United States Steel Corporation

Sulfur

Safety Data Sheet (SDS)

USS IHS Number: 7973

Locations: Fairfield, Gary, Granite City, Great Lakes, Hamilton, Lorain, Lake Erie, and Mon Valley

Original: 8/25/1985 **Revision: 12/31/2020**

Section 1 – Identification

1(a) Product Identifier used on Label: Sulfur

1(b) Other Means of Identification: Sulphur, Brimstone

1(c) Recommended use of the chemical and restrictions on use: None

1(d) Name, Address, and Telephone Number:

United States Steel Corporation
600 Grant Street, Room 1662
Pittsburgh, PA 15219-2800

Phone number: (412) 433-6840 (8:00 am to 5:00 pm)
FAX: (412) 433-5019

1(e) Emergency Phone Number: 1-800-262-8200 (CHEMTREC)

Section 2 – Hazard(s) Identification

2(a) Classification of the Chemical: Sulfur is considered a hazardous material according to the criteria specified in REACH [REGULATION (EC) No 1907/2006] and CLP [REGULATION (EC) No 1272/2008] and OSHA 29 CFR 1910.1200 Hazard Communication Standard. The categories of Health Hazards as defined in "GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS (GHS), Third revised edition ST/SG/AC.10/30/Rev. 3" United Nations, New York and Geneva, 2009 have been evaluated. Refer to Section 3, 8 and 11 for additional information.

2(b) Signal Word, Hazard Statement(s), Symbols and Precautionary Statement(s):

Hazard Symbol	Hazard Classification	Signal Word	Hazard Statement(s)
	Skin Irritation - 2	**WARNING**	Causes skin irritation. May form combustible dust concentrations in air.
NA	Combustible Dust		

Precautionary Statement(s):

Prevention	Response	Storage/Disposal
Wear protective gloves. Wash thoroughly after handling.	If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse.	Dispose of contents in accordance with federal, state and local regulations.

2(c) Hazards not otherwise classified: None Known

2(d) Unknown acute toxicity statement (mixture): None Known

Section 3 – Composition/Information on Ingredients

3(a-c) Chemical name, common name (synonyms), CAS number and other identifiers, and concentration:

Chemical Name	CAS Number	EC Number	% weight
Sulfur	7704-34-9	231-722-6	100

EC - European Community
CAS - Chemical Abstract Service

Section 4 – First-aid Measures

4(a) Description of necessary measures:

- **Inhalation:** If inhaled: Remove person to fresh air and keep comfortable for breathing. Seek medical advice/attention.
- **Eye Contact:** Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue Rinsing.

Section 4 – First-aid Measures (continued)

4(a) Description of necessary measures (continued):

- **Skin Contact:** If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse.
- **Ingestion:** Immediately call a poison center or doctor/physician. Do NOT induce vomiting.

4(b) Most Important Symptoms/Effects, Acute and Delayed (Chronic):

Acute effects:

- **Inhalation:** Sulfur dust may irritate the gastrointestinal tract. Hydrogen sulfide may be present in the vapors of this product. Hydrogen sulfide (H_2S) gas is a rapidly acting systemic poison, which causes respiratory paralysis with consequent asphyxia at high concentrations. The sense of smell is rapidly paralyzed on exposure at 200 ppm H_2S. Less than half an hour exposure at about 300-500 ppm H_2S can result in headache, dizziness, staggering gait, nausea, and dryness and pain in the respiratory tract (followed later by bronchitis and pulmonary edema). Paralysis of the breathing centers can occur after a few breaths at 1000-2000 ppm H_2S, followed by collapse and quick death if removal to fresh air and restoration of breathing is not rapidly accomplished. Irritation of the respiratory tract begins above 20 ppm H_2S and increases with concentration and exposure time.
- **Eye:** Sulfur may irritate eyes. H_2S is an eye irritant above 20 ppm and increases with concentration and exposure time.
- **Skin:** Skin contact with dusts may cause irritation or sensitization, possibly leading to dermatitis. H_2S is a skin irritant to all moist tissues.
- **Ingestion:** May be converted into hydrogen sulfide in the intestine.

Delayed (chronic) Effects:

Sulfur compounds, present in the fumes, may irritate the skin, eyes, lungs and gastrointestinal tract. May cause damage to the lung from prolonged or repeated exposure, Sulfur dioxide vapor is irritating to the respiratory tract and can cause lung damage with repeated or prolonged exposure.

4(c) Immediate Medical Attention and Special Treatment: Treat symptomatically

Section 5 – Fire-fighting Measures

5(a) Suitable (and unsuitable) Extinguishing Media: Use steam, water fog, dry chemical or carbon dioxide. Avoid straight streams, which will dust.

5(b) Specific Hazards arising from the chemical: Sulfur may release hydrogen sulfide. Hydrogen sulfide is heavier than air and will seek the lowest level. Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard. Hazardous in contact with oxidizing materials; forms explosive mixtures.

5(c) Special protective equipment and precautions for fire-fighters: Self-contained MSHA/NIOSH approved respiratory protection and full protective clothing should be worn when fumes and/or smoke from fire are present. Heat and flames cause emittance of acrid smoke and fumes. Do not release runoff from fire control methods to sewers or waterways. Firefighters should wear full face-piece self-contained breathing apparatus and chemical protective clothing with thermal protection. Direct water stream will scatter and spread flames and, therefore, should not be used. Evacuate area. Remove pressurized gas cylinders from the immediate vicinity. Cool containers exposed to flames with water until well after the fire is out. Close the valve if no risk is involved. Fight fire from a protected location. Prevent buildup of vapors or gases to explosive concentrations.

Section 6 - Accidental Release Measures

6(a) Personal Precautions, Protective Equipment and Emergency Procedures: For spills, clean-up personnel should be protected against contact with eyes and skin. Large spills should be diked and foam applied. Do not release into sewers or waterways. Use absorbent material such as vermiculite or sand to soak up spill. Contain material and follow normal clean-up procedures. Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations. Keep unnecessary people away. Isolate hazard area and deny entry. Stay upwind.

6(b) Methods and materials for containment and clean up: Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations. Follow applicable OSHA regulations (29 CFR 1910.120) and all other pertinent state and federal requirements.

Section 7 - Handling and Storage

7(a) Precautions for safe handling: Wash thoroughly after handling. Avoid direct contact on skin, eyes or on clothing. Handle and use in accordance with OSHA 29 CFR 1910.106 or local codes. Observe proper industrial hygiene practices. Emergency safety showers and eye wash stations should be present.

7(b) Conditions for safe storage, including any incompatibilities: Store in a well-ventilated place.

Section 8 - Exposure Controls / Personal Protection

8(a) Occupational Exposure Limits (OELs): The following exposure limits are offered as reference, for an experience industrial hygienist to review.

Ingredients	OSHA PEL [1]	ACGIH TLV [2]	NIOSH REL [3]	IDLH [4]
Sulfur	NE	NE	NE	NE

Section 8 - Exposure Controls / Personal Protection (continued)

8(a) Occupational Exposure Limits (OELs) (continued):

Ingredients	OSHA PEL [1]	ACGIH TLV [2]	NIOSH REL [3]	IDLH [4]
Hydrogen sulfide	"C" 20 ppm "Peak" 50 ppm (10 minutes)	1.0 ppm "STEL" 5.0 ppm	"C" 10 ppm (10 minutes)	100 ppm

NE - None Established

1. OSHA PELs (Permissible Exposure Limits) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday. An Action level (AL) is used by OSHA and NIOSH to express a health or physical hazard. They indicate the level of a harmful or toxic substance/activity, which requires medical surveillance, increased industrial hygiene monitoring, or biological monitoring. Action Levels are generally set at one half of the PEL but the actual level may vary from standard to standard. The intent is to identify a level at which the vast majority of randomly sampled exposures will be below the PEL.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. ACGIH TLVs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes. DSEN – May cause dermal sensitization. This notation is used to indicate the potential for dermal sensitization resulting from the interaction of an absorbed agent and ultraviolet light (i.e. photosensitization). RSEN – May cause respiratory sensitization.
3. The National Institute for Occupational Safety and Health Recommended Exposure Limits (NIOSH-REL)- Compendium of Policy and Statements. NIOSH, Cincinnati, OH (1992). NIOSH is the federal agency designated to conduct research relative to occupational safety and health. As is the case with ACGIH TLVs, NIOSH RELs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
4. The "immediately dangerous to life or health air concentration values (IDLHs)" are used by NIOSH as part of the respirator selection criteria and were first developed in the mid-1970's by NIOSH. The Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs) is a compilation of the rationale and sources of information used by NIOSH during the original determination of 387 IDLHs and their subsequent review and revision in 1994. Ca is designated as carcinogen.

8(b) Appropriate Engineering Controls: Use controls as appropriate to minimize exposure to fumes, vapors, gasses and heat during handling operations. Provide general or local exhaust ventilation systems to minimize airborne concentrations. Local exhaust is necessary for use in enclosed or confined spaces. Provide sufficient general/local exhaust ventilation in pattern/volume to control inhalation exposures below current exposure limits.

