

SUBSTANCE SPECIFIC

HYDROGEN SULPHIDE (H₂S)**What is Hydrogen Sulphide**

Hydrogen sulphide is a colorless, flammable, extremely hazardous gas with a “rotten egg” smell. Some common names for the gas include sewer gas, stink damp, swamp gas and manure gas.

Where is it Found

It occurs naturally in crude petroleum, natural gas, and hot springs. In addition, hydrogen sulphide is produced by bacterial breakdown of organic materials and human and animal wastes (e.g., sewage). Activities that can produce the gas include petroleum/natural gas drilling and refining, well treatment and wastewater treatment. Hydrogen sulphide can also be produced as a by-product during the treatment of wells with mineral acids.

The Risks**Health Effects**

Hydrogen sulphide is both an irritant (a material that causes redness and swelling) and a chemical asphyxiate (a material that prevents oxygen from getting to the brain). Its health effects can vary depending on the concentration in air and length of exposure. Low concentrations irritate the eyes, nose, throat and lungs (e.g., burning/tearing of eyes, cough and shortness of breath). People with asthma may experience breathing difficulties. The effects can be delayed for several hours, or sometimes several days, when working in low-level concentrations. Repeated or longer exposures may cause eye redness, headache, a feeling of tiredness, irritability, inability to sleep, upset stomach and weight loss. Moderate concentrations can cause more severe eye and lung irritation (including coughing, difficulty breathing, and build-up of fluid in the lungs), headache, dizziness, nausea, vomiting, staggering and excitability. High concentrations can cause shock, seizures or spasms, inability to breathe, extremely rapid unconsciousness, coma and death. Effects can occur within a few breaths, and possibly a single breath.

Primary Routes of Exposure

The main way it enters the body is when it is inhaled with air into the lungs. Absorption through the skin is minimal. People can smell the “rotten egg” odour of hydrogen sulphide at low concentrations in air. However, with continuous low-level exposure, or at high concentrations, a person loses his/her ability to smell the gas even though it is still present (olfactory fatigue).

Actions**Steps to Evaluate Risk**

The risk to worker health increases with length of time exposed to H₂S, the concentration in air, and the amount of worker contact with production fluids (e.g., crude oil and natural gas) containing the chemical. It is important to know how much H₂S is present before you begin work. This information can usually be estimated from information found on the Safety Data Sheet and from previous chemical analysis done of gas and crudes from the same production field or area. Appendix A provides a list of common oilfield “H₂S Critical Tasks” and guidance on when respiratory protection and gas monitoring equipment should be used.

Before entering areas where hydrogen sulphide may be present:

1. Air must be tested for the presence and concentration of hydrogen sulphide by a qualified person using air monitoring equipment, such as hydrogen sulphide detector tubes or a multi-gas meter that detects the gas.

Testing should also include lower explosive limit (LEL) measurements and fire/explosion precautions as necessary.

2. If the gas is present, the space/area must be ventilated continually to remove the gas.
3. If the gas cannot be removed, the person entering the space/area must use appropriate respiratory protection and any other necessary personal protective equipment, rescue and communication equipment.

The Controlling Chemical Hazards Guideline is designed to help you use this basic information to define the procedures and control approaches you need to follow to protect worker health and safety. Go to www.enform.ca to gain assistance with controlling H₂S exposures for your specific operation.

Procedures

- » Whenever possible, enclose operations (e.g., mixing and storage) as much as possible and ensure the equipment is vapor-tight.
- » Can you reduce the need for people to be there by using automated systems to monitor the process?
- » Can you time certain operations (e.g., maintenance) for a time when less people will be present?

