

SULPHUR SAFETY DATA SHEET

SECTION 1. IDENTIFICATION

Product Identity: Molten Sulphur.

Trade Names and Synonyms: Sulfur, flowers of sulfur, brimstone.

Manufacturer:

Teck Metals Ltd.
Trail Operations
Trail, British Columbia
V1R 4L8
Emergency Telephone: 250-364-4214

Supplier:

Teck Metals Ltd.
Trail Operations
Trail, British Columbia
V1R 4L8

Preparer:

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Date of Last Review: December 7, 2018.

Date of Last Edit: December 7, 2018.

Product Use: Raw material used in the manufacture of sulphuric acid and sulphur dioxide.

Restrictions on Use: None identified to date.


Note: Although this SDS was prepared to address the hazards of molten sulphur, Teck Metals Ltd. recognizes that the product transforms into a solid rapidly upon cooling. Sections 2, 4, 5, 6, 7, 8, 9, and 11 address the hazards of the dry, as well as the molten, state of sulphur.

SECTION 2. HAZARDS IDENTIFICATION

CLASSIFICATION:

Health	Physical	Environmental
Acute Toxicity (Oral, Inhalation) – Does not meet criteria	Flammable Solids – Category 2 Combustible Dust – Category 1	Aquatic Toxicity – Short Term/Long Term Does not meet criteria
Skin Corrosion/Irritation – Does not meet criteria		
Eye Damage/Eye Irritation – Does not meet criteria		
Respiratory or Skin Sensitization – Does not meet criteria		
Mutagenicity – Does not meet criteria		
Carcinogenicity – Does not meet criteria		
Reproductive Toxicity – Does not meet criteria		
Specific Target Organ Toxicity		
Acute Exposure – Does not meet criteria		
Chronic Exposure – Does not meet criteria		

LABEL:

<p>Symbols:</p> <div style="text-align: center;">  </div>	<p>Signal Word:</p> <p style="text-align: center;">WARNING</p>
<p style="text-align: center;"><u>Hazard Statements</u></p> <p>WARNING! Flammable Liquid/Solid. May form combustible dust concentrations in air.</p>	<p style="text-align: center;"><u>Precautionary Statements:</u></p> <p>Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. No smoking. Ground and bond container and receiving equipment. Use explosion-proof equipment if dust cloud can occur. Wear protective gloves, clothing and eye protection (and face protection where appropriate). IN CASE OF FIRE: Use dry sand, etc. on small fires. Use water spray, fog or foam on larger fires.</p>

Emergency Overview: An amber-to-yellow liquid or a bright yellow powder. Sulphur is relatively non-toxic and poses little immediate health hazard to the environment or emergency response personnel unless it is involved in a fire. Both solid and liquid

sulphur are combustible and generate large quantities of toxic and irritating sulphur dioxide gas on burning. Molten sulphur is hot enough to cause serious thermal burns to unprotected skin. Wear full protective clothing and positive pressure self-contained breathing apparatus in emergency situations involving burning sulphur.

Potential Health Effects: Sulphur is relatively non-toxic to humans, causing only mild local irritation to the eyes, nose, throat and upper airways. However, under certain circumstances it may release toxic hydrogen sulphide and/or sulphur dioxide gases. Sulphur is not listed as a carcinogen by OSHA, NTP, IARC or ACGIH (see Toxicological Information, Section 11).

Potential Environmental Effects: This product has the potential to pose ecological risks to organisms in both aquatic and terrestrial environments. Discharge of the product to soil and water should be prevented (see Ecological Information, Section 12).

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS	CAS Registry No.	CONCENTRATION (% wt./wt.)
Sulphur	7704-34-9	99.5%

Note: See Section 8 for Occupational Exposure Guidelines.

SECTION 4. FIRST AID MEASURES

Eye Contact: *Symptoms:* Mild eye irritation, redness: Do not allow victim to rub eye(s). Let the eye(s) water naturally for a few minutes. If particle/dust does not dislodge, flush with lukewarm, gently flowing water for 5 minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, obtain medical advice/attention. DO NOT attempt to manually remove anything stuck to the eye.

Skin Contact: *Symptoms:* Mild irritation, dryness, thermal burn from molten sulphur. *Dry sulphur:* No health effects expected. If irritation does occur, wash with mild soap under lukewarm, gently flowing water for 5 minutes. If irritation persists, obtain medical advice/attention. *Molten sulphur:* Flush contact area to solidify and cool but do not attempt to remove encrusted material or clothing. Cover burns and seek medical attention immediately.

Inhalation: *Symptoms:* Coughing, irritation in heavy dust clouds. Remove source of contamination or move victim from exposure area to fresh air. Obtain medical advice/attention if you are concerned or feel unwell.

Ingestion: *Symptoms:* Throat dryness, sulphur taste. If swallowed, no specific intervention is indicated as this material is not likely to be hazardous by ingestion. However, if irritation or discomfort occurs or you are concerned, obtain medical advice/attention.

SECTION 5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Both molten and solid forms are combustible and will ignite at high temperatures (>200°C), burning with a pale blue flame that may be difficult to see in daylight. Sulphur dust suspended in air ignites easily and can cause explosions in confined spaces. Sulphur dust clouds can be ignited by friction, static electricity, heat, sparks or flames. Traces of hydrogen sulphide and sulphur vapor may present an explosion hazard if evolved into a confined space or enclosed space, particularly from molten sulphur. The LEL of hydrogen sulphide (4.3% by volume in air) may be exceeded in enclosed spaces above molten sulphur.

Extinguishing Media: Use water spray, fog or foam. Do not use direct water streams as the burning sulphur may float and further spread the fire. Sand, dry chemical or fine earth/finely crushed stone may be used for small fires. Steam or inert gases are excellent extinguishers for use in containers that can be tightly closed.

Fire Fighting: Evacuate non-essential personnel from the fire area immediately. Toxic fumes of sulphur dioxide will result from combustion. Fire fighters must be fully-trained and wear full protective clothing including an approved, self-contained breathing apparatus which supplies a positive air pressure within a full face-piece mask. Do not spray water directly into containers of molten sulphur due to the danger of boil over. Also avoid spraying direct streams of water that may scatter burning sulphur and spread the fire or create sulphur dust clouds and cause an explosion. For large fires, consider evacuation of an area downwind of fire if necessary. Fire will rekindle until mass has been cooled to below approximately 150°C. Cool surrounding area and containers until well after the fire is out to prevent re-ignition.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Procedures for Cleanup: Control source of spillage if possible to do so safely. Contain spill, isolate area, and deny entry to unauthorized personnel. Remove all potential ignition sources. Ventilate area. Prevent spread of liquid by diking or ditching and allowing material to cool and solidify. Clean up spilled material immediately, observing precautions in Section 8, Personal Protection and using methods which will minimize dust generation (e.g., dampen material and shovel or wet sweep using natural

fiber brooms and aluminum shovels to prevent sparks). Return uncontaminated spilled material to the process if possible. Place contaminated material in suitable labeled containers for later recovery or disposal. Treat or dispose of waste material in accordance with all local, regional, and national requirements. If molten sulphur is accidentally released into a confined or enclosed space, monitor for hydrogen sulphide and sulphur dioxide build-up in the vapor space above the spill.

Personal Precautions: Protective clothing, gloves, and an acid gas/particulate respirator are recommended for persons responding to an accidental release. Close-fitting safety goggles may also be necessary in some circumstances to prevent eye contact with sulphur dust.

Environmental Precautions: This product has the potential to pose ecological risks to organisms in both aquatic and terrestrial environments. Discharge of the product to soil and water should be prevented. Prevent spillage from entering sewers or natural watercourses.

