The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

## Sources of Exposure

### General Populations

- There are natural and anthropogenic sources of hydrogen sulfide. It is generated by bacteria in the mouth and gastrointestinal tract during the metabolism of sulfhydryl-containing amino acids (e.g., cysteine).
- Hydrogen sulfide occurs naturally in the gases from volcanoes, sulfur springs, swamps, and stagnant bodies of water.
- Hydrogen sulfide is released by a number of industries pulp and paper mills, natural gas production, swine containment and manure handling, or geothermal power plants.
- For the general population, exposure to hydrogen sulfide most likely occurs through inhalation of ambient air.

### Occupational Populations

- Facilities where hydrogen sulfide is produced, used, or generated include petroleum refineries, natural gas plants, petrochemical plants, coke oven plants, kraft paper mills, viscose rayon manufacturing plants, sulfur production plants, iron smelters, food processing plants, manure treatment facilities, landfills, textile plants, waste water treatment facilities, and tanneries.

## Toxicokinetics and Normal Human Levels

### Toxicokinetics

- Hydrogen sulfide is readily and rapidly absorbed through the lungs. It can also be absorbed through the gastrointestinal tract and skin, but there are limited data for these routes.
- Absorbed hydrogen sulfide is rapidly distributed throughout the body.
- It is metabolized through three pathways: oxidation, methylation, and reactions with metalloproteins or disulfide-containing proteins.
- Sulfate metabolites are excreted in the urine. In a human study, peak levels of urinary thiosulfate occurred 15 hours after an acute exposure.

### Normal Human Levels

- Hydrogen sulfide is produced in the mouth; concentrations ranging from 1 to 100 ppb have been measured in mouth air.
- Hydrogen sulfide can compose up to 10% of intestinal gases. Hydrogen sulfide concentrations as high as 18 ppm were measured in the flatus of individuals on a normal diet.
- Sulfide concentrations in blood samples from six adults ranged from 0.3 to 3 µg/mL.

## Biomarkers/Environmental Levels

### Biomarkers

- Urinary thiosulfate levels can be used as biomarker of exposure. However, it is not unique to hydrogen sulfide exposure.

### Environmental Levels

*Air*

- Ambient air concentrations range from 0.11 and 0.33 ppb; in urban areas concentrations are generally <1 ppb.
- Much higher concentrations (often exceeding 90 ppb) have been detected in communities located near natural sources or industries releasing hydrogen sulfide.

*Sediment and Soil*

- No data are available for hydrogen sulfide levels in soil.
- Levels in undisturbed anoxic sediment may be as high as 100 ppb and levels in disturbed sediments range from 1-30 ppb.

*Water*

- Hydrogen sulfide readily evaporates from surface water.
- No data are available for hydrogen sulfide levels in drinking water.

### Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Hydrogen Sulfide. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

# ToxGuide™ for Hydrogen Sulfide $H_2S$

CAS# 7783-06-4

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**U.S. Department of Health and Human Services**
**Public Health Service**
**Agency for Toxic Substances and Disease Registry**
www.atsdr.cdc.gov

**Contact Information:**
Division of Toxicology
and Environmental Medicine
Applied Toxicology Branch

1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-800-CDC-INFO
1-800-232-4636
www.atsdr.cdc.gov/toxpro2.html

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

## Chemical and Physical Information

### Hydrogen Sulfide is a Gas

- Hydrogen sulfide is a flammable, colorless gas with a characteristic odor of rotten eggs.
- It can dissolve in water where it will dissociate into bisulfide ion and sulfide ion.
- Hydrogen sulfide can form insoluble sulfide salts with various metals (i.e., copper, zinc, nickel, iron) that may be present in the soil or water.
- There is considerable individual variability in the odor threshold for hydrogen sulfide in humans; the thresholds can range from 0.0005 to 0.3 ppm. However, at high concentrations individuals may lose their ability to smell it. This can make hydrogen sulfide very dangerous.

## Routes of Exposure

- Inhalation – The primary route of exposure for the general population and workers.
- Oral and Dermal – Minor routes of exposure; these routes only contribute a small amount to the overall body burden

### Hydrogen Sulfide in the Environment

- Hydrogen sulfide is produced naturally and as a result of human activity.
- Natural sources (e.g., gases from volcanoes, sulfur springs, swamps) account for about 90% of the hydrogen sulfide in the atmosphere.
- It can be released to the environment by various industries including natural gas production, municipal sewage pumping and treatment plants, swine containment and manure-handling operations, animal slaughter, facilities, tanneries, petroleum refining, and pulp and paper operations.

## Relevance to Public Health (Health Effects)

**Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.**

### Minimal Risk Levels (MRLs)

*Inhalation*

- An MRL of 0.07 ppm has been derived for acute-duration inhalation exposure (≤14 days).
- An MRL of 0.02 ppm has been derived for intermediate-duration inhalation exposure (15-364 days).
- