochlorites, perchlorates, peroxides, nitrates, nitrites..

8. Exposure Controls / Personal Protection

EXPOSURE LIMITS

	Authority	15 MINS STEL	8-HOURS
Sulfur (CAS 7704-34-9)	No exposure limits established by ACGIH, OSHA or NIOSH		
Hydrogen sulfide (CAS 7783-06-4)	ACGIH TLV	5 ppm (7 mg/m ³)	1 ppm (1.4 mg/m ³)
	OSHA PEL	20 ppm Ceiling 50 ppm 10-min peak, once/8-hr shift	None
	NIOSH REL	10 ppm (15 mg/m ³) Ceiling;10-min	None
Sulfur dioxide (CAS 7446-09-5)	ACGIH TLV	0.25 ppm (0.65 mg/m ³)	None
	OSHA PEL	None	5 ppm (13 mg/m ³)
	NIOSH REL	5 ppm (13 mg/m ³)	2 ppm (5 mg/m ³)



ENGINEERING CONTROLS

- Engineering control methods to reduce hazardous exposures are preferred. Methods include mechanical ventilation, process or personal enclosure, control or process conditions, and process modification.
- Ventilate area (mechanical general and/or local exhaust ventilation) where product is used, stored and/or handled to maintain airborne concentration of potential H₂S below the LEL and OEL, especially in confined spaces.
- Ventilation system must be explosion proof, grounded and separate from other exhaust ventilation systems.
- Supply sufficient replacement air to make up for air removed by exhaust systems.



PERSONAL PROTECTIVE EQUIPMENT

Gloves: Recommended: rubber or neoprene gloves, and heat-resistant outerwear as well as fire retardant clothing and insulated protective gloves when handling molten sulfur. Not recommended: PVC, latex.

Clothing: Flame-retardant e.g. Nomex, Proban.

Respirator: A SABA (Supplied Air Breathing Apparatus) or SCBA (Self-Contained Breathing Apparatus) is required if there is a potential for uncontrolled release, exposure levels are unknown, or any other circumstance exists where an air-purifying respirator may not provide adequate protection. Where appropriate, a NIOSH/MSHA approved air-purifying respirator with dust cartridges and acid gas cartridges can be used. When assessing the proper type of respiratory protection, also consider the occupational exposure limits applicable to individual ingredients.

Eye: Chemical goggles and face shield unless full-face respiratory protection is being worn.

9. Physical and Chemical Properties

Chemical Formula: S	Molecular Weight: 32.0 g/mole	Chemical Family: Non-metallic element
Appearance: Opaque, amber "molten solid" (liquid)	Odor: Odorless; rotten egg odor when hydrogen sulfide is present	Odor Threshold: ~0.01-0.005 ppm (for H ₂ S) NOT Sulfur
pH: N/AP	Freezing/Melting Point: 113 – 120°C (235.4 – 248°F)	Boiling Point: 445°C (833°F)
Flashpoint and Method: 207°C (405°F) Cleveland Open Cup	Flammability: Yes	Evaporation Rate: Not available
Upper-Lower Explosive Limit: Not Available	Vapor Pressure: 1 mmHg @ 184°C (363°F)	Vapor Density: >38.9 (air = 1)
Specific Gravity: ~1.8 @20°C/4°C	Percent Soluble (@25°C): Insoluble in water	Slightly soluble in alcohol, ether, chloroform, toluene and benzene. Very soluble in carbon disulfide
Partition Coefficient n-octanol/water: Not Available	Auto-Ignition Temperature: 232°C (449.6°F)	Decomposition Temp.: Not available.
Viscosity: The viscosity of molten sulfur changes due to the various degree of polymerization. Just above the melting pt. of 120°C its viscosity is ~6x of the viscosity of water. At ~185°C it becomes so viscous that it cannot be poured. The viscosity decreases again at higher temperature, and decreases to ~10 times that of water at the boiling point of ~445°C.		

10. Stability and Reactivity

Reactivity: Avoid incompatible materials: may react violently with oxidizers.
Chemical Stability: Stable under normal temperatures and pressures.
Possibility of Hazardous Reactions: Polymerization has not been reported to occur under normal temperature and pressure conditions.
Conditions to Avoid: Keep away from heat/sparks/open flames/hot surfaces and incompatible materials.
Incompatible Materials: <ul style="list-style-type: none"> • Reacts violently with oxidizing agents such as perchlorates, peroxides, permanganates, nitrates and halogens (chlorine, bromine, fluorine, iodine). • Reacts with hydrocarbons to form carbon disulfides and hydrogen sulfides. • Can react with metals such as sodium, calcium, tin, nickel or zinc under certain conditions.
Hazardous Decomposition Products: No decomposition if stored and applied as directed. Combustion products may include sulfur dioxide SO ₂ .