8(c) Individual Protection Measures:

- **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use only a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Concentration in air of the various contaminants determines the extent of respiratory protection needed. Protection by air purifying both negative-pressure and powered air respirators is limited. Use a positive-pressure-demand, full-face, supplied air respirator or self-contained breathing apparatus (SCBA) for concentrations above 50 times the exposure limit. The potential presence of hydrogen sulfide needs to be factored into respiratory protection selection process if working around molten material. If exposure is above the IDLH (Immediately dangerous to life or health) for any of the constituents, or there is a possibility of an uncontrolled release or exposure levels are unknown, then use a positive-demand, full-face, supplied air respirator with escape bottle or SCBA.

  Warning! Air-purifying respirators both negative-pressure and powered-air do not protect workers in oxygen-deficient atmospheres.
- **Eyes**: Employees should be required to wear chemical safety glasses to prevent eye contact. Chemical goggles, face shields or glasses should be worn to prevent eye contact. Contact lenses should not be worn where industrial exposure to this material is likely.
- **Skin**: Persons handling this product should wear appropriate clothing to prevent skin contact. Wear protective gloves. Wash skin that has been exposed with soap and water.
- **Other protective equipment**: An eyewash fountain and deluge shower should be readily available in the work area.

Section 9 - Physical and Chemical Properties

9(a) Appearance (physical state, color, etc.): Yellow crystals, powder, granular, lump, etc

9(b) Odor: No odor

9(c) Odor Threshold: NA

9(d) pH: NA

9(e) Melting Point/Freezing Point: 118.3-121.7˚C, 245-251˚F

9(f) Initial Boiling Point and Boiling Range: 444.4˚C, 832˚F

9(g) Flash Point: 187.8˚C, 370˚F

9(h) Evaporation Rate: NA

9(i) Flammability (solid, gas): Combustible Dust

9(j) Upper/lower Flammability or Explosive Limits: ND

9(k) Vapor Pressure: 0.175mm Hg @ 148.9˚C, 300˚F evaporation Rate (Ether = 1)

9(l) Vapor Density (Air = 1): 15,750 $ft.^3$/lb

9(m) Relative Density: 1.76g/ml @ 148.9˚C, 300˚ F SG

9(n) Solubility(ies): 60-70%

9(o) Partition Coefficient n-octanol/water: ND

9(p) Auto-ignition Temperature: 247.8 – 266.1˚C, 478 – 511˚F

9(q) Decomposition Temperature: ND

9(r) Viscosity: 0.0893 poises @ 121.1˚C, 250˚F

NA - Not Applicable

ND - Not Determined for product as a whole

Section 10 - Stability and Reactivity

10(a) Reactivity: Not Determined (ND)

10(b) Chemical Stability: Conditions contributing to instability are high heat, open flames and other sources of ignition. Sulfur is stable under normal storage, and handling conditions.

Section 10 - Stability and Reactivity (continued)

10(c) Possibility of hazardous reaction: None Known

10(d) Conditions to Avoid: Open flames, and other sources of ignition. Avoid storage with incompatible materials.

10(e) Incompatible Materials: Sulfur must be stored to avoid contact with oxidizers (such as perchlorates, peroxides, permanganates, chlorates and nitrates); chemically active metals (such as potassium, sodium, lithium, zinc, tin) metal carbides (such as calcium carbide) and halogens and many other substances since violent reactions can occur.

10(f) Hazardous Decomposition Products: Toxic sulfur dioxide (SO_2) is produced when sulfur is burned. Hydrogen sulfide (H_2S) may evolve from liquid sulfur. When exposed to excessive heat (fire conditions), vapor/decomposition products including hydrogen sulfide and sulfur dioxide may be released forming explosive/toxic mixtures in air.

Section 11 - Toxicological Information

11 Information on toxicological effects: The following toxicity data has been determined for **Sulfur** when further processed using the information available for its components applied to the guidance on the preparation of an SDS under the GHS requirements of OSHA and the EU CPL:

Hazard Classification	Hazard Category		Hazard Symbols	Signal Word	Hazard Statement
	EU	OSHA			
Skin Irritation (covers Categories 1A, 1B, and 2)	2	2[b]		**Warning**	Causes skin irritation.

