Hydrogen and Hydrogen Sulfide Gases

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HYDROGEN AND HYDROGEN SULFIDE GASES

Over the last few decades, paper mills in response to environmental and economic pressures have begun to close up their water systems and move toward zero effluent discharge. Closing a mill's water system can lead to changes in a mill's water chemistry, including a build up of nutrients which can increase the amount of microbes in a mill's system. In the absence of oxygen such as in tanks, chests, and pipes, anaerobic bacteria can thrive.

When certain types of anaerobic bacteria break down the organic material found in a mill, hydrogen sulfide and hydrogen gases can be formed and released. One group of anaerobic bacteria, sulfate-reducing bacteria or SRB, produce hydrogen sulfide gas as a byproduct of their metabolic process. Other anaerobic bacteria, including clostridia, produce hydrogen gas as a byproduct of their metabolic processes.

Both these gases if present in sufficient amounts can be a safety concern in a paper mill. Monitoring for these gases can help detect harmful levels of the gases before incident occurs.

HYDROGEN SULFIDE GAS

Hydrogen sulfide, H_2S is a colorless, toxic gas, which at low concentrations has a strong odor that smells like rotten eggs. Hydrogen sulfide is heavier than air and will collect in depressions in the ground and in confined spaces. However higher than permissible levels of the gas have been reported in the area above open chests and drains. The release of high levels of gas can occur when stagnant pulp is disturbed releasing gas that may have been entrapped underneath a crust of stock. This may also occur when a chest that has been run at high levels for several days is drained and pulled into the process.

Hydrogen sulfide gas can be detected by smell at levels as low as 10 parts per billion (ppb). At levels of 50-100 parts per million (ppm), the sense of smell begins to break down. At 100 ppm, coughing, eye irritation and loss of sense of smell occur after 2-15 minutes of exposure. At 200-300 ppm, marked conjunctivitis and respiratory tract irritation occur after 1 hour of exposure. At 500-700 ppm, loss of consciousness and possible death occur after 30 minutes to 1 hour of exposure. Above 1000 ppm, immediate unconsciousness, cessation of breathing and death occur in a few minutes.

In addition to being toxic, hydrogen sulfide gas is also explosive. It will ignite and explode when subjected to a spark or ordinary flame in concentrations from 4% to 44% of air. It is also soluble in water and oil, so it may flow for a considerable distance from its origin before escaping above ground or in an entirely unexpected place.

OSHA's 8 hour exposure limit for hydrogen sulfide gas is 10 ppm for an 8 hour shift.. The acceptable maximum peak concentration for an 8-hour shift is 50 ppm. This is for a 10-minute

period of time and can occur only once during the shift.

HYDROGEN GAS

Hydrogen gas, H_2 is a colorless, odorless, tasteless gas that is lighter than air. Hydrogen gas is not toxic like hydrogen sulfide gas so exposure to this gas itself is not harmful. If you breathe a lot of it, the hydrogen won't harm you, but the lack of oxygen might. Hydrogen however, is very flammable and explosive over a range of concentrations in air of 4 to 75%. Hydrogen also has an extremely low ignition-energy requirement which means sparks generated by virtually all types of electrical equipment as well static charges on clothes can cause ignition.

Because hydrogen is not toxic, OSHA does not report a ceiling concentration or maximum peak concentration for exposure.

MONITORING FOR H_2S AND H_2

Workers may want to test for the presence of hydrogen and hydrogen sulfide in areas of stagnant stock before using equipment with a flame such as welding torches or that produce a spark, which could ignite the gas. This is especially true if the mill has been shut down for a period of time allowing stock to stagnate in pipes and chests. Hand held multi gas detectors are available for this purpose. Additionally, prior to working in areas where stock has stood stagnant for a period of time, workers may want to monitor the quality of air in their work environment to avoid exposure to hydrogen sulfide gas at levels greater than OSHA's permissible limits. Multi-gas monitoring instruments are available for detecting these gases. These monitors use electrochemical sensors to detect the gas. Hydrogen sulfide can generally be detected quite specifically. Therefore if you believe there is the potential for hydrogen sulfide gas to be in a particular area and the instrument produces a reading from the hydrogen sulfide sensor, you can presume that hydrogen sulfide is present in the atmosphere. If the level exceeds 10 parts per million, you should evacuate the area immediately and ventilate the area to remove the gas hazard.

The same instrument equipped with a combustible gas detector will measure the level of combustible gases present as a percentage of the lower explosive limit. However, the instrument measures all combustible gases, not just hydrogen and/or hydrogen sulfide. The instrument will not tell you how much of any one combustible gas is present in the air, but will sound an alarm when the amount of combustible gases exceeds 10 percent of the lower combustion limit for that monitor.

While the technologies may sound complicated, the instruments are quite easy to use. If the instrument is in the area of concern, any gas present will be detected. From outside of the immediate area, a sample of the atmosphere can be delivered to the monitor by using a remote sample pump. In either case, pay attention to the readings and the alarms indicated by the instrument. If the instrument alarms at any time, evacuate the area first, and determine the cause and source of the gas hazard later.

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