

Section 1: IDENTIFICATION

Product Name: Sulphur, Molten

Synonyms: Sulfur; Molten Sulphur.

Product Use: A raw material used in the manufacture of sulphuric acid and other chemical manufacturing.

Restrictions on Use: Not available.

Manufacturer/Supplier: Penn West Petroleum Ltd.
Suite 200, 207-9th Avenue SW
Calgary, Alberta T2P 1K3

Phone Number: (403) 777-2500

Emergency Phone: Emergency Telephone Number: 1-877-792-2990
Emergency Spill Information: (613) 996-6666 Canutec (Canada)
(800) 424-9300 Chemtrec (USA)

Date of Preparation of SDS: December 8, 2014

Section 2: HAZARD(S) IDENTIFICATION**GHS INFORMATION**

Classification: Flammable Solids, Category 2
Skin Irritation, Category 2

LABEL ELEMENTS**Hazard****Pictogram(s):****Signal Word:** Danger

Hazard Statements: Flammable solid.
Causes skin irritation.

Precautionary Statements

Prevention: Keep away from heat, sparks, open flames, and hot surfaces. – No smoking.
Ground/bond container and receiving equipment.
Use explosion-proof electrical, ventilating, and lighting equipment.
Wash thoroughly after handling.
Wear protective gloves, protective clothing, eye protection and face protection.

Response: If on skin: Wash with plenty of soap and water.
If skin irritation occurs: Get medical advice/attention.
Take off contaminated clothing and wash it before reuse.
In case of fire: Use dry chemical, CO₂, sand, earth, water spray or regular foam to extinguish.

Storage: Not applicable.

Disposal: Not applicable.

Hazards Not Otherwise Classified: Not applicable.

Ingredients with Unknown Toxicity: None.

This material is considered hazardous by the OSHA Hazard Communication Standard, (29 CFR 1910.1200).

Section 3: COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredient(s)	Common name / Synonyms	CAS No.	% wt./wt.
Sulfur	Sulphur	7704-34-9	100
Sulfur dioxide	Not available.	7446-09-5	Trace
Hydrogen sulfide (H ₂ S)	Hydrogen sulphide	7783-06-4	Trace

Impurities / Stabilizing additives: Hydrogen sulphide, Sulfur dioxide.

Section 4: FIRST-AID MEASURES

Inhalation: If inhaled: Call a poison center or doctor if you feel unwell.

Acute and delayed symptoms and effects: May cause respiratory irritation. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain. This product may contain small amounts of Hydrogen sulphide which may accumulate in confined spaces. Inhalation of Hydrogen sulphide may cause loss of sense of smell, major irritation of the respiratory tract, headache, nausea, vomiting, dizziness, and fluid buildup in the lungs (pulmonary edema), which can be fatal. At 300 ppm unconsciousness may occur after 20 minutes. From 300 to 500 ppm, death can occur within 1 to 4 hours of continuous exposure. At 500 ppm the respiratory system is paralyzed, the victim collapses almost instantaneously, and death can occur after exposure of only 30 to 60 minutes. Above 500 ppm Hydrogen sulphide may cause immediate loss of consciousness; death is rapid, and possibly immediate. Inhalation of Sulphur dioxide at concentrations of approximately 6 ppm will result in eye, nose and throat irritation. Severe overexposure may result in death from systemic acidosis, pulmonary edema or from respiratory arrest. Prolonged or repeated inhalation of sulphur dioxide may cause impaired lung function, bronchitis, cough and fatigue.

Eye Contact: If in eyes: Rinse cautiously with water for at least 30 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center or doctor.

Acute and delayed symptoms and effects: May cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision. Hot liquid product may cause serious thermal burns on direct contact.

Skin Contact: If on skin (or hair): Rinse skin with water/shower. Get immediate medical advice/attention. Remove non-adhering contaminated clothing. Cool adherent materials and burned areas with ice and/or cold water. Do not remove adherent material or clothing. Wash contaminated clothing before

reuse.

Acute and delayed symptoms and effects: Causes skin irritation. Signs/symptoms may include localized redness, swelling, and itching. Hot liquid product may cause serious thermal burns on direct contact.

