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Sources And Effects of Hydrogen Sulfide

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ABSTRACT

Almost all of the chemicals are hazardous and toxic when it enters the environment and the human body beyond the threshold level. Safety against all these chemicals have become a great concern since at some value all chemicals are life taking though it's a boon for various other progressive works. Out of these chemicals, hydrogen sulfide is one that is of great concern since it is released both naturally and anthropologically , which affects human health along with environmental degradation. So knowing the cause will help to prevent a person from such kind of toxic chemicals. "Nothing is harmful if the cause is identified and acted upon, in a wiser and innovative way"

Keywords: Hydrogen sulfide, Sources, effects.

INTRODUCTION

No doubt H_2S is a very useful gas for various chemical and physical experiments and in many other important areas but the harm it does on a person is even higher. It's a daily encountered gas by almost everyone whether in the field or outside and keeping this in mind a brief note on the effects of H_2S is discussed.

Hydrogen sulfide is a pollutant that is commonly regarded as toxic. Its threshold level value is 10 ppm. It goes by many names: H_2S, sour gas, sewer gas, stink damp and sulfuretted hydrogen. Hydrogen sulfide in low concentrations is easily recognizable by its characteristic foul odor similar to rotten eggs. Hydrogen sulfide is a colourless, flammable gas. It is produced naturally and also as a result of human activity.

SOURCES

Natural sources include non-specific and anaerobic bacterial reduction of sulfates and sulfur-containing organic compounds. Hydrogen sulfide is found naturally in crude petroleum, natural gas, volcanic gases, and hot springs. It is also found in groundwater. It is released from stagnant or polluted waters and manure or coal pits. Hydrogen sulfide may be produced by a variety of commercial methods. The principal source of hydrogen sulfide is as a by-product in the purification of natural and refinery gases. It is also a by-product of Kraft pulp and paper manufacturing and

carbon disulfide production. It is used as an intermediate in the manufacture of sulfuric acid and inorganic sulfides and as an agricultural disinfectant. Hydrogen sulfide is also produced as a decomposition product of xanthates (used in the mining industry) when they come into contact with water. It also produced by the reduction of sulfate and organo sulphur compounds by the bacterium *Desulphovibrio desulphuricans* and associated with methane thiol (CH_3SH),dimethyl disulphide (CH_3 .S.S.CH_3) and carboxyl sulphide (COS).

Another common source is Chemistry Laboratories and R& D labs. and Industries. They must use exhaust chamber for using this gas. Properties of hydrogen sulfide are given in table 1

EFFECTS

Accidental release or improper disposal of materials resulting from these processes may result in hydrogen sulfide emissions. Releases to the environment are primarily in emissions to the ambient air, where the chemical is likely to remain for less than 1 day, but may persist for as long as 42 days in winter. Hydrogen sulfide may evaporate easily from water, depending on temperature and pH. It is unlikely to bioconcentrate and biomagnifying in the food-chain.

Table 1: Properties of H_2S

Colour	Colourless
Odor	Very offensive, commonly referred to as odor of rotten eggs at low concentration; no odor at high concentration.
Vapor density	H_2S in its pure form is heavier than air 1.189 (Air = 1.00)
Exposure Limits	4.3 to 46.0 % in volume in air
Auto ignition temperature	260 ^{0} C
Flammability	Forms explosive mixture with air or oxygen
Water solubility	2.9g 100mL^{-1} water at 20 ^{0} C
Reactivity	Can react with iron to produce iron sulfide which will ignite in the presence of air unless it is kept wet.

Humans may be exposed to hydrogen sulfide from endogenous production and from exogenous sources. Most endogenous production results from the metabolism of sulfhydryl-containing amino acids (e.g., cysteine) by bacteria present in both the intestinal tract and the mouth. Hydrogen sulfide is also produced in the brain and several smooth muscles (e.g., thoracic aorta, ileum, and portal vein) by enzymes found in these tissues.

The concentration of hydrogen sulfide in air in unpolluted areas is very low, between 0.03 and 0.1 ppb.But Inhalation of high concentrations of hydrogen Sulfide can be lethal. The geometric mean odor threshold is11 ppb. At concentrations greater than 140 ppm, olfactory paralysis occurs, making hydrogen sulfide very dangerous, because a few breaths at 700 ppm can be fatal. Short-term inhalation exposure to high concentrations of hydrogen sulfide causes health effects in many systems. The lowest observed-adverse-effect level (LOAEL) is 2.8 ppm in asthmatic individuals for respiratory and neurological effects.

Hydrogen Sulfide mainly attacks the neural system and important organs, like the liver and the kidney. Many industrial processes generate significant quantities of Hydrogen Sulfide, continued exposure or exposure to concentrations over 100 ppm temporarily eliminates a person's ability to

smell the gas. The effect usually misleads the person into thinking the danger has passed; often with tragic results.

Human health effects of exposure to Hydrogen Sulfide, an irritant and an asphyxiant, depends on the concentration of the gas and the length of exposure. Background ambient levels of H_2S in urban areas range from 0.11 to 0.33 ppb, while in undeveloped areas concentrations can be as low as 0.02 to 0.07 ppb. A rotten egg odor characterizes H_2S at low concentrations, and some people can detect the gas by its odor at concentrations as low as 0.5 ppb. About half of the population can smell H_2S at concentrations as low as 8 ppb, and more than 90% can smell it at levels of 50 ppb. Hydrogen Sulfide, however, is odorless at concentrations above 150 ppb, because it quickly impairs the olfactory senses. Some of the Health effects of H_2S on human are given in the table 2

Table 2: Health Effects Of H_2S

1 ppm	Can be smelled.
10 ppm	Allowable for 8 h of exposure
15 ppm	An unprotected worker may not be exposed above this concentration.
20-50 ppm	Severe eye irritation. Nose, throat and lung irritation. Loss of appetite.
100-200 ppm	Severe nose, throat and lung irritation. Ability to smell odour completely disappears (150 ppm)
500 ppm	Severe lung irritation. Headaches, dizziness, staggering, collapse.
500-1000 ppm	Respiratory paralysis. Irregular heart beat, collapse or death.

**ppm = Parts of gas per million parts of air by volume. : 1% = 10,000 ppm*

Prolonged exposure to concentrations below 150 ppb can also cause olfactory fatigue. This effect of disabling the sense of smell at levels that pose serious health risks and possibly are life-threatening is one especially insidious aspect of Hydrogen Sulfide exposure. Odor is not necessarily a reliable warning signal of the presence of H_2S.

Most effects to humans occur from inhalation, though exposure generally also affects the eyes. Because most organ systems are susceptible to its effects, hydrogen Sulfide is considered as a broad spectrum toxicant. The organs and tissues with exposed mucous membranes (eyes, nose) and with high oxygen demand (lungs, brain) are the main targets of hydrogen Sulfide.

Hydrogen Sulfide acts similarly to hydrogen cyanide, interfering with cytochrome oxidase and with aerobic metabolism. Essentially, Hydrogen Sulfide blocks cellular respiration, resulting in cellular anoxia, a state in which the cells do not receive oxygen and die.

Hydrogen sulfide is metabolized through three pathways: oxidation, methylation, and reactions with metalloproteins or disulfide-containing proteins. Oxidation in the liver is the major detoxification pathway. The major oxidation product is thiosulfate, which is then converted to sulfate and excreted in the urine. The methylation pathway also serves as a detoxification route. The toxicity of hydrogen sulfide is a result of its reaction with metalloenzymes. In the mitochondria, cytochrome oxidase, the final enzyme in the respiratory chain, is inhibited by hydrogen sulfide; this disrupts the electron transport chain and impairs oxidative metabolism. Nervous and cardiac tissues, which have the highest oxygen demand, are especially sensitive to the disruption of

oxidative metabolism. In the central nervous system, this effect may result in death from respiratory arrest.

At levels up to 100 to 150ppm, hydrogen sulfide is a tissue irritant, causing keratoconjunctivitis (combined inflammation of the cornea and conjunctiva), respiratory irritation with lacrimation (tears) and coughing. Skin irritation is also a con symptom. Instantaneous loss of consciousness, rapid apnea (slowed or temporarily stopped breathing) and death may result from acute exposure to levels above 1,000ppm. At these higher levels, it becomes an asphyxiant.

The non-lethal effects can be summarized as neurological – consisting of symptoms such as dizziness, vertigo, agitation, confusion, headache, somnolence, tremulousness, nausea, vomiting, convulsions, dilated pupils, and unconsciousness, and pulmonary – with symptoms including cough, chest tightness, dyspnea (shortness of breath), cyanosis (turning blue from lack of oxygen), hemoptysis (spitting or coughing up blood), pulmonary edema (fluid in the lungs), and apnea with secondary cardiac effects.

Table 3: Case study of Accident

Barnett Complex Mine H_2S Poisoning

Seven men died Monday, April 12, 1971, as a result of exposure to hydrogen sulfide gas in advance workings on the 800-foot level of the Barnett Complex Mine, Ozark-Mahoning Company, Pope, County, Illinois

Drifting and test drilling operations to locate an ore vein were being conducted at the extreme end of the 800-foot south level, on Friday, April 9. Near the end of the day shift, the third of three test holes struck a watercourse and water under high pressure was released into the drift. Work was discontinued in the area, and the water allowed to flow into the drift on the belief the body of water would soon be drained. Reportedly, hydrogen sulfide was not liberated on Friday; the two workers who were drilling did not smell the gas or suffer eye irritation.

The presence of hydrogen sulfide gas was first detected during the day shift on Saturday, when two miners, out of curiosity, went to the face to look at the water flow. The miners reported that the gas irritated their eyes and caused "tightness" in their chests.

At some time between the end of the second shift on Saturday and Monday morning, one of three fans in the auxiliary ventilation system for the 800 south level failed. What ventilation existed at the south end of the 800-foot level thereafter is unknown.

On Monday, April 12, installation of a replacement fan was completed shortly after noon. Before the fan was started, a miner went in by the fan to obtain measuring sticks. He was seen by the men installing the fan, but testimony is not clear as to his being aware of or warned of a potential danger. In about a half hour, the miner's brother went into the area to look for him. When neither of the two men returned, other miners, without respiratory protection, attempted rescue. At this time the replacement fan was started. In the course of events, five additional miners were overcome while several others, although repeatedly entering the drift and being affected by the gas, did escape by cutting into the ventilation tubing for fresh air.

At approximately 1:30 p.m., the Company officials notified the Illinois Department of Mines and Minerals of the accident.

CONCLUSIONS

Most of the affects are to the natural side because approximately 90% of release gas is natural, therefore looking into the fact, people should be well aware and new technology should be brought to monitor the concentration of H_2S so that life of the people as well as environment will be safe. New methods should also be implemented in the lab for those person who uses H_2S in their work regularly. The hydrogen sulphide gas pollutant can be removed in Industrial air effluents. One method is to setting up of a sulphur recovery unit to convert hydrogen sulphide gas into pure elemental sulphur or it is trapped as the insoluble metal sulphide (CdS, ZnS, HgS or Ag_2S) in absorption reagent. "To be safe from a chemical is to promote the effect of it to the grass root level of the society. Learn and be safe."

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