SULFUR

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CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
Brimstone	Liquid (molten solid)	Yellow, orange, tan, brown, or gray	Faint rotten eggs odor
	Thickens and sinks in water.		

Keep people away. Avoid contact with liquid and solid.
Shut off ignition sources and call fire department.
Notify local health and pollution control agencies.
Protect water intakes.

Fire	Combustible. POISONOUS GAS IS PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with water or sand.
Exposure	CALL FOR MEDICAL AID. LIQUID Will burn skin and eyes. Harmful if swallowed. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
Water Pollution	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Dredge
Do not burn

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 0; Unassigned cargoes
2.2 Formula: S
2.3 IMO/UN Designation: Not listed
2.4 DOT ID No.: 1350
2.5 CAS Registry No.: 7704-34-9
2.6 NAERG Guide No.: 133
2.7 Standard Industrial Trade Classification: 52226

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Safety goggles with side shields; approved respirator; heat-resistant gloves; leather heat-resistant clothing. If recovered sulfur, refer to hydrogen sulfide.*
3.2 Symptoms Following Exposure: Can cause eye irritation; may rarely irritate skin. If recovered sulfur, refer to hydrogen sulfide.*
3.3 Treatment of Exposure: EYES: wash eyes carefully for at least 15 min. SKIN: Treat molten sulfur burns with petroleum jelly or mineral oil. If recovered sulfur, treat as for hydrogen sulfide.*
3.4 TLV-TWA: Not listed.
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: None
3.10 Vapor (Gas) Irritant Characteristics: Non-volatile
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
3.12 Odor Threshold: If recovered sulfur, see hydrogen sulfide.*
3.13 IDLH Value: Not listed. *Significant amounts of hydrogen sulfide, a very poisonous gas, may collect in poorly ventilated containers of liquid sulfur that has been recovered from hydrogen sulfide.
3.14 OSHA PEL-TWA: Not listed.
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 405°F C.C. for recovered sulfur, see hydrogen sulfide.
4.2 Flammable Limits in Air: Not pertinent
4.3 Fire Extinguishing Agents: Water
4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
4.5 Special Hazards of Combustion Products: Produces toxic sulfur dioxide gas.
4.6 Behavior in Fire: Burns with a pale blue flame that may be difficult to see in daylight.
4.7 Auto Ignition Temperature: 450°F; for recovered sulfur, see hydrogen sulfide.
4.8 Electrical Hazards: Not pertinent
4.9 Burning Rate: Not pertinent
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 4.8 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 1.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No hazardous reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity: 10,000 ppm/96 hr/mosquito fish/TL_m/fresh water
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): Currently not available
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 0/0
Human Oral hazard: 0
Human Contact hazard: 0
Reduction of amenities: 0

7. SHIPPING INFORMATION

7.1 Grades of Purity: Frasch liquid sulfur: 99.8+%; solid sulfur is sold in many varieties and grades; these are not presently covered in this manual.
7.2 Storage Temperature: 270°F
7.3 Inert Atmosphere: Ventilated (natural)
7.4 Venting: Open
7.5 IMO Pollution Category: III
7.6 Ship Type: 3
7.7 Barge Hull Type: 3

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Class 9
8.2 49 CFR Class: 9
8.3 49 CFR Package Group: III
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification	
Health Hazard (Blue).....	1	2
Flammability (Red).....	1	1
Instability (Yellow).....	0	0

8.6 EPA Reportable Quantity: Not listed.
8.7 EPA Pollution Category: Not listed.
8.8 RCRA Waste Number: Not listed
8.9 EPA FWPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Solid
9.2 Molecular Weight: 256.51
9.3 Boiling Point at 1 atm: 832.3°F = 444.6°C = 717.8°K
9.4 Freezing Point: 251°F = 121.7°C = 394.9°K
9.5 Critical Temperature: Not pertinent
9.6 Critical Pressure: Not pertinent
9.7 Specific Gravity: 1.80 at 120°C (liquid)
9.8 Liquid Surface Tension: 60.8 dynes/cm = 0.0608 N/m at 120°C
9.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 127°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.582 (est.)
9.12 Latent Heat of Vaporization: 120 Btu/lb = 69 cal/g = 2.9 X 10^5 J/kg
9.13 Heat of Combustion: –4.741 Btu/lb = –2,634 cal/g = –110.3 X 10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 9.2 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: Very low

NOTES

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9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
255	112.400	260	0.230		N	251	11.130
260	112.299	280	0.232		O	252	11.010
265	112.099	300	0.234		T	253	10.890
270	112.000	320	0.236			254	10.770
275	111.900	340	0.237		P	255	10.660
280	111.700	360	0.239		E	256	10.550
285	111.599	380	0.241		R	257	10.440
290	111.400	400	0.243		T	258	10.330
295	111.299	420	0.244		I	259	10.220
300	111.200	440	0.246		N	260	10.110
305	111.000	460	0.248		E	261	10.000
310	110.900	480	0.250		N	262	9.901
315	110.799	500	0.252		T	263	9.798
320	110.599	520	0.253			264	9.697
		540	0.255			265	9.597
		560	0.257			266	9.498
		580	0.259			267	9.401
		600	0.260			268	9.305
		620	0.262			269	9.210
		640	0.264			270	9.116
		660	0.266			271	9.024
		680	0.268			272	8.932
		700	0.269			273	8.842
		720	0.271			274	8.753
						275	8.665
						276	8.579

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	260	0.001	260	0.00005	90	0.021
	N	280	0.003	280	0.00008	100	0.021
	S	300	0.004	300	0.00014	110	0.021
	O	320	0.007	320	0.00023	120	0.021
	L	340	0.012	340	0.00036	130	0.021
	U	360	0.019	360	0.00056	140	0.021
	B	380	0.030	380	0.00085	150	0.021
	L	400	0.046	400	0.00127	160	0.021
	E	420	0.068	420	0.00185	170	0.021
		440	0.100	440	0.00266	180	0.021
		460	0.144	460	0.00375	190	0.021
		480	0.205	480	0.00522	200	0.021
		500	0.287	500	0.00716	210	0.021
		520	0.397	520	0.00968	220	0.021
		540	0.541	540	0.01294	230	0.021
		560	0.729	560	0.01709	240	0.021
		580	0.971	580	0.02232	250	0.021
		600	1.279	600	0.02885	260	0.021
		620	1.668	620	0.03692		
		640	2.154	640	0.04681		
		660	2.757	660	0.05884		
		680	3.498	680	0.07334		
		700	4.401	700	0.09069		
		720	5.495	720	0.11130		
		740	6.810	740	0.13570		