Ingestion: If swallowed: Rinse mouth. Immediately call a poison center or doctor. If vomiting occurs naturally, have victim lean forward to reduce the risk of aspiration. Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

Acute and delayed symptoms and effects: Hot product may cause thermal burns. Signs/symptoms may include severe mouth, throat and abdominal pain, nausea, vomiting, and diarrhea, blood in the feces and/or vomitus may also be seen. Sulphur may be converted into Hydrogen sulphide in the intestine.

General Advice: In case of accident or if you feel unwell, seek medical advice immediately (show the label or SDS where possible).

Note to Physicians: Symptoms may not appear immediately. For inhalation of Hydrogen Sulphide, consider oxygen.

Section 5: FIRE-FIGHTING MEASURES

FLAMMABILITY AND EXPLOSION INFORMATION

Flammable solid. May be ignited by friction, heat, sparks or flames. Substance may be transported in a molten form at a temperature that may be above its flash point. May re-ignite after fire is extinguished. When heated, this material may evolve toxic and flammable Hydrogen sulphide.

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.

Fire involving Tanks or Car/Trailer Loads: Cool containers with flooding quantities of water until well after fire is out. 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 devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire.

Sensitivity to Mechanical Impact: This material is not sensitive to mechanical impact.

Sensitivity to Static Discharge: This material is sensitive to static discharge.

MEANS OF EXTINCTION

Suitable Extinguishing Media: Small Fire: Dry chemical, CO₂, sand, earth, water spray or regular foam.

Large Fire: Water spray, fog or regular foam. Move containers from fire area if you can do it without risk.

Unsuitable Extinguishing Media: Do not spray water onto burning product as this may cause spattering and spreading of the flame.

Products of Combustion: Oxides of sulphur.

Protection of Firefighters: Fire may produce irritating and/or toxic gases. Contact may cause burns to skin and eyes. Contact with molten substance

may cause severe burns to skin and eyes. Runoff from fire control may cause pollution. Hydrogen sulphide is heavier than air and may collect in low lying areas and confined spaces. Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection.

Section 6: ACCIDENTAL RELEASE MEASURES

- Emergency Procedures:** As an immediate precautionary measure, isolate spill or leak area for at least 25 meters (75 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- Personal Precautions:** Do not touch or walk through spilled material. Use personal protection recommended in Section 8. Don full-face, positive pressure, self-contained breathing apparatus.
- Environmental Precautions:** Prevent entry into waterways, sewers, basements or confined areas.
- Methods for Containment:** Stop leak if without risk. Contain hot liquid by dyking and allow to cool and solidify. Do not flush to sewer or allow to enter waterways.
- Methods for Clean-Up:** Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Other Information:** See Section 13 for disposal considerations.

Section 7: HANDLING AND STORAGE

Handling:

Do not swallow. Keep away from heat, sparks, open flames, and hot surfaces. – No smoking. Ground/bond container and receiving equipment. Wash thoroughly after handling. Grounding of containers/pouring equipment is necessary when transferring hot liquid product.

Storage:

Store away from incompatible materials. See Section 10 for information on Incompatible Materials. Keep out of the reach of children. Head spaces in storage containers may contain toxic Hydrogen sulphide gas. Structural materials and lighting and ventilation systems should be corrosion resistant.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines Component

Sulphur [CAS No. 7704-34-9]

ACGIH: 10 mg/m³ (TWA) (Inhalable.); 3 mg/m³ (TWA) (Respirable.); For Particles (Insoluble or Poorly Soluble) Not Otherwise Specified

OSHA: 15 mg/m³ (Total dust) (TWA), 5 mg/m³ (Respirable fraction) (TWA); For Particulates Not Otherwise Regulated (PNOR).

Sulfur dioxide [CAS No. 7446-09-5]

ACGIH: 0.25 ppm (STEL); A4 (2008)

OSHA: 5 ppm (TWA), 13 mg/m³ (TWA);
2 ppm (TWA); 15 ppm (STEL) [Vacated];

Hydrogen sulphide [CAS No. 7783-06-4]

ACGIH: 1 ppm (TWA); 5 ppm (STEL); (2009);

OSHA: 20 ppm (C); 50 ppm (Peak) (Maximum duration: 10 mins. once only if no other meas. exp. occurs.)
10 ppm (TWA); 15 ppm (STEL) [Vacated];

TWA: Time-Weighted Average

STEL: Short-Term Exposure Limit

C: Ceiling

Engineering Controls:

Use ventilation adequate to keep exposures (airborne levels of dust, fume, vapour, gas, etc.) below recommended exposure limits. Use explosion-proof electrical, ventilating, and lighting equipment.

PERSONAL PROTECTIVE EQUIPMENT (PPE)



Eye/Face Protection:

Wear chemical safety goggles. If product is hot, wear full face-shield. Ensure that eyewash stations are close to the workstation location. Use equipment for eye protection that meets the standards referenced by CSA Standard CAN/CSA-Z94.3-92 and OSHA regulations in 29 CFR 1910.133 for Personal Protective Equipment.

Hand Protection:

Wear protective gloves. If product is hot, thermally protective gloves are recommended. Consult manufacturer specifications for further information.

Skin and Body Protection:

Wear protective clothing. Flame resistant clothing that meets the NFPA 2112 and CAN/CGSB 155.20 standards is recommended in areas where material is stored or handled. Clothing with full length sleeves and pants should be worn.

Respiratory Protection:

If engineering controls and ventilation are not sufficient to control exposure to below the allowable limits then an appropriate NIOSH/MSHA approved air-purifying respirator that meets the requirements of CSA Standard CAN/CSA-Z94.4-11, or self-contained breathing apparatus must be used. Supplied air breathing apparatus must be used when oxygen concentrations are low or if airborne concentrations exceed the limits of the air-purifying respirators.

General Hygiene Considerations:

Handle according to established industrial hygiene and safety practices. Consult a competent industrial hygienist to

determine hazard potential and/or the PPE manufacturers to ensure adequate protection.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Yellow hot liquid.
Colour:	Yellow.
Odour:	Rotten eggs.
Odour Threshold:	0.0047 ppm, (Hydrogen sulphide) 0.67 ppm, (Sulphur dioxide)
Physical State:	Liquid (at high temperatures).
pH:	Not available.
Melting Point / Freezing Point:	113 to 120 °C (235.4 to 248 °F)
Initial Boiling Point:	Not available.
Boiling Point:	445 °C (833 °F)
Flash Point:	207 °C (404.6 °F) (Closed Cup)
Evaporation Rate:	Not available.
Flammability (solid, gas):	Not applicable.
Lower Flammability Limit:	35 g/m ³
Upper Flammability Limit:	1400 g/m ³
Vapor Pressure:	3.95 x 10 ⁻⁶ mmHg at 30.4 °C (86.7 °F)
Vapor Density:	0.00005 lb/ft ³ at 32.2 °C (90 °F)
Relative Density:	Not available.
Solubilities:	Insoluble in water.
Partition Coefficient: n-Octanol/Water:	Not available.
Auto-ignition Temperature:	232 °C (449.6 °F)
Decomposition Temperature:	Not available.
Viscosity:	11.13 cP at 121.7 °C (251 °F)
Percent Volatile, wt. %:	0
VOC content, wt. %:	Not available.
Density:	2.07 kg/L at 20°C (68 °F)
Coefficient of Water/Oil Distribution:	Not available.

Section 10: STABILITY AND REACTIVITY

Reactivity: Contact with incompatible materials. Sources of ignition. Exposure to heat.

Chemical Stability: Stable under normal storage conditions.

Possibility of Hazardous Reactions: None known.

Conditions to Avoid: Contact with incompatible materials. Sources of ignition. Exposure to heat.

Incompatible Materials: Acids. Oxidizers.

Hazardous Decomposition Products: Hazardous sulphur dioxide, and related oxides of sulphur may be generated upon combustion.

Section 11: TOXICOLOGICAL INFORMATION

EFFECTS OF ACUTE EXPOSURE

Product Toxicity

Oral: Not available.

Dermal: Not available.

