



TESSENDERLO DAVISON
COMPANIES, LLC

Sodium Hydrosulfide Handbook

November 2005



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OVERVIEW

Sodium hydrosulfide, NaHS, is a highly alkaline liquid with a pH range of 11.5 to 12.5. The liquid solution is typically yellow to dark green in color and has a strong hydrogen sulfide (rotten egg) odor. Solutions of NaHS are considered stable in normal transportation. Solutions range from 20 to 45% strength by weight and weigh 9.6 to 10.9 pounds per U.S. gallon (1.15 - 1.306 gm/cc)

The vapor space over NaHS solutions contains highly toxic hydrogen sulfide (H₂S) vapors. Hydrogen sulfide is a colorless gas and is heavier than air. It will remain low to the ground and concentrate in low-lying areas and depressions. The level of H₂S vapors evolving from the solution is significantly increased by lowering the pH of the solution by allowing the solution to come into contact with acids or acidic materials. The vapors are increased to a lesser degree by heating the solution or diluting the solution (which lowers the pH).

Sodium hydrosulfide solutions have been stored in mild and stainless steel and lined mild steel tanks (See Construction Materials for Storage and Handling). Transfers of NaHS to and from storage should be done utilizing a closed loop vapor return system to minimize personnel exposure to product vapors.

Personnel handling sodium hydrosulfide solutions should wear Personnel Protective Equipment (PPE) to avoid exposure to the skin or eyes (See Handling). Personnel should wear Self-Contained Breathing Apparatus (SCBA) or In-line Breathing System Respirator when working near open storage tank covers or open dome covers on tank trucks or rail cars containing NaHS solutions because of the potential H₂S vapors which may exist at these openings.

HEALTH HAZARDS

The primary health hazards associated with sodium hydrosulfide are the inhalation of highly toxic H₂S vapors and the corrosiveness of the solution in contact with human tissue.

INHALATION

Inhalation of product vapors, hydrogen sulfide, is very dangerous. Hydrogen sulfide is a colorless gas with a rotten egg odor. The gas has a odor threshold of 0.13 ppm (possibly less). Exposure to low concentrations of the gas may result in the loss of sense of smell, coughing, choking, eye irritation, headache, dizziness, weakness and difficulty in breathing. Continued exposure to low concentrations (100 - 200 ppm) or short term exposure to high concentrations (greater than 700 ppm) can result in unconsciousness, respiratory paralysis and death.

SKIN OR EYE CONTACT

Skin contact with NaHS solutions may cause first degree burns and, depending on solution strength and duration of contact, cause second and third degree burns to the skin. Eye contact with mist or solution may result in pain, sensitivity to light, conjunctivitis (inflammation of the eyelids) and possible severe corneal injury.

INGESTION

Ingestion of NaHS may cause burns to all portions of the gastrointestinal tract. Pain may occur in the throat and abdomen followed by nausea, vomiting and diarrhea. Severe cases may result in collapse, unconsciousness and death due to respiratory paralysis.

FIRST AID

Treatment of personnel exposed to solutions of sodium hydrosulfide begins with the removal of the victim to an uncontaminated atmosphere. Always wear the correct Personal Protective Equipment (PPE) to avoid exposure to other personnel. SCBA gear must be worn when rescuing personnel overcome by exposure to product vapors.

INHALATION

Remove the victim from contaminated atmosphere to fresh air. Wear necessary PPE. If victim's breathing is labored, administer oxygen. If breathing has ceased, clear airway and start CPR. If heart has stopped beating, external heart massage should be applied. Obtain immediate medical attention.

EYE CONTACT

Immediately flush eyes with large quantities of water for 15 minutes. Hold eyelids open during irrigation to insure thorough flushing of the entire eye and lids with water. Obtain immediate medical attention.

SKIN CONTACT

Immediately flush the exposed area with large quantities of water. Remove contaminated clothing under a safety shower. Obtain immediate medical attention.

INGESTION

DO NOT INDUCE VOMITING. If victim is conscious, immediately give two to four glasses of water to dilute ingested material. If vomiting does occur, repeat fluid administration. Obtain immediate medical attention.

FLAMMABILITY

Solutions of sodium hydrosulfide are not flammable. The hydrogen sulfide vapors in the vapor space above the liquid however may be highly flammable. Hydrogen sulfide has a flammable range from 4% by volume in air up to 46%. The H₂S gas is heavier than air and may travel a considerable distance before finding an ignition source and flashing back to its source. Combustion of hydrogen sulfide yields sulfur dioxide, a severe respiratory hazard.

If H₂S vapor is burning above a solution of NaHS, all efforts should be made to eliminate the source of ignition before attempting to put out the hydrogen sulfide fire. Failure to do so could result in a fire flash back from the ignition source.

FIRE RESPONSE

If vessels containing NaHS are involved in a fire, fire fighting personnel should be equipped with SCBA gear because of the potential of hydrogen sulfide and sulfur dioxide vapors and necessary PPE to prevent bodily contact with the solution. Use extinguishing media suitable for the combustible materials involved in the fire. Fire fighting personnel should approach the fire from the upwind direction.

Vessels of sodium hydrosulfide should be kept cool with water spray to preclude the evolution of large quantities of H₂S gas. Be aware that pressurized containers exposed to high heat may rupture from excessive pressure.

STORAGE

For Construction materials See "CONSTRUCTION MATERIALS" Section.

Storage Tanks

Locate storage vessels in open, well ventilated areas away from any combustible materials or potential sources of heat. If storage is in a containment area, the containment area should not include storage of flammable or acidic products. Storage vessels should be pressurized or closed from the atmosphere with tank vapors vented through a sodium hydroxide (caustic) scrubber.

Small containers (drums, pails) should be stored in cool, dry, well ventilated areas out of direct sunlight. Small containers, 55 gallon drums or less, can develop very high hydrogen sulfide vapor pressures if left exposed to direct sunlight for very long. Such exposure can place the drums integrity in question or place personnel opening such drums in a deadly atmosphere as soon as the drum seal is broken. All storage tanks and containers should be electrically grounded during storage and during product loading or unloading.

The freezing point of high strength solutions is quite high (See Appendix C), about 16.7°C (62°F). Where lower temperatures may be encountered, the tanks should be insulated and equipped with a temperature controlled stainless steel steam heater.

Corrosion in mild steel storage vessels occurs more rapidly when the tank is only partially full because the reaction of hydrogen sulfide vapors with moisture will form weak acidic solutions. In the past, this reaction and the suppression of hydrogen sulfide vapors have been controlled by the use of a small layer of diesel fuel on top of the NaHS solution. As the solution level moves up and down, the walls are coated with a thin protective film of diesel. The diesel is somewhat successful at suppressing the H₂S vapors but usually becomes heavily saturated and more diesel must be added. The use of diesel is really only recommended where the storage is on or in conjunction with a refinery which can handle the diesel layer when the tank must be drained and cleaned. Otherwise the diesel layer becomes an expensive disposal problem since it must be disposed of as a combustible waste.

HANDLING

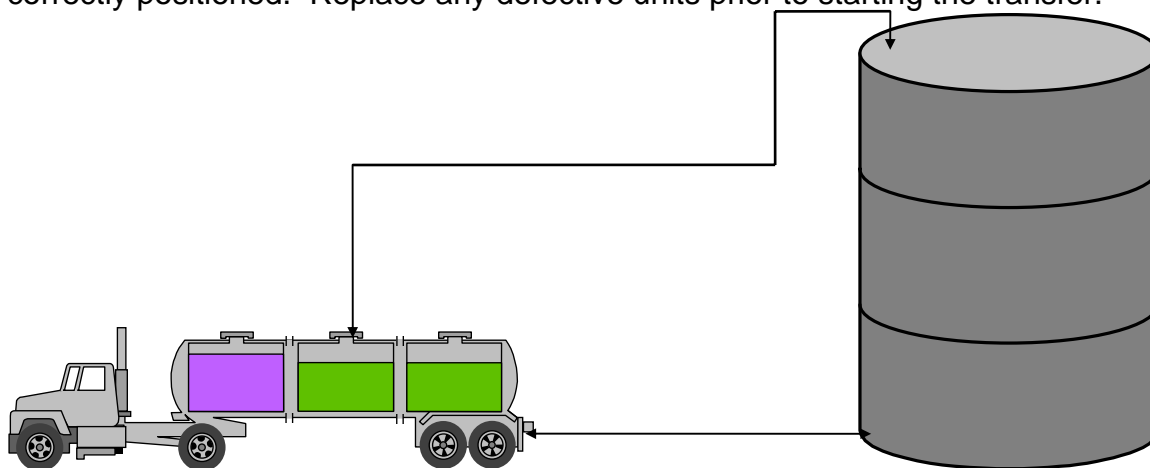
Solutions of NaHS should be handled with two criteria in mind. Avoid any solution contact with the skin and/or eyes. Secondly minimize personal exposure to product vapors (hydrogen sulfide) by avoiding product exposure to heat and/or acids or acidic materials.

PERSONAL PROTECTIVE EQUIPMENT (PPE).

Contact with the skin or eyes can be largely prevented by wearing the correct PPE. For routine handling of small quantities, minimum PPE consists of a neoprene apron, gloves, chemical boots, chemical goggles and full-face shield. When larger quantities are handled or where the likelihood of splashes or releases under pressure may occur (i.e. uncoupling hoses or breaking into pipelines) the apron should be replaced with a complete chemical suit. A self-contained breathing apparatus (SCBA) or airline supplied respirator, with 5 minute escape pack, should be readily available at solution transfer points. If duties require opening the dome of a tank truck or railcar containing NaHS or work is to be performed near an open storage tank cover, an SCBA or airline supplied respirator, with 5 minute escape pack, must be worn to prevent personnel exposure to hydrogen sulfide vapors.

TRANSFERS.

