An Overview of Hydrogen Sulfide Toxicology

Hydrogen sulfide, H_2S, is a colorless, flammable gas having an odor of "rotten eggs." Since that "rotten egg" odor is often detected in or near swamps and sewers, it is commonly known as "swamp gas" or "sewer gas." The human nose is quite sensitive to the odor of hydrogen sulfide; generally that odor can be detected at a concentration of about 0.02[1] ppm (parts per million) -- a very low airborne concentration. At a much greater concentration (around 20 parts per million), the smell goes away. An airborne concentration of H_2S above 100 ppm is "immediately dangerous to life and health"[2-3]. To give some perspective: the IDLH for carbon monoxide is 1200 ppm.[4]

H_2S occurs naturally on earth (in decaying biological materials including plants and animals, animal by-products, crude oil, natural gas, sewage treatment plants, and others) and is also man-made (emissions from paper mills, refineries, and others). H_2S is also produced by bacterial action inside the human body.

About three hundred years ago, Bernardino Ramazzini, an Italian physician, "the father of occupational medicine," published his masterful work *De Morbis Artificum Diatriba* (A Treatise on Occupational Illness). The chapter entitled, "Diseases of Cleaners of Privies and Cesspits," is an essay describing the effects of H_2S on the eyes of privy and cesspit workers. Ramazzini said of the effects on the workers' eyes "…those foul exhalations wage ruthless war, and they attack so cruelly with their piercing stings that they rob them of life, that is to say of light." In an study published in the Journal of Industrial Hygiene in 1925, Howard Haggard, a professor at Yale University stated that "Prolonged exposure to low concentrations of hydrogen sulphide is generally believed to result in a chronic form of poisoning" that is particularly damaging to the central nervous system and the eyes[5]. Perhaps the worst case of general population exposure to hydrogen sulfide occurred early in the morning of November 24, 1950. A malfunction at a natural gas-treatment plant in Poza Rica, Mexico resulted in an accidental release of hydrogen sulfide. In the localized area around the plant, 22 were killed and 320 were hospitalized.

Chronic exposures cause health problems, too. A chronic exposure results is one that occurs over a long time interval, and usually at a low concentration. Several published research studies have concluded that chronic exposure to hydrogen sulfide can result in adverse human health effects ranging eye irritation, a sore throat and cough, shortness of breath, and fluid in the lungs. These symptoms will usually subside within a few weeks, but other changes such as memory problems may occur. Inhaling H_2S on a long-term basis may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness.[6]

Since H_2S is a gas, the primary route of exposure is by breathing air containing it. The concentration of H_2S in the air you breathe ranges generally from about 0.11ppb (parts per billion, 1000 ppb = 1 ppm) to 0.33 ppb. If you are exposed to H_2S on your job, the exposure concentration can be much higher.

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[1] See Raffle, P.A.F., Adams, P.H., et. al., *Hunter's Diseases of Occupations*, 8th ed., Edward Arnold, London, 1994, p. 248 for these data.

[2] U.S. Department of Health and Human Services, Centers for Disease Control, NIOSH Pocket Guide to Chemical Hazards, June 1997, p. 170.

[3] IDLH: Immediately Dangerous to Life and Health. "A condition 'that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed adverse health effects or prevent escape from such an environment.'' From U.S. Department of

Health and Human Services, NIOSH Publication No.87-108, *NIOSH Respirator Decision Logic*, as found in U.S. Department of Health and Human Services, Centers for Disease Control, NIOSH Pocket Guide to Chemical Hazards, June 1997, pp. xii-xiii.

[4] U.S. Department of Health and Human Services, Centers for Disease Control, *NIOSH Pocket Guide to Chemical Hazards*, June 1997, p. 54.

[5] As reported in a Houston Chronicle Special Report "*The Brimstone Battles*," http://www.chron.com/content/chronicle/nation/h2s/index.html

[6] see ATSDR *Public Health Statement for Hydrogen Sulfide* July 1999, http://www.atsdr.cdc.gov/toxprofiles/phs114.html