* Not Rated

Toxicological data listed below are presented regardless to classification criteria. Individual hazard classification categories where the toxicological information has met or exceeded a classification criteria threshold are listed above.

a. The following LC_{50} or LD_{50} has been established for **Sulfur**:
- LD_{50} = 2500 mg/kg (Oral/Rabbit)

b. The following Skin (Dermal) Irritation data available for **Sulfur:**
- Rabbit irritation, edema and erythema 4 at 72 hours all resolved by day 7. (REACH)

c. No Eye Irritation data available for **Sulfur.**

d. No Skin (Dermal) Sensitization data available for **Sulfur.**

e. No Respiratory Sensitization data available for **Sulfur.**

f. No Germ Cell Mutagenicity data available for **Sulfur.**

g. Carcinogenicity: IARC, NTP, and OSHA do not list **Sulfur** as a carcinogen. However, the following Carcinogenicity information was found for potential decomposition product:
- **Hydrogen Sulfide:** EPA-I, Data are inadequate for an assessment of human carcinogenic potential.

h. No Toxic Reproduction data available for **Sulfur.**

i. No Specific Target Organ Toxicity (STOT) following a Single Exposure data available for **Sulfur.**

j. No Specific Target Organ Toxicity (STOT) following Repeated Exposure data was available for **Sulfur.**

The above toxicity information was determined from available scientific sources to illustrate the prevailing posture of the scientific community. The scientific resources includes: The American Conference of Governmental Industrial Hygienist (ACGIH) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure indices (BEIs) with Other Worldwide Occupational Exposure Values 2020, The International Agency for Research on Cancer (IARC), The National Toxicology Program (NTP) updated documentation, the World Health Organization (WHO) and other available resources, the International Uniform Chemical Information Database (IUCLID), European Union Risk Assessment Report (EU-RAR), Concise International Chemical Assessment Documents (CICAD), European Union Scientific Committee for Occupational Exposure Limits (EU-SCOEL), Agency for Toxic Substances and Disease Registry (ATSDR), Hazardous Substance Data Bank (HSDB), and International Programme on Chemical Safety (IPCS).

Section 12 - Ecological Information

12(a) Ecotoxicity (aquatic & terrestrial): No Data Available for **Sulfur** as sold/shipped.

12(b) Persistence & Degradability: No Data Available

12(c) Bioaccumulative Potential: No Data Available

12(d) Mobility (in soil): No Data Available.

12(e) Other adverse effects: None Known

Additional Information:

Hazard Category: No Category **Signal Word:** No Signal Word

Hazard Symbol: No Hazard Symbol

Hazard Statement: No Hazard Statement

Section 13 - Disposal Considerations

Disposal: This material is considered a hazardous waste. Dispose in approved landfill or incinerate. Follow applicable Federal, state, and local regulations for disposal of hazardous waste accumulated during handling operations of the product.

Section 13 - Disposal Considerations (continued)

Container Cleaning and Disposal: Follow applicable federal, state and local regulations. Observe safe handling precautions. European Waste Catalogue (EWC): 05 06 99 (wastes from the pyrolytic treatment of coal - wastes not otherwise specified).

Please note this information is for Sulfur in its original form. Any alterations can void this information.

Section 14 - Transport Information

14 (a-g) Transportation Information:

US Department of Transportation (DOT) under 49 CFR 172.101 regulates **Sulfur** as a hazardous material. All federal, state, and local laws and regulations that apply to the transport of this type of material must be adhered to.

Shipping Name: Sulfur	**Packaging Authorizations**	**Quantity Limitations**
Shipping Symbols: D	**a) Exceptions:** None	**a) Passenger, Aircraft, or Railcar:** Forbidden
Hazard Class: 9	**b) Group:** 213	**b) Cargo Aircraft Only:** Forbidden
UN No.: NA2448	**c) Authorization:** 247	**Vessel Stowage Requirements**
Packing Group: III		**a) Vessel Stowage:** C
DOT/ IMO Label: Code 9		**b) Other:** 61
Special Provisions (172.102): 30, IB3, T1, TP3		**DOT Reportable Quantities**: NA

International Maritime Dangerous Goods (IMDG) and the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) classification, packaging and shipping requirements follow the US DOT Hazardous Materials Regulation.

Regulations Concerning the International Carriage of Dangerous Goods by Road (ADR) regulates **Sulfur** as a hazardous material.

Shipping Name: Sulphur, Molten	**Packaging**	**Portable Tanks & Bulk Containers**
Classification Code: 4.1	**a) Packing Instructions:** NA	**a) Instructions:** T1
UN No.: 2448	**b) Special Packing Provisions:** NA	**b) Special Provisions:** TP3
Packing Group: III	**c) Mixed Packing Provisions:** NA	
ADR Label: NA		
Special Provisions: NA		
Limited Quantities: 0		

International Air Transport Association (IATA) regulates **Sulfur** as a hazardous material.