A vapor return system should be used for all bulk solution transfers to prevent releasing hydrogen sulfide vapors to the atmosphere. Hydrogen sulfide vapors are highly flammable and all storage tanks, tank trucks and railcars must be properly grounded before any transfer is started. Carefully inspect all connections (including hoses) which use seals, gaskets or packing to make certain that they are in good condition and correctly positioned. Replace any defective units prior to starting the transfer.



CONSTRUCTION MATERIALS

Copper (including brass and bronze), Zinc (including galvanized materials) and Aluminum or any of their other alloys are not resistant to NaHS solutions. None of these materials of construction should ever be used for storage or anywhere in the product handling system (piping, valves and pumps) where they would come in direct contact with NaHS.

Solutions of NaHS are only slightly corrosive to mild steel at moderate temperatures and in the absence of moist air. Product solutions have been successfully stored in mild steel, stainless steel and lined mild steel storage tanks and drums. Storage tanks of carbon steel, ½ inch thick, should last at least 10 years. Several FRP (fiberglass) tanks are now in service with NaHS and performing well. Consult with tank manufacturers to confirm whether a specific resin is acceptable for NaHS service.

Equipment

SAFETY EQUIPMENT

A safety shower, with eye wash, should be located in the immediate area of transfer points and any other locations where there is a possible exposure to the product.

Valves

The following types of valves will provide good service in NaHS use:

Plug valves with Teflon seats

Ball valves with Teflon seats

Teflon-lined plug or ball valves are also acceptable

For good long term service, 316 stainless steel is recommended for these valves. Brass or bronze valves should not be use in NaHS service.

Piping

Carbon steel piping can be used for most applications. Welded and flanged connections are preferred over threaded connections. Schedule 80 piping is preferred for lines in continuous service. In designs where excessively high pipeline velocities may occur, please consult with Tessengerlo Kerley, Technical service engineers for design restrictions. Buna-n or EPDM gaskets are recommended for flanged fittings.

Protection of lines against low temperature will depend upon location of the line, amount of exposure to low temperatures, and whether or not the line will be self-draining. In cold weather climates, piping in intermittent service should be steam traced and insulated. It is a good practice to equip all lines with a steam connection so that they may be blown out before and after use to insure there are no crystal deposits.

SHIPPING

The Department of Transportation (DOT) has classified sodium hydrosulfide as a corrosive and toxic liquid for commercial shipments. The proper shipping description for all shipments is:

Corrosive liquids, toxic, n.o.s., 8 (6.1), UN2922, PG II (sodium hydrosulphide solution)

The U.S. Coast Guard recognizes a different shipping name for international shipment over water. The proper bulk shipping description is:

Sodium hydrosulfide solution, 8, UN2949, PG II Code: SHR

For barges the USCG Code for NaHS is SSI

The Environmental Protection Agency (EPA) has designated sodium hydrosulfide as a "Hazardous Substance" (40 CFR 302) and assigned it a 5,000 pound "Reportable Quantity" (RQ). All shipments whose individual containers have a quantity of 5,000 pounds or greater (100% basis) of sodium hydrosulfide must add the designation "RQ" to the shipping description on all shipping papers.

PLACARDING & LABELING

Bulk shipments of sodium hydrosulfide will be placarded CORROSIVE.

Non-bulk shipments will be labeled as CORROSIVE and TOXIC.

CONTAINERS

The proper shipping containers which should be used for bulk shipments of NaHS are listed in 49 CFR 173.243

The proper shipping containers which should be used for non-bulk shipments of NaHS are listed in 49 CFR 173.202.

RELEASES

[See 2000 Emergency Response Guidebook (Guide 154) for additional information]

Personnel responding to releases of sodium hydrosulfide must be properly trained in accordance with OSHA's 29 CFR 1910.120(q), "Hazardous Waste Operations and Emergency Response".

Sodium hydrosulfide is a corrosive liquid and may evolve toxic hydrogen sulfide, H₂S, in dangerous concentrations. Restrict access to release area. Keep unprotected personnel upwind of release. Wear the proper personal protective equipment to avoid skin or eye contact with the liquid and inhalation of H₂S vapors. Monitor area for hydrogen sulfide concentration. At H₂S concentrations greater than 10 ppm personnel should leave the area or wear SCBA or airline supplied respirators, with 5 minute escape pack.

In the event of a release non-essential and untrained personnel should be evacuated from the area. Use 2000 Emergency Response Guidebook, Table of Initial Isolation and Protection Action Distances (Green section of book) for hydrogen sulfide (ID # 1053) as a guide for evacuation distances.

NOTIFICATION

An immediate telephone notification to the National Response Center (NRC), (800) 424-8802, is required by 40 CFR 302 if the quantity released equals or exceeds the Reportable Quantity (RQ) for hydrogen sulfide or sodium hydrosulfide. The RQ for sodium hydrosulfide is 5,000 pounds (100% basis) and the RQ for hydrogen sulfide is 100 pounds (100% basis). Telephone notification is also required by Superfund Amendments & Reauthorization Act (SARA), Title III, Section 304, to the affected State Emergency Response Commission and Local Emergency Planning Committee. NaHS produced by this company varies from 20 to 45% in concentration. Reportable quantities for these solutions are shown on the MSDS.

SMALL SPILLS/LEAKS

Absorb with earth, sand, clay, fly ash or other inert commercial sorbents. Apply a spray of dilute hydrogen peroxide (3 - 5%) or weak sodium hypochlorite (bleach) to oxidize any reactive sulfides to sulfates and stop the evolution of hydrogen sulfide. This reaction will also effectively reduce the pH of the solution toward a more neutral solution.

RELEASES (Cont.)

LARGE SPILLS/LEAKS

Contain the release to as small an area as possible by diking with earth, sand or other available materials. Do not allow product into sewers or drains because of the toxicity and flammability of hydrogen sulfide vapors (which may be evolved). Do not allow product to discharge into surface waterways because of potential aquatic toxicity.

If hydrogen sulfide is evolved in undesirable quantities, evacuate non-essential personnel to a safe upwind position (See previous discussion), then use a water spray (not too effective) in a wide-angle, fog or fine mist pattern to help reduce the vapors. Use only sufficient water to minimize vapors without adding significantly to the size of the spill.

Once product is contained, use a pump or vacuum truck and recover as much of the product as possible back into enclosed containers (drums or storage tank). Cover the remaining material with a dilute solution of an oxidizer to oxidize any potential reactive sulfides to environmentally safe sulfates (stops the evolution of H₂S). Hydrogen peroxide (3 - 5%) is a preferred oxidizer or a weak solution of sodium hypochlorite may be used. The effectiveness of the oxidation can be checked with lead acetate strips which are readily available from any commercial laboratory equipment supplier. The lead acetate strips are highly sensitive to sulfides (changing from a light beige to a brown, to a solid black as the concentration of sulfides increases) and provide a quick, non-quantitative indication.

After the oxidation, neutralize with a very dilute, weak acid (i.e. acetic) only if the oxidation did not sufficiently neutralize the spilled solution. Both the oxidizer and acid solution used should be weak solutions because strong solutions will react violently evolving heat and toxic hydrogen sulfide vapors in substantial quantities.

Place contaminated soil in sealed containers and dispose of in a chemical waste landfill in accordance with all governmental regulations.

Disposal Considerations

Sodium hydrosulfide solutions released to the environment exhibit two characteristics which may cause the released material to be classified as a hazardous waste in accordance with 40 CFR 261. Normal solution pH will range from 11.5 to 12.5. Occasionally solutions may exceed 12.5 pH causing the released solution to be classified as a D002, Corrosive Waste.

Released NaHS solutions may contain reactive sulfides. Examination should be made to determine if levels are sufficient to characterize the materials as a D003, Reactive Waste.

Appendix A

Sodium hydrosulfide

Material Safety Data Sheet



TESSENDERLO DAVISON
COMPANIES, LLC

Material Safety Data Sheet

Sodium hydrosulfide solution

MSDS Number 8000TDC (Revised: 7/21/04)

Section 1: CHEMICAL PRODUCT and COMPANY IDENTIFICATION

- 1.1 Product Name** **Sodium hydrosulfide solution**
 Chemical Family Inorganic salt solution
 Synonyms Sodium hydrogen sulfide, sodium sulfhydrate' sodium bisulfide, sodium mercaptan, KI-300
 Formula H-Na-S
- 1.2 Manufacturer** Tessenderlo Davison Companies, LLC
 1916 Farmerville Highway
 Ruston, Louisiana 71270
 Information (318) 242-5305
- 1.3 Emergency Contact** (800) 877-1737
(800) 424-9300 (CHEMTREC)

Section 2: COMPOSITION, INFORMATION ON INGREDIENTS

2.1 Chemical Ingredients (% by wt.)		
Sodium hydrosulfide	CAS #:16721-80-5	20-45%
Sodium sulfide	CAS #: 1313-82-2	<1.0% (Typical)
Sodium carbonate	CAS #: 497-19-8	<3.0% (Typical)
Water	CAS #:7732-18-5	54-79%

(See Section 8 for exposure guidelines)

Section 3: HAZARDS IDENTIFICATION

NFPA: Health - 3 Flammability - 2 Reactivity - 1



Section 3: HAZARDS IDENTIFICATION, Cont.

EMERGENCY OVERVIEW

Warning: Solution is highly alkaline
Contains hydrogen sulfide , a highly toxic gas.
Eye contact will cause marked eye irritation and possibly severe corneal damage.
Skin contact will result in irritation and possible corrosion of the skin. Ingestion will irritate/burn mouth, throat and gastrointestinal tract. Contact with stomach acid will cause hydrogen sulfide vapors to be released. Heating or acid will cause hydrogen sulfide gas to evolve. Dilution of NaHS with water will also cause increased evolution of hydrogen sulfide.

3.1 POTENTIAL HEALTH EFFECTS

EYE: Contact with the eyes will cause marked eye irritation and possibly severe corneal damage.

SKIN CONTACT: Contact with the skin will cause skin irritation or burning sensation. Prolonged contact will result in corrosion of the skin.

SKIN ABSORPTION: Absorption is unlikely to occur.

INGESTION: Ingestion will result in severe burning and corrosion of mouth, throat and the gastrointestinal tract. If the ingested material contacts stomach acid, highly toxic hydrogen sulfide gas will be evolved.

INHALATION: Product solution and vapors contain highly toxic hydrogen sulfide gas. Exposure to this gas causes, headaches, nausea, dizziness and vomiting. Continued exposure can lead to loss of consciousness and death..

CHRONIC EFFECTS/CARCINOGENICITY: Not listed as a carcinogen by NTP, IARC or OSHA.

Section 4: FIRST AID MEASURES

4.1 EYES: Immediately flush with large quantities of water for 15 minutes. Hold eyelids apart during irrigation to insure thorough flushing of the entire area of the eye. Obtain immediate medical attention.

4.2 SKIN: Immediately flush with large quantities of water. Remove contaminated clothing under a safety shower. Obtain immediate medical attention

4.3 INGESTION: DO NOT INDUCE VOMITING. If victim is conscious, immediately give 2 to 4 glasses of water. If vomiting does occur, repeat fluid administration. Obtain immediate medical attention.

4.4 INHALATION: Remove victim from contaminated atmosphere. If breathing is labored, administer oxygen. If breathing has ceased, clear airway and start mouth to mouth resuscitation. If heart has stopped beating, external heart massage should be applied. Obtain immediate medical attention.

Section 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

FLASH POINT: Not flammable

METHOD USED: NA

Section 5: FIRE FIGHTING MEASURES, Cont.

5.2 FLAMMABLE LIMITS Hydrogen sulfide LFL: 4% UFL: 44%

5.3 EXTINGUISHING MEDIA: Water spray or foam or as appropriate for combustibles involved in fire.

5.4 FIRE & EXPLOSIVE HAZARDS: Solution is non-flammable. However if these solutions are exposed to heat or acids, hydrogen sulfide will be released and may form explosive mixtures with air (see above).

Keep containers/storage vessels in fire area cooled with water spray. Heating may cause the release of hydrogen sulfide vapors.

5.5 FIRE FIGHTING EQUIPMENT: Because of the possible presence of toxic gases and the corrosive nature of the product, wear self-contained breathing apparatus, pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Section 6: ACCIDENTAL RELEASE MEASURES

6.1 Small releases: Isolate for 100 feet. Confine area to qualified response personnel. Wear proper Personnel Protective equipment (See Section 8). Confine release material by berming or diverting its path. Absorb on sand, earth or other inert dry absorbent. Do not allow into sewer, storm drains or any waterway. Oxidize residual reactive sulfides with a weak (3-5%) hydrogen peroxide solution to stop the release of toxic hydrogen sulfide. Remove contaminated soil and dispose of in accordance with all governmental regulations.

6.2 Large releases: Activate Emergency Response Plan procedures. Isolate release area for 700 feet. Confine area to qualified response personnel. Wear proper Personnel Protective Equipment (See Section 8). Shut off release, if safe to do so. Dike spill area to prevent runoff into sewers, drains (potential toxic and explosive mixtures of hydrogen sulfide in confined spaces) or surface waterways (potential aquatic toxicity). Recover as much of the solution as possible. Treat remaining material as a small release (above).

Section 7: HANDLING and STORAGE

7.1 Handling: Wear proper protective equipment (See Section 8). Avoid breathing product vapors. Avoid contact with skin and eyes. Use only in a well ventilated area. Dilute product only in enclosed containers. Wash thoroughly after handling.

7.2 Storage: Store in well ventilated areas. Do not store combustibles in the area of storage vessels. Keep away from any sources of heat or flame. Store tote and smaller containers out of direct sunlight at moderate temperatures [$<80^{\circ}$ F (27° C)]. (See Section 10.4 for materials of construction)

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

8.1 RESPIRATORY PROTECTION: If working near open container, storage vessel opening or open tank truck dome cover, wear self-contained breathing apparatus, pressure demand, MSHA/NIOSH (approved or equivalent).

8.2 SKIN PROTECTION: Neoprene rubber gloves, chemical suit and boots should be worn to prevent contact with the liquid. Wash contaminated clothing prior to reuse. Contaminated leather shoes cannot be cleaned and should be discarded.

8.3 EYE PROTECTION: Chemical goggles and a full face shield.

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION, Cont.

8.4 EXPOSURE GUIDELINES:

	OSHA		ACGIH	
	TWA	STEL	TLV	STEL
Hydrogen sulfide	20 ppm (ceiling)		10 ppm (ceiling)	

8.5 ENGINEERING CONTROLS: Use adequate exhaust ventilation to prevent inhalation of product vapors. Where feasible scrub process or storage vessel vapors with caustic solution. Maintain eyewash/safety shower in areas where chemical is handled.

Section 9: PHYSICAL and CHEMICAL PROPERTIES

- 9.1 APPEARANCE:** May be yellow to red, to dark green to black liquid.
- 9.2 ODOR:** Hydrogen sulfide (rotten egg), hydrocarbon (mercaptan) odor.
- 9.3 BOILING POINT:** 253 °F(122.8 °C) - 269 °F (131.7 °C)
- 9.4 VAPOR PRESSURE:** 17 mm Hg @ 68 °F (20 °C)
- 9.5 VAPOR DENSITY: (Air = 1.0)** 1.17
- 9.6 SOLUBILITY IN WATER:** Complete
- 9.7 SPECIFIC GRAVITY:** 1.152 - 1.303 (9.6 - 10.9 lbs/gal)
- 9.8 FREEZING POINT:** 0° F (-17.8° C) - 20%
56° F (13.3° C) - 45%
- 9.9 pH:** 11.5 - 12.5
- 9.10 VOLATILE:** Not determined

Section 10: STABILITY and REACTIVITY

10.1 STABILITY: This is a stable material

10.2 HAZARDOUS POLYMERIZATION: Will not occur.

10.3 HAZARDOUS DECOMPOSITION PRODUCTS: Heating this product will evolve hydrogen sulfide. Fire conditions will also cause the production of sulfur dioxide. Hydrogen sulfide (4-44%) may form flammable mixtures with air. Heating to decomposition emits toxic fumes of sulfoxides and Na₂O

10.4 INCOMPATIBILITY: Acids will cause the release of highly toxic hydrogen sulfide. Reacts violently with diazonium salts. Sodium hydrosulfide solution is not compatible with copper, zinc, aluminum or their alloys (i.e. bronze, brass, galvanized metals, etc.). Corrosive to steel above 150° F (65.5° C). These materials of construction should not be used in handling systems or storage containers for this product (SEE Section 7.2, Storage). Dilution of NaHS with water will increase the evolution of hydrogen sulfide. Dilution should be done in an enclosed container.

Section 11: TOXICOLOGICAL INFORMATION

11.1 ORAL: Data not available

11.2 DERMAL: Data not available

Section 11: TOXICOLOGICAL INFORMATION, Cont.

11.3 INHALATION: INH-RAT LC₅₀: 444 ppm (hydrogen sulfide)
INH-MOUSE LC₅₀: 1,500 mg/m³ 18 minutes
INH-RAT LC₅₀: 1,500 mg/m³ 14 minutes

11.4 CHRONIC/CARCINOGENICITY: No evidence available

11.5 TERATOLOGY: Data not available

11.6 REPRODUCTION: Data not available

11.7 MUTAGENICITY: Data not available

Section 12: ECOLOGICAL INFORMATION

Static acute 96 hour-LC₅₀ for mosquito fish is 206 mg/L. (Tl_m - fresh water)
LC₅₀ fly inhalation 1,500 mg/m³, 7 minutes
TL_m Gammarus 0.84 mg/L, 96 hours (hydrogen sulfide)
TL_m Ephemera 0.316 mg/L, 96 hours (hydrogen sulfide)
TL_m Flathead minnow 0.071 – 0.55 mg/L @ 6-24°C, 96 hour flow through bioassay (hydrogen sulfide)
TL_m Bluegill 0.0090 – 0.0140 mg/L @ 20-22°C, 96 hour flow through bioassay (hydrogen sulfide)
TL_m Brook trout 0.0216 – 0.0308 mg/L @ 8-12.5°C, 96 hour flow through bioassay (hydrogen sulfide)

Section 13: DISPOSAL CONSIDERATIONS

If released to the environment for other than its intended purpose, this product contains some reactive sulfides which may be in sufficient quantity to meet the definition of a D003, hazardous waste.

Section 14: TRANSPORT INFORMATION

14.1 DOT Shipping Name: Corrosive liquids, toxic, n.o.s.
14.2 DOT Hazard Class: 8
14.3 UN/NA Number: UN2922 UN2949 (IMDG - over water)
14.4 Packing Group: II
14.5 DOT Placard: Corrosive
14.6 DOT Label(s): Corrosive, Toxic
14.7 IMO Shipping Name: Sodium hydrosulphide solution
14.8 RQ (Reportable Quantity): 5,000 lbs (2268 Kg) 100% basis
[2,604 gal (20%) 1,019 gal (45%)]

Section	14: TRANSPORT INFORMATION, Cont
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14.9 RR STCC Number: 28-123-33/49-352-04

14.10 USCG Codes: Bulk SHR (sodium hydrosulfide solution)
 Barge SSI (Sodium sulfide, hydrosulfide solutions, H₂S greater than 15 ppm but less than 200 ppm)

Section	15: REGULATORY INFORMATION
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15.1 OSHA: This product is listed as a hazardous material under criteria of the Federal OSHA Hazard Communication Standard, 29 CFR 1910.1200.

15.2 SARA TITLE III:

a.	EHS (Extremely Hazardous Substance) List:	No
b.	Section 311/312, (Tier I,II) Categories:	Immediate (acute) Yes
	Fire	Yes
	Sudden release	No
	Reactivity	Yes
	Delayed (chronic)	No
c.	Section 313 (Toxic Release Report-Form R):	No
d.	TPQ (Threshold Planning Quantity):	No

15.3 CERCLA/SUPERFUND: RQ (Reportable Quantity) 5,000 lbs (2270 Kg)

15.4 TSCA (Toxic Substance Control Act) Inventory List: Yes

15.5 RCRA (Resource Conservation and Recovery Act) Status: D003 (See Section 13)

15.6 WHMIS (Canada) Hazard Classification: E, D1

15.7 DOT Hazardous Material: (See Section 14) Yes

15.8 CAA Hazardous Air Pollutant (HAP) No

Section	16: OTHER INFORMATION
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REVISIONS: The entire MSDS was reformatted to comply to ANSI Standard Z400.1-1993.

- Revised Sections 1.1, 8.3, 11, 12, 5/7/02
- Revised pH range in Section 8, 6/19/02
- Revised shipping info & RQ data, 1/15/03
- Revised Section 3, Emergency Overview & Section 10.4 to include dilution caution. 1/23/04
- Revised Section 2.1, Ingredients & Section 15, added USCG Codes. 5/3/04
- Revised Section 14.10 (added), 15.9 (deleted), USCG shipping codes, 7/21/04.

THE INFORMATION PUBLISHED IN THIS MATERIAL SAFETY DATA SHEET HAS BEEN COMPILED FROM OUR EXPERIENCE AND OSHA, ANSI, NFPA, DOT, ERG, AND CHRIS. IT IS THE USER'S RESPONSIBILITY TO DETERMINE THE SUITABILITY OF THIS INFORMATION FOR THE ADOPTION OF NECESSARY SAFETY PRECAUTIONS. WE RESERVE THE RIGHT TO REVISE MATERIAL SAFETY DATA SHEETS PERIODICALLY AS NEW INFORMATION BECOMES AVAILABLE.

Appendix B

Hydrogen Sulfide

Toxicity Chart

ATTACHMENT B

Toxicity of Hydrogen Sulfide

PPM **	0 - 2 Minutes	2 - 15 Minutes	15 - 38 Minutes	38 Minutes to Hours	1 - 4 Hours	4 - 8 Hours	8 – 48 Hours
20 - 100				Mild conjunctivitis, respiratory tract irritation	Symptoms worsen, fatigue, headache	Symptoms worsen	
100 - 150		Coughing, Irritation of eyes, loss of sense of smell	Disturbed respiration, pain in eyes, sleepiness	Throat irritation	Salivation and mucous disch, sharp pain in eyes, coughing	Increased symptoms	Death
150 - 200		Loss of sense of smell	Throat and eye irritation	Throat and eye irritation	Difficult, blurred vision, light shy	Death	
200 – 350	Irritation of eyes, loss of sense of smell	Irritation of eyes	Painful secretion of tears, weariness	Light shy, nasal catarrin, pain in eyes, difficult breathing	Suffocate, poison in blood, Death		
350 – 450	Loss of sense of smell	Irritation of eyes, dizziness	Difficult breathing, coughing, eye irritation, fatigue, nausea	Death			
450 - 700	Respiratory disturbances, irritation of eyes, collapse, unconsciousness	Coughing, collapse, unconsciousness, Death	Palpitation of the heart, Death				
Over 700	Collapse, Unconsciousness, Death						

** ppm, parts per million by volume; different levels of exposure, and not regulatory values.

Susceptibility varies between individuals

Appendix C

Freezing Points of

Sodium hydrosulfide solutions

Last Crystal Point: The temperature at which
The last crystal dissolves
Into solution on warming.

Crystallization Point: The temperature at which
The first crystals appear
Upon cooling.

Freezing Point: The temperature at which
The solution crystallizes to
a mush on cooling.

The Freezing Points of Sodium Hydrosulfide

Last Crystal Point

%NaHS	20	33.0	34.9	37.7	40.0	42.8	45.0	47.0	49.1	51.3
T, °F(°C)	-44.7(-42.6)	38.7(3.7)	50 (10)	68 (20)	86 (30)	104 (40)	122 (50)	140 (60)	158 (70)	176 (89)

%NaHS	53.6
T, °F(°C)	194 (90)

Crystal Point

% NaHS	20	38	41.3	43.2	45.1	46.8	48.2	49.3
T, °F(°C)	3.7 (-15.7)	46.4 (8)	59. (15)	68(20)	77 (25)	86 (30)	95 (35)	104 (40)

Freezing Point

% NaHS	20	30	40.0	42.3	44.2	46.1	50	52.4	59.4
T, °F (°C)	-50 (-45.5)	-1.1 (-18.4)	39.2(4.0)	50 (10)	59.0(15)	68 (20)	86.0 930)	95 (35)	104(40)

% NaHS	62.1
T, °F (°C)	104.1(40.1)

Data in these charts are taken from a Stauffer Chemical Company handbook on Sodium Hydrosulfide. The results were obtained utilizing high purity NaHS. Your results may vary if there are impurities in the NaHS. The shaded areas of the chart represent extrapolation results obtained from extending the previous experimental data and may in no way represent results obtained from actual experimental data

Appendix D

Viscosity of

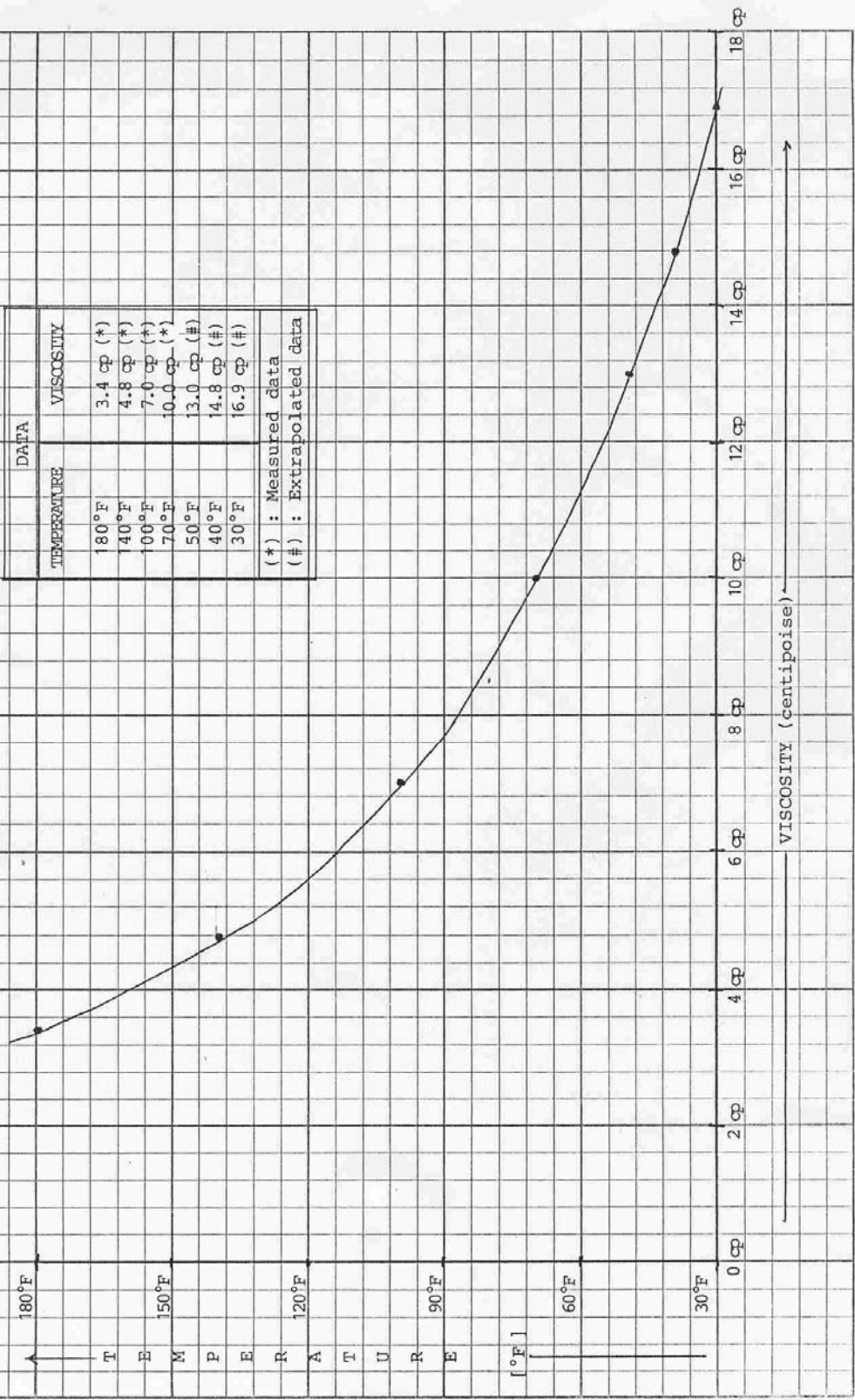
A Typical 45%

Sodium hydrosulfide solutions

VISCOSITY-VS-TEMPERATURE FOR A 45% SODIUM HYDROSULFIDE (NaHS) SOLUTION

DATA	
TEMPERATURE	VISCOSITY
180°F	3.4 cp (*)
140°F	4.8 cp (*)
100°F	7.0 cp (*)
70°F	10.0 cp (*)
50°F	13.0 cp (#)
40°F	14.8 cp (#)
30°F	16.9 cp (#)

(*) : Measured data
 (#) : Extrapolated data



Data is based on a typical NaHS solution. Results may vary based on any contaminants in NaHS sample used.