

HYDROGEN SULFIDE & SOUR CRUDE OIL

"HAZARD TO LIFE A POTENTIAL KILLER"

The primary and essential difference between regular crude oil and "sour" crude oil is the presence of a gas known as hydrogen sulfide (H₂S).

In very low concentrations, less than 1 part of gas in a million parts of air (<1 ppm), it has a characteristic odor like that of rotten eggs. In high concentrations, it has other important characteristics.

1. **Hydrogen sulfide is extremely toxic.** A major factor in its toxicity is its ability to fatigue the sense of smell. H₂S loses the typical rotten eggs odor when the concentration rises, and exposed workers may not be aware of increased gas concentrations. Exposure to concentrations above 600 ppm can be rapidly fatal.
2. **It causes extreme corrosion.** Corrosion of pipes, valves and fittings can cause a breakdown of gas and oil gathering systems and be a serious threat to employees and the public.
3. **The gas is flammable and forms explosive mixtures** in a range of 4.3% to 45.5% by volume in air.

The following information deals primarily with the toxicity of H₂S. Dismayed by a number of deaths resulting from hydrogen sulfide, the seriousness of the hazard can be explained in the following way:

1. "The toxicity and **rapidity of death** from exposure to hydrogen sulfide approaches that of hydrogen cyanide.

Cyanides have had better 'press' coverages than the sulfides. If states had exacted the death penalty by the use of hydrogen sulfide rather than hydrogen cyanide, we might have greater respect for the hydrogen sulfide hazard."

2. "Exposure to hydrogen sulfide rapidly produces **olfactory fatigue!**

Stated more simply, it puts your nose 'out of business'. From then on, odor is no longer an indicator of the hazard and gas concentrations may increase to a hazardous level with no detectable change. The exposed individual loses the ability to gauge exposure.

In one plant where hydrogen sulfide was released from a chemical operation, the operator was asked about the gas and his response was: "Oh, do you smell hydrogen sulfide? I noticed it when I started this morning but thought it had stopped because I haven't smelled it for some time."

3. "Comparing the effects of hydrogen sulfide to the effects of ethyl alcohol (the active ingredient in bourbon, scotch, gin, beer, etc.):

If you inhale ethyl alcohol vapors in a concentration of 1000 ppm (0.1% by volume) for eight hours, you may get drunk. If you inhale hydrogen sulfide in a concentration of 1000 ppm (0.1% by volume) for only a few seconds, you will be dead."

You may ask, "**Has this gas killed people and under what circumstances?**" Read on--

- ** Two employees of a fertilizer company in Riga, Michigan, were assigned to install a new float valve in an old 35-foot deep cistern for a new 300-foot well. This cistern was covered with a concrete slab with entry through a covered manhole. The first worker entered the cistern and as he reached a plank platform six feet below the opening, he was instantly overcome and fell unconscious into the water below. The man on the surface immediately ran to the nearby plant for help. Several workmen responded and two of them entered the cistern to render aid. They met the fate of the first worker. A passerby who had been drawn to the scene by the crowd which had gathered was told by an excited bystander that several men in the cistern were drowning. Upon hearing this, he shouted, "I can swim, I can swim" and pulled away from a company employee who was trying to restrain him. Now there were four bodies in the well.

Shortly afterward the fire department arrived at the scene with proper rescue equipment. The fire chief entered the cistern wearing a self-contained breathing apparatus. After reaching the plank platform, he removed his face mask to shout instructions to those on the surface and he, too, was instantly overcome. All five persons died in the cistern.

Tests of the cistern atmosphere revealed that H₂S in a concentration of about 1000 parts per million was present when the five deaths occurred. The water pumped up from the deep well contained dissolved hydrogen sulfide which was released in the unventilated cistern.

- ** In the construction of a water intake in Wayne County, an electrician descended to the bottom of a 52-foot deep shaft where he was overcome by hydrogen sulfide being released from water seeping into the tunnel. Although the presence of hydrogen sulfide was known and ventilation was usually provided, at the time of the worker's entry the ventilation was not operating and no gas tests were made. Three workers who attempted rescue efforts also collapsed at the bottom of the shaft. Fortunately, there was an ample supply of compressed air available and air hoses were dropped into the shaft to provide dilution air. A muck bucket was lowered by crane and the unconscious workers were returned to the surface. The three rescuers recovered but the first worker died of exposure to H₂S.

- ** For incidents relating to sour crude oil, perhaps the earliest reported occurred at Poza Rica, Mexico. Twenty-two persons died and 320 were hospitalized as a result of exposure to hydrogen sulfide which was released into the atmosphere within a 20-minute period. The source of the gas appeared to be a malfunctioning flare intended to burn off excess gas from a sulfur recovery plant. The symptoms of the affected people (loss of smell, severe headache, nausea and unconsciousness) relate primarily to exposure to H₂S.

The gas coming into the plant contained 3.14% (31,400 ppm) hydrogen sulfide and 15% carbon dioxide. The gas piped to the flare contained 81% carbon dioxide, 16% hydrogen sulfide and 3% hydrocarbons and water.

- ** Nine persons, including an oil company employee summoned by a call for help, were killed by gases leaking from an unattended carbon dioxide injection system designed to extract oil from a west Texas well. Eight of the victims were in a house 100 yards from the well. A spokesman for the Texas Department of Public Safety said that the gases were hydrogen sulfide and carbon dioxide. H₂S was blamed for the deaths.

** Two Otter Lake, Michigan, village employees drove a tank truck to a sour oil well tank farm to obtain waste brine. When they failed to get a flow of brine from a ground level connection just outside the tank farm dike, they proceeded to the brine tank. One employee went to the top of the tank which was 13 feet above the ground. At this point he yelled a warning and was instantly overcome by escaping hydrogen sulfide-rich gas. He was later found dead on the platform beside the top of the tank. The other worker waiting near the top of the stairs was overcome and collapsed before he could retreat. Fortunately, he fell down the stairway out of the area of contamination and regained consciousness. The hatch that had been opened was upwind of the access platform and about two feet above it.

In reviewing the cases related above, the following is clear:

1. Hydrogen sulfide is a deadly gas. It can kill without warning.
2. Deaths have occurred in operations related to sour crude oil.
3. Deaths have occurred from H₂S exposures in open air locations as well as confined places. You must abide by applicable health and safety rules in these situations.

This bulletin is intended as a source of general public information and may not contain all of the details pertinent to specific hazard identification and/or control of personal exposure. For further information, consult MIOSHA, Consultation Education and Training Division, 7150 Harris Drive, P.O. Box 30643, Lansing, Michigan 48909-8143. Telephone: (517) 322-1809.