Shipping Name: Sulphur, Molten	**Passenger & Cargo Aircraft**		**Cargo Aircraft Only**	**Special Provisions:** NA
Class/Division: 4.1	**Limited Quantity (EQ)**		**Pkg Inst:** Forbidden	
Hazard Label (s): NA	**Pkg Inst:** Forbidden	**Pkg Inst:** Forbidden		**ERG Code:** 3L
UN No.: 2448			**Max Net Qty/Pkg:** NA	
Packing Group: NA	**Max Net Qty/Pkg:** NA	**Max Net Qty/Pkg:** NA		
Excepted Quantities (EQ): NA				

Pkg Inst – Packing Instructions Max Net Qty/Pkg – Maximum Net Quantity per Package ERG – Emergency Response Drill Code

Transport Dangerous Goods (TDG) Classification: Molten Sulfur Class 4.1 UN2448, PGIII

Section 15 - Regulatory Information

Regulatory Information: *The following listing of regulations relating to a U. S. Steel product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities.*

This product and/or its constituents are subject to the following regulations:

SARA Potential Hazard Categories: Immediate Acute Health Hazard, Delayed Chronic Health Hazard

SARA 313 Supplier Notification: The product, **Sulfur** does not contain any of the toxic chemicals subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

State Regulations: The product, **Sulfur** is listed in some state regulations.

California Prop. 65: NA The product, **Sulfur** does not contain chemicals which is known to the State of California to cause cancer or reproductive toxicity. For more information go to www.P65Warnings.ca.gov.

Other Regulations:

WHMIS Classification (Canadian): The product, **Sulfur** is listed:

Ingredients	WHMIS Classification
Sulfur	Flammable solids - Category 2; Skin corrosion/irritation - Category 2; Combustible dusts*

* This product belongs to the hazard class "Combustible dust" if 5% or more by weight of its composition has a particle size < 500 µm.

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

Section 16 - Other Information

Prepared By: United States Steel Corporation

Revision History:

12/31/2020 – Update to sections 2, 8, 11, 15
12/31/2017 - Update WHIMIS 2015
5/28/2015 - Update based on new information
8/25/1985 - Original

Expiration Date: 12/31/2023

Additional Information:

Hazardous Material Identification System (HMIS) Classification

Health Hazard	**2**
Fire Hazard	**1**
Physical Hazard	**0**

HEALTH= **2**, * Denotes Temporary or minor injury may occur.
FIRE= **1**, Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200°F. (Class IIIB).
PHYSICAL HAZARDS= **0** (Materials that are normally stable).

National Fire Protection Association (NFPA)

HEALTH = **2**- Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.
FIRE = **1** - Must be preheated before ignition can occur.
INSTABILITY = **0** (Normally stable)

ABBREVIATIONS/ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	**NIF**	No Information Found
BEIs	Biological Exposure Indices	**NIOSH**	National Institute for Occupational Safety and Health
CAS	Chemical Abstracts Service	**NTP**	National Toxicology Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	**ORC**	Organization Resources Counselors
CFR	Code of Federal Regulations	**OSHA**	Occupational Safety and Health Administration
CNS	Central Nervous System	**PEL**	Permissible Exposure Limit
GI, GIT	Gastro-Intestinal, Gastro-Intestinal Tract	**PNOR**	Particulate Not Otherwise Regulated
HMIS	Hazardous Materials Identification System	**PNOC**	Particulate Not Otherwise Classified
IARC	International Agency for Research on Cancer	**PPE**	Personal Protective Equipment
LC50	Median Lethal Concentration	**ppm**	parts per million
LD50	Median Lethal Dose	**RCRA**	Resource Conservation and Recovery Act
LD_{Lo}	Lowest Dose to have killed animals or humans	**RTECS**	Registry of Toxic Effects of Chemical Substances
LEL	Lower Explosive Limit	**SARA**	Superfund Amendment and Reauthorization Act
$\mu g/m^3$	microgram per cubic meter of air	**SCBA**	Self-contained Breathing Apparatus
mg/m^3	milligram per cubic meter of air	**STEL**	Short-term Exposure Limit
mppcf	million particles per cubic foot	**TLV**	Threshold Limit Value
SDS	Safety Data Sheet	**TWA**	Time-weighted Average
MSHA	Mine Safety and Health Administration	**UEL**	Upper Explosive Limit
NFPA	National Fire Protection Association		

Disclaimer: This information is taken from sources or based upon data believed to be reliable. However, United States Steel Corporation makes no warranty as to the absolute correctness or sufficiency of any of the foregoing or that additional or other measures may not be required under particular conditions.