Inhalation: Not available.

Component Toxicity

Component	CAS No.	LD ₅₀ oral	LD ₅₀ dermal	LC ₅₀
Sulphur	7704-34-9	> 8437 mg/kg (rat)	Not available.	Not available.
Sulfur dioxide	7446-09-5	Not available.	Not available.	2520 ppm (rat); 1H
Hydrogen sulphide	7783-06-4	Not available.	Not available.	444 ppm (rat); 4H

Likely Routes of Exposure: Eye contact. Skin contact. Inhalation. Ingestion.

Target Organs: Skin. Eyes. Gastrointestinal tract. Respiratory system. Lungs. Blood. Cardiovascular system. Central nervous system.

Symptoms (including delayed and immediate effects)

Inhalation: May cause respiratory irritation. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain. This product may contain small amounts of Hydrogen sulphide which may accumulate in confined spaces. Inhalation of Hydrogen sulphide may cause loss of sense of smell, major irritation of the respiratory tract, headache, nausea, vomiting, dizziness, and fluid buildup in the lungs (pulmonary edema), which can be fatal. At 300 ppm unconsciousness may occur after 20 minutes. From 300 to 500 ppm, death can occur within 1 to 4 hours of continuous exposure. At 500 ppm the respiratory system is paralyzed, the victim collapses almost instantaneously, and death can occur after exposure of only 30 to 60 minutes. Above 500 ppm Hydrogen sulphide may cause immediate loss of consciousness; death is rapid, and possibly immediate. Inhalation of Sulphur dioxide at concentrations of approximately 6 ppm will result in eye, nose and throat irritation. Severe overexposure may result in death from systemic acidosis, pulmonary edema or from respiratory arrest. Prolonged or repeated inhalation of sulphur dioxide may cause impaired lung

function, bronchitis, cough and fatigue.

Eye: May cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision. Hot liquid product may cause serious thermal burns on direct contact.

Skin: Causes skin irritation. Signs/symptoms may include localized redness, swelling, and itching. Hot liquid product may cause serious thermal burns on direct contact.

Ingestion: Hot product may cause thermal burns. Signs/symptoms may include severe mouth, throat and abdominal pain, nausea, vomiting, and diarrhea, blood in the feces and/or vomitus may also be seen. Sulphur may be converted into Hydrogen sulphide in the intestine.

Skin Sensitization: Not available.

Respiratory Sensitization: Not available.

Medical Conditions Not available.

Aggravated By Exposure:

EFFECTS OF CHRONIC EXPOSURE (from short and long-term exposure)

Target Organs: Skin. Eyes. Gastrointestinal tract. Respiratory system. Lungs. Blood. Cardiovascular system. Central nervous system.

Chronic Effects: Prolonged or repeated contact may dry skin and cause irritation. Several human studies have shown that repeated exposure to Sulphur dioxide at levels exceeding the exposure limit has caused permanent pulmonary impairment. Hydrogen sulphide may reduce lung function; cause neurological effects such as headaches, nausea, depression and personality changes; eye and mucous membrane irritation; damage to cardiovascular system.

Carcinogenicity: Product is not classified as a carcinogen. See Component Carcinogenicity table below for information on individual components.

Component Carcinogenicity

Component	ACGIH	IARC	NTP	OSHA	Prop 65
Sulfur dioxide	A4	Group 3	Not listed.	Not listed.	Not listed.

Mutagenicity: May cause genetic damage.

Reproductive Effects: Not available.

Developmental Effects

Teratogenicity: Not available.

Embryotoxicity: Not available.

Toxicologically Synergistic Materials: Not available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: Daphnia magna (Water flea, age <24 hr): EC50 >5000000 ug/L, 48-hr, freshwater, static; Effect: intoxication, immobilization;

Daphnia magna (Water flea, 1st instar larvae); EC50 = 3850000 ug/L, 96 hr, freshwater, static; Effect: intoxication, immobilization;

Americamysis bahia (Opossum Shrimp, age 24 hr): LC50 = 736000 ug/L, 96 hr (95% confidence interval: 646000-839000 ug/L), saltwater, static;

Lepomis macrochirus (Bluegill): LC50 < 14000 ug/L, 96 hr, freshwater, static;

Lepomis macrochirus (Bluegill, juvenile): LC50 > 180000 ug/L, 96 hr, freshwater, static;

Oncorhynchus mykiss (Rainbow trout): Concentration: LC50 > 180000 ug/L, 96 hr, freshwater, static.

