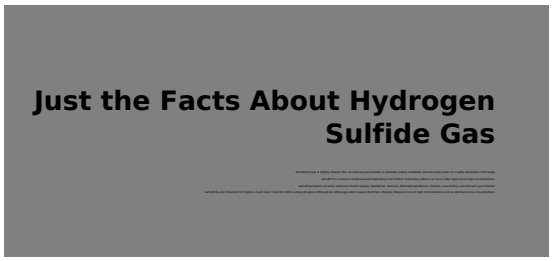
Safeguarding Workers Against H 2 S Gas with Detection Monitoring SystemsWith DetectionMonitoring Systems

The rotten-egg smell of hydrogen sulfide gas should never be underestimated. Here's advice on dealing with conditions that can lead to dangerous exposure as well as a review of features offered by today's gas detection devices

By Shankar Baliga



Almost everyone has experienced that unpleasant rotten egg smell that comes from hydrogen sulfide (H_2S) gas, but it is generally not a serious health problem when we're traveling past a dairy, poultry farm, or wastewater treatment plant. The exposure level is low and brief, but it should never be ignored because it can be fatal.

The same cannot always be said about H_2S gas accidents within the workplace. Exposure to high levels of H_2S gas for even a brief time can be fatal. And most people don't realize that H_2S is also combustible, capable of causing major explosions and fires. It is never to be underestimated in its potential for harm in the workplace.

H_2S is produced naturally by decaying organic matter and is released from sewage sludge, liquid manure, sulfur hot springs, and natural gas. It is a byproduct of many industrial processes including petroleum refining, tanning, mining, wood pulp processing, rayon manufacturing, sugar beet processing, and hot asphalt paving. It's also used to produce elemental sulfur, sulfuric acid, and heavy water for nuclear reactors.

H_2S is a colorless, flammable, highly toxic gas. It is shipped as a liquefied compressed gas. It has a very noticeable rotten-egg odor. Inhalation is the major route of H_2S exposure and can be deadly in high concentrations.

Various agencies of the U.S. government have set the following H_2S exposure standards:

OSHA Permissible Exposure Limit or PEL = 20 ppm if no other exposure occurs in an eight-hour work shift

NIOSH Recommended Exposure Limit or REL = 10 ppm for 10 minutes

NIOSH Immediately Dangerous to Life or Health or IDLH = 100 ppm AIHA Emergency Response Planning Guideline or ERPG-2 = 30 ppm (This is the maximum airborne concentration below which it's believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.)

According to the Agency for Toxic Substances & Disease Registry, H_2S gas is rapidly absorbed in the lungs. It's slightly heavier than air and may accumulate in enclosed, poorly ventilated, and low-lying areas.

The odor threshold (0.5 ppb) is much lower than the OSHA ceiling (20 ppm). Although its strong odor is readily identified, olfactory fatigue occurs at high concentrations and at continuous low concentrations. For this reason, odor is not a reliable indicator of H_2S's presence and may not provide adequate warning of hazardous concentrations.

H_2S is a mucous membrane and respiratory tract irritant; pulmonary edema, which may be immediate or delayed, can occur after exposure to high concentrations. Symptoms of acute exposure include nausea, headaches, delirium, disturbed equilibrium, tremors, convulsions, and skin and eye irritation. Persons exposed to H_2S pose no serious risks of secondary contamination to personnel outside the exposed area.

In petrochemical plants, oil/gas production, and wastewater treatment facilities, there is the potential for H_2S accidents. Some common problem areas and gas monitoring applications include the following:

H_2S Sludge De-Watering: Sludge from waste treatment facilities may contain H_2S and methane gas. The sludge is transported through a spiral conveyor into the dewatering system, where water is removed.

Crude Oil Tank Storage: Storage tank farms for crude oil and H_2S require continuous monitoring for gas leaks. In addition to the tanks, common leak sources include pipes and valves, which require monitoring sensors.

Remote Oil/Gas Well Sites: Remote automated oil/gas well production sites require protection against H_2S gas leaks in and around the site. Common monitoring locations include the well heads, flare stacks, and storage tanks.

Oil/Gas Drilling Sites: Leaks, such as blowouts in oil drilling applications, release

large quantities of H_2S gas into areas around the site. Typical gas monitoring locations include the driller stand, bell nipple, shale shaker, and mud tank.

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To prevent H_2S accidents, it is critical to audit processes and facilities for H_2S gas hazards. This includes reviewing gas detectors and monitors in place to make sure they continue to provide the protection necessary. Facility expansions, upgrades, and retrofits all have the potential to introduce new hazards or reduce the effectiveness of gas monitoring equipment that is already in place.

There are two primary sensor technologies used in the detection of H_2S gas: thin film metal-oxide semiconductor (MOS) and electrochemical cell. Depending on the application, the potential safety threat, and reliability required, they are both generally good choices.

MOS-based H_2S sensors are derived from semiconductor technology. The MOS film is deposited onto a substrate between two electrodes. With no gas present, the resistance between the two electrodes is very high. As gas comes into contact with the sensor, the resistance decreases and indicates the presence of the gas.

Electrochemical cell H_2S sensors are designed with a sensing electrode, a counter electrode, and a reference electrode separated by an electrolyte reservoir. Gas contacting the sensor diffuses through a capillary diffusion barrier, which controls the amount of gas entering the sensor. In an electrochemical cell, the gas reacts at the surface of the sensing electrode by either oxidation or reduction. Reactions are catalyzed by electrodes matching the specific gas.

When selecting a gas detector, whether for toxic or combustible gas hazards, the two most important criteria are performance and reliability. The detector must be designed to detect H_2S gas, and the typical detection range for the gas is 0-100 ppm. When considering the detector's reliability, find out if the design is robust enough for the environment in which it will be placed. Be sure to determine if the device features major industry approvals such as FM, CSA, UL, ULC, and CE Marking, and ATEX if your plant is located in the European market.

The importance of reliability goes hand in hand with the need to review plant environmental conditions. Be sure to consider temperature extremes, humidity, dust, etc. Depending on where the gas detector is located, maintenance can be a concern. It's crucial to read the manufacturer's product manual to check the installation and recalibration requirements for the maintenance of the detector. Sensor life is also not infinite: MOS and electrochemical sensors require periodic replacement to operate properly, and the times vary from manufacturer to manufacturer.

In conclusion, you can help prevent dangerous H_2S gas accidents by reviewing potential H_2S hazards within your facility, developing a safety monitoring plan, installing and maintaining the proper equipment, and training employees. H_2S deserves respect and caution because at its worst it can be a killer.

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