SECTION 7. HANDLING AND STORAGE

Precautions for Safe Handling: Hydrogen sulphide gas may accumulate in storage tanks and bulk transport compartments containing this material, particularly when molten, so always exercise caution when working around or opening bulk containers. Closed tanks or pits should be vented to the atmosphere using steam jacketed vent lines. Head space above molten sulphur may contain high concentrations of hydrogen sulphide or sulphur dioxide in the toxic and explosive range. Ventilate thoroughly before permitting entry. Avoid generating dust and the release of dust into the workplace as this creates a potential explosion hazard. Since dry sulphur may accumulate static charge build-up, which could become an ignition source, transfer using proper grounding procedures. See the latest edition of NFPA Standard 655 – Prevention of Sulphur Fires and Explosions for specific guidance on dust explosion prevention.

Conditions for Safe Storage: Keep container closed and store in a dry, cool, covered, and well-ventilated area, away from flammable materials, sources of ignition and oxidizing agents.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Guidelines: (*Time-Weighted Average (TWA) concentration over 8 hrs. unless otherwise indicated*)

<u>Component</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>NIOSH REL</u>
Sulphur	None established*	None established*	None established*

NOTE: OEGs for individual jurisdictions may differ from those given above. Check with local authorities for the applicable OEGs in your jurisdiction.

ACGIH - American Conference of Governmental Industrial Hygienists; OSHA - Occupational Safety and Health Administration; NIOSH - National Institute for Occupational Safety and Health. TLV – Threshold Limit Value, PEL – Permissible Exposure Limit, REL – Recommended Exposure Limit.

* - NOTE: While there are no established OELs for elemental sulphur as such, there are OELs for the sulphur dioxide gas which will be formed during any combustion processes. The OSHA PEL for SO₂ is a time-weighted average concentration (TWA) of 5 ppm, the ACGIH TLV is a short term exposure limit (STEL) of 0.25 ppm and the NIOSH REL is a TWA of 2 ppm and a STEL of 5 ppm.

NOTE: The selection of the necessary level of engineering controls and personal protective equipment will vary depending upon the conditions of use and the potential for exposure. The following are therefore only general guidelines that may not fit all circumstances. Control measures to consider include:

Ventilation: Use adequate local or general ventilation to maintain the concentration of sulphur dioxide and hydrogen sulphide in the working environment well below recommended occupational exposure limits. Use a non-sparking, grounded ventilation system separate from other exhaust ventilation systems. Locate dust collectors outdoors if possible and provide dust collectors with explosion vents. Supply sufficient replacement air to make up for air removed by the exhaust system. Ventilation systems may need to be designed using steam tracing or other means to prevent plugging with sublimed sulphur.

Protective Clothing: Gloves and coveralls, shop coat or other work clothing with long sleeves are recommended to prevent direct skin contact, particularly when handling molten sulphur. Eye protection should be worn where fume or dust is generated. Chemical splash goggles and full face shield should be worn where any possibility exists that eye or face contact with liquid sulphur may occur. Respiratory protection may be required where fume or dust is generated. Workers should wear insulated gloves and heat- and chemical-resistant clothing when handling molten sulphur. Safety type boots are recommended.

Respirators: Where dust or sulphur dioxide is generated and cannot be controlled to within acceptable levels, use appropriate NIOSH-approved respiratory protection equipment (a combination of a 42CFR84 Class N, R or P-95 or 100 particulate filter and an acid gas cartridge). Where hydrogen sulphide is present or possibly present in confined spaces at hazardous levels a NIOSH-approved supplied air respirator or self-contained breathing apparatus (SCBA) is necessary.

General Hygiene Considerations: Precautions should be taken to minimize skin and eye contact with material. Refrain from eating or drinking in work areas. Smoking should not be permitted in any sulphur storage or handling areas. Thoroughly wash hands before eating, drinking, or smoking in appropriate designated areas.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Amber to Yellow Liquid/Solid	Odour: Odourless or faint rotten egg odour	Odour Threshold: H ₂ S – <0.01 ppm	pH: Not Applicable
Vapour Pressure: <0.001 mm Hg @ 20°C 0.11 mm Hg @140°C	Vapour Density: Not Applicable	Melting Point/Range: 112-120°C	Boiling Point/Range: 444.6°C
Relative Density (Water = 1): 1.92 - 2.07 Solid Sulphur 1.811 Molten Sulphur	Evaporation Rate: Not Available	Coefficient of Water/Oil Distribution: Not Available	Solubility: Insoluble
Bulk Density:	Liquid 1.811 kg/L (113 lb/ft ³)	Lumps 1201-1842 kg/m ³ (75 – 115 lb/ft ³)	Powder 528-1281 kg/m ³ (33 – 80 lb/ft ³)
Flash Point: 160°C (Closed Cup)	Flammable Limits (LEL/UEL): 35 g/m ³ / 1400 g/m ³ (Dust)	Auto-ignition Temperature: 232°C	Decomposition Temperature: Thermally stable

SECTION 10. STABILITY AND REACTIVITY

Stability & Reactivity: Sulphur is stable and not considered reactive under normal temperatures and pressures. Hazardous polymerization or runaway reactions will not occur.

Incompatibilities: Oxidizing agents, alkali metals, hydrogen, chlorine, fluorine. Sulphur may form explosive mixtures with powerful oxidizing agents such as chlorates, perchlorates and/or nitrates. Damp sulphur is corrosive to steel, particularly in the presence of chlorides.

Hazardous Decomposition Products: Burning sulphur liberates large volumes of sulphur dioxide which will be extremely irritating to eyes and breathing passages. Hydrogen sulphide gas may be released from molten sulphur under certain storage conditions and can accumulate to toxic and potentially explosive concentrations in the vapor space of molten sulphur storage or transportation systems.

SECTION 11. TOXICOLOGICAL INFORMATION

General: Sulphur itself is essentially non-toxic. Molten sulphur is a hazardous material because of its high temperature (>122°C). Under certain conditions both heated and dry sulphur may evolve toxic hydrogen sulphide and/or sulphur dioxide gases. At increasing concentration levels, these gases can cause eye and respiratory irritation. Breathing failure, unconsciousness and death may result from exposure to high concentrations of hydrogen sulphide, without any warning odour being sensed.

Acute:

Skin/Eye: *Molten:* Skin contact with molten material will cause thermal burns. Molten sulphur in the eye will cause burns and permanent damage. Exposure to sulphur vapours may be irritating to the eyes. *Dry:* Eye contact with dusts may be irritating.

Inhalation: Dusts may be irritating to the throat and lungs. Inhalation of low levels of vapours containing hydrogen sulphide or sulphur dioxide can produce respiratory tract irritation characterized by sneezing, coughing, sore throat and chest pain. At increasing concentrations exposure to hydrogen sulphide and sulphur dioxide can result in pulmonary edema, dizziness, nausea, respiratory paralysis, unconsciousness and death. Asthmatics may be more susceptible to sulphur dioxide exposures.

Ingestion: Ingestion of dry sulphur may cause irritation of the mouth and sore throat.

Chronic: Repeated or prolonged contact with dry sulphur powder may be irritating to the eyes and skin in some individuals, leading to dermatitis, eczema, skin ulcers, and allergic reactions. Repeated inhalation exposure to dust may cause bronchitis and irritation to mucous membranes and the respiratory tract. Prolonged exposure to low levels of sulphur dioxide has produced respiratory problems in animals. Sulphur is not considered a human carcinogen by the Occupational Safety and Health Administration (OSHA), the National Toxicology Program (NTP), the American Conference of Governmental Industrial Hygienists (ACGIH) or the International Agency for Research on Cancer (IARC).

Animal Toxicity:

<u>Hazardous Ingredient:</u>	<u>Acute Oral Toxicity:</u>	<u>Acute Dermal Toxicity:</u>	<u>Acute Inhalation Toxicity:</u>
Sulphur	>8437 mg/kg [†]	>2000 mg/kg*	>5.43 mg/L [‡]
	[†] LD ₅₀ , Rat, Oral,	* LD ₅₀ , Rat, Dermal	[‡] LC ₅₀ , Rat, Inhalation, 4 hour

SECTION 12. ECOLOGICAL INFORMATION

There is minimal immediate ecological risk from spills of this product. However, over long-term exposure under aerobic conditions, sulphur can oxidize, yielding acidic runoff (water) or acidic conditions in soils; the oxidized form, due to its acid nature, has the potential to adversely affect aquatic and terrestrial organisms. In addition, under anaerobic conditions, elemental sulphur can be biochemically reduced to forms such as sulphide ion or hydrogen sulphide, which have the potential to pose ecological risks.

SECTION 13. DISPOSAL CONSIDERATIONS

If material cannot be returned to process or salvage, dispose of in accordance with applicable regulations.

SECTION 14. TRANSPORT INFORMATION

Proper Shipping Name U.S. DOT and Transport Canada..... Sulfur, molten
 Transport Canada and U.S. DOT Hazard Classification Class 4.1, Packing Group III
 Transport Canada and U.S. DOT Product Identification Number..... UN2448
 Marine Pollutant No
 IMO Classification Class 4.1

**Product is transported in a molten state.*

SECTION 15. REGULATORY INFORMATION**U.S.**

Ingredient Listed on TSCA Inventory Yes
 Hazardous Under Hazard Communication Standard Yes
 CERCLA Section 103 Hazardous Substances..... No
 EPCRA Section 302 Extremely Hazardous Substance..... No
 EPCRA Section 311/312 Hazard Categories Physical Hazard - Flammable Solid
 EPCRA Section 313 Toxic Release Inventory: This product does not contain toxic chemicals subject to Toxic Release Inventory reporting requirements.

Canada:

Listed on Domestic Substances List Yes

SECTION 16. OTHER INFORMATION

Date of Original Issue: December 18, 1998 **Version:** 01 (*First edition*)

Date of Latest Revision: December 7, 2018 **Version:** 12

The information in this Safety Data Sheet is based on the following references:

- American Conference of Governmental Industrial Hygienists, 2004, Documentation of the Threshold Limit Values and Biological Exposure Indices, 7th Edition plus updates.
- American Conference of Governmental Industrial Hygienists, 2018, Guide to Occupational Exposure Values.
- American Conference of Governmental Industrial Hygienists, 2018, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
- Bretherick's Handbook of Reactive Chemical Hazards, 20th Anniversary Edition. (P. G. Urban, Ed), 1995.
- Commission de la santé et la sécurité du travail, Service du répertoire toxicologique, Soufre, 2008-03.
- Extoxnet Pesticide Information Profile – Sulfur (Revised 9/95), National Pesticide Information Centre, Oregon State University.
- Health Canada, Hazardous Products Regulations SOR/2015-17, 11 February 2015.
- International Labour Office (WHO/ILO) Encyclopedia of Occupational Health & Safety 4th Ed. CD-ROM Version (1998).
- European Chemical Agency (ECHA) - Registered Substances Database - Sulfur (last accessed 26 November 2018).
- Merck & Co., Inc., 2001, The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, Thirteenth Edition.
- National Library of Medicine, National Toxicology Information Program, Hazardous Substance Data Bank. (on-line version).
- New Zealand Department of Labour, Approved Code of Practice for the Prevention of Sulphur Fires and Explosions, Sept 1993.

- Patty's Toxicology, Fifth Edition, 2001: E. Bingham, B. Cohns & C.H. Powell, Ed.
- U.S. Dept. of Health and Human Services, National Institute for Occupational Safety and Health, Registry of Toxic Effects of Chemical Substances (RTECS) CCOHS Web Access subscription (*last accessed 26 November 2018*).
- U.S. Occupational Safety and Health Administration, 1989, Code of Federal Regulations, Title 29, Part 1910.1000 and 1910:1200.
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- Acronyms not spelled out elsewhere in the SDS:
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- CAS: Chemical Abstracts Service
- CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
- DOT: Department of Transport
- EPCRA: Emergency Planning and Community Right-to-Know Act
- IMO: International Maritime Organization
- LD50 LC50: Lethal Dose 50%, Lethal Concentration 50%
- TSCA: Toxic Substances Control Act
- Wt.: Weight

Notice to Reader

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