Persistence / Degradability:

Solid sulfur is biodegradable; microbiological reduction to hydrogen sulfide or oxidation to acidic oxy-sulfur species is possible. Both of these products can have environmental consequences. Reclamation of sulfur rich wastes is preferred over solid waste disposal. Commercial sulfur waste reclaimers are available. Disposal must be in a certified landfill site approved for the use of elemental sulfur. Special simultaneous application of limestone normally required.

Bioaccumulation / Accumulation:

Not anticipated to be bioaccumulative.

Mobility in Environment:

Fugitive sulfur dust can be carried considerable distances from origin especially in low humidity and windy conditions. Prolonged exposure of soil and vegetation to such dust can be harmful.

Other Adverse Effects:

Not available.

Section 13: DISPOSAL CONSIDERATIONS

Disposal Instructions: Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.

Section 14: TRANSPORT INFORMATION

U.S. Department of Transportation (DOT)

Proper Shipping Name: UN2448, SULFUR, MOLTEN, 4.1, PG III

Class: 4.1

UN Number: UN2448

Packing Group: III

Label Code:



Canada Transportation of Dangerous Goods (TDG)

Proper Shipping Name: UN2448, SULFUR, MOLTEN, 4.1, PG III

Class: 4.1

UN Number: UN2448

Packing Group: III

Label Code:



Section 15: REGULATORY INFORMATION

Chemical Inventories

US (TSCA)

The components of this product are in compliance with the chemical notification requirements of TSCA.

Canada (DSL)

The components of this product are in compliance with the chemical notification requirements of the NSN Regulations under CEPA, 1999.

Federal Regulations

Canada

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.

WHMIS Classification: Class B4 - Flammable Solids.
Class D2B - Skin Irritation.

Hazard Symbols:



United States

This SDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SARA Title III

Component	Section 302 (EHS) TPQ (lbs.)	Section 304 EHS RQ (lbs.)	CERCLA RQ (lbs.)	Section 313	RCRA CODE	CAA 112(r) TQ (lbs.)
Sulfur dioxide	500	500	Not listed.	Not listed.	Not listed.	5000
Hydrogen sulphide	500	100	100	313s	U135	10000

State Regulations

Massachusetts

US Massachusetts Commonwealth's Right-to-Know Law (Appendix A to 105 Code of Massachusetts Regulations Section 670.000)

Component	CAS No.	RTK List
Sulphur	7704-34-9	Listed.
Sulfur dioxide	7446-09-5	E
Hydrogen sulphide	7783-06-4	E

Note: E = Extraordinarily Hazardous Substance

New Jersey

US New Jersey Worker and Community Right-to-Know Act (New Jersey Statute Annotated Section 34:5A-5)

Component	CAS No.	RTK List
Sulphur	7704-34-9	Listed.
Sulfur dioxide	7446-09-5	Listed.
Hydrogen sulphide	7783-06-4	SHHS

Note: SHHS = Special Health Hazard Substance

Pennsylvania

US Pennsylvania Worker and Community Right-to-Know Law (34 Pa. Code Chap. 301-323)

Component	CAS No.	RTK List
Sulphur	7704-34-9	Listed.
Sulfur dioxide	7446-09-5	E
Hydrogen sulphide	7783-06-4	E

Note: E = Environmental Hazard

California

California Prop 65: WARNING: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Component	Type of Toxicity
Sulfur dioxide	developmental

Section 16: OTHER INFORMATION

Disclaimer:

The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to satisfy oneself as to the suitability and completeness of this information for his own particular use.

Date of Preparation of SDS: December 8, 2014

SDS Expiry Date (Canada): December 7, 2017

Version: 1.0

GHS SDS Prepared by: Deerfoot Consulting Inc.

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