11. Toxicological Information

Exposure Route	Acute Health Effects	Symptoms of Exposure
Inhalation:	<u>Low concentration H₂S (<10 ppm):</u> May cause slight irritation of the nose, throat and lungs.	Cough, running nose, difficulty in breathing.
	<u>High concentration H₂S (>10 ppm):</u> Effects on the Central Nervous system (CNS)	Headache, dizziness, nausea, vomiting. Respiratory failure and possible death at > 100ppm H ₂ S exposure
Skin:	Irritation (from fumes)	Redness and pain
	Thermal burn (from direct contact)	From redness/pain to blisters. Severe burn: no pain and dry skin if nerve endings and sweat glands are damaged
Eye:	Irritation (from fumes)	Redness and pain
	Thermal burn (from direct contact)	Severe eye damage, blindness
Ingestion:	No a likely exposure route	

<p>Chronic Exposure: Long-term exposure to H₂S may cause skin sensitization, so that severe allergic reaction may occur even when exposed to very low levels. Long term exposure to SO₂ may cause respiratory sensitization.</p>			
<p>Ingestion and Inhalation: Repeated or prolonged exposure to fumes may cause irritation to the mucous membranes. Bronchi-pulmonary disease may occur which, after several years, may be complicated by emphysema and bronchiectasis. Early symptoms in sulfur miners often include upper respiratory tract catarrh (inflammation of the mucous membrane), with cough and expectoration which is mucoid and may even contain granules of sulfur. Asthma is a frequent complication.</p>			
<p>Sensitization: Sulfur dioxide SO₂ in the molten sulfur may cause allergy or asthma symptoms or breathing difficulties if inhaled.</p>	<p>Reproductive Toxicology: Sulfur dioxide SO₂ in the molten sulfur is suspected of damaging fertility or the unborn child.</p>	<p>Teratogenicity: No</p>	<p>Mutagenicity: No</p>
<p>Carcinogenicity: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.</p>	<p>Irritancy: Irritant to eyes, nose, throat, gastrointestinal tract & skin.</p>	<p>Target Organs:</p> <ul style="list-style-type: none"> • Central Nervous System • Cardiovascular System • Respiratory System • Blood System. 	

Lethality Tests:

Chemical Name	CAS No.	LD50	LC50
Sulfur	7704-34-9	Rabbit, dermal >2000 mg/kg Rat, oral >3000 mg/kg	Rat, inhalation >9.23 mg/L, 4 hrs.
Hydrogen sulfide	7783-06-4		Rat, inhalation 0.99 mg/L, 1 hr.
Sulfur dioxide	7446-09-5		Rat, inhalation 2500 ppm, 1 hr.

12. Ecological Information

Persistence & Degradability: No data available.	Bioaccumulative Potential: No.
Mobility: No data available.	Other Adverse Effects: No data available.

As sulfur is insoluble in water at 20°C, there is minimal immediate risk from spills. However, sulfur can oxidize under certain conditions to form acidic runoffs. Spilled sulfur should therefore be contained/recovered, and kept away from drainage and waterways.

Eco Toxicity Tests

Chemical Name	CAS No.	Species	Test Method	LC50/ EC50/
Sulfur	7704-34-9	Brachydanio rerio (Zebra Dario fish)	Static test; 96 hrs.	LC50 = 866 mg/L
		Lepomis macrochirus (Bluegill fish)	Static test; 96 hrs.	LC50 < 14 mg/L
		Oncorhynchus mykiss (Rainbow Trout)	Static test; 96 hrs.	LC50 > 180 mg/L
Hydrogen sulfide	7783-06-4	Lepomis macrochirus (Bluegill fish)	Flow-through; 96 hrs.	LC50 = 0.0448 mg/L
		Pimephales promelas (Fathead minnow)	Flow-through; 96 hrs.	LC50 = 0.016 mg/L

13. Disposal Considerations

Waste Disposal:

- Dispose of waste material at an approved (hazardous) waste treatment/disposal facility in accordance with applicable local, provincial, and federal regulations.
- Do not dispose of waste with normal garbage, or to sewer systems.

14. Transport Information

DOT (U.S.) CLASSIFICATION

PROPER SHIPPING NAME: Sulfur, Molten

CLASS: 4.1

UN NUMBER: UN2448

PACKING GROUP: III

LABEL/PLACARD:



IATA

- Not permitted for transport (IATA Passenger or Cargo)

15. Regulatory Information

UNITED STATES

Sulfur is on the

- TSCA Toxic Substances Control Act list

16. Other Information

NFPA Hazard Rating:

Health 4, Flammability 1, Instability 0



Prepared for:

Keyera Health and Safety

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August 31, 2015

Revisions:

- Original
- 1st revision
- 2nd revision
- 3rd revision

Dates:

January 3, 2011
 October 31, 2013
 October 15, 2014
 August 31, 2015

Main Changes

By Deerfoot Consultant
 format and general content changes
 GHS format
 Change emergency contact number

Glossary

ACGIH – American Conference of Governmental Industrial Hygiene

DOT – US Department of Transportation

IARC – International Agency for Research on Cancer

IDLH – Immediately Dangerous to Life and Health

NIOSH – National Institute for Occupational Safety & Health

NTP – National Toxicology Program

OSHA – Occupational Safety & Health Administration of the US Department of Labour

PEL – Permissible Exposure Limit

SARA – Superfund Amendments and Reauthorization Act of 1986

SCBA – Self-Contained Breathing Apparatus

STEL – Short Term Exposure Limit

TDG – Canada Transportation of Dangerous Goods

TRI – US Toxic Release Inventory

TSCA – Toxic Substance Control Act

TWA – Time Weighted Average

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~ End of Safety Data Sheet ~