Control Approaches

In order of preference there are four basic hazard control approaches: elimination/substitution; engineering controls (e.g., enclosing/containing the material or ventilation); administrative controls (e.g., safe work procedures); and personal protective equipment (GS Respiratory Protective Equipment and GS PPE). All or just some of the approaches may be required to control worker exposure to hydrogen sulphide. You need to evaluate the specific risks associated with the work you wish to complete and to develop specific a Safety Protocol for Chemical Management based on this risk assessment. (GS General Guidance)

If you are required to enter an area with more than 10 ppm H₂S use:

- » a full face piece pressure demand self-contained breathing apparatus(SCBA) with a minimum service life of thirty minutes, or
- » a combination full face piece pressure demand supplied-air respirator with an auxiliary self-contained air supply (SABA).
- » Workers in areas containing hydrogen sulphide must be monitored for signs of overexposure. (GS H₂S Gas Monitors)
- » Workers using respiratory protection for H₂S may still be at risk of a flash fire or explosion and as such lower explosive limit (LEL) measurements are required
- » NEVER attempt a rescue in an area that may contain hydrogen sulphide without using appropriate respiratory protection and without being trained to perform such a rescue.
- » Backup personnel are required when entering an area with greater than 100 ppm H₂S. Backup personnel should be fully trained in rescue.

Facilities

Provide clean facilities: a washroom, showers, storage for clean and contaminated work clothing and a refreshment area.

Information Training and Supervision

Employer responsibilities:

- » Providing information on the hydrogen sulfide containing materials that will be present at the workplace (e.g., Safety Data Sheets, previous analysis of fluids from the same or similar production fields)
- » Using the Controlling Chemical Hazards Guideline to define the required chemical management for the work you wish completed.

Supervisor responsibilities:

- » Ensuring the availability of the required Guidance Sheets for chemical management.
- » Organizing the work to limit the time workers are exposed to hydrogen sulfide.
- » Educating workers about the hazards of and on hydrogen sulfide through completion of H₂S Alive training.
- » Providing backup personnel that have both of H₂S Alive training and training in local emergency response and rescue personnel if entry into atmospheres with more than 100 ppm.
- » Providing required respiratory protective and gas monitoring equipment

Worker responsibilities:

- » Workers must participate in training and monitoring programs in the workplace
- » Workers must use and maintain all controls and equipment used to reduce exposure properly
- » Workers must use respiratory protective and gas monitoring equipment if required.

PRECAUTIONS YOU SHOULD TAKE

- Ask your employer about the risks.
- What precautions to take and what to do in an emergency.
- Follow the safe working procedures laid down by your employer.
- Keep your H₂S Alive Training current.
- Use the gas monitoring equipment and personal protective equipment provided, e.g., respiratory protection and H₂S monitors.
- Don't enter any area that may contain H₂S before it has been tested.
- Report to your employer or safety representative any damaged or defective ventilation systems or protective equipment.

Appendix A: Examples of Critical H₂S Tasks

The following table should be used as a guide to operations where high hydrogen sulfide exposures may be expected. However, it is not comprehensive. A risk assessment of the work operation should be performed, taking into account the following:

- » H₂S content of the process stream;
- » previous exposure monitoring results;
- » operation factors (e.g., purging, degassing, temperature/pressure of process stream), and;
- » ventilation.

Task	H ₂ S Monitors Required	SCBA/SABA Required
Any task where a risk assessment has determined that hazardous H ₂ S concentrations may be present	yes	yes
Any time when H ₂ S concentration in the air is known or suspected to be >10 ppm	yes	yes
Any time there is an indication of equipment failure or product leak	yes	yes
Entering a confined space where H ₂ S may be present or contains sour liquids	yes	yes
Entering caissons, sewer, deep excavations or other low-lying areas where H ₂ S may be present	yes	yes
Routine operation of sewage-treatment facilities	Yes	no
Responding to H ₂ S alarms	yes	yes
Entering buildings with H ₂ S alarms/beacons activated	yes	yes
Well maintenance (valve, pump jack servicing, etc.)	yes	no
Pigging	yes	yes
Breaking equipment integrity or when > 10 ppm H ₂ S in air	yes	yes
Maintenance on equipment without breaking integrity	yes	no
Filter changes	yes	yes
Entering compressor basements	yes	yes
Responding to H ₂ S alarms	yes	yes
Sampling with open containers	yes	yes
Sampling with closed containers	yes	no
Gauging tanks	yes	yes
Maintenance on purged equipment	yes	no
Entering dikes/fire walls	yes	no
Routine operations	yes	no
General trucking sour fluids	yes	no
Uncoupling lines containing sour products	yes	yes
Sulphur truck loading with degassing	yes	no
without degassing	yes	yes
Sulphur rail car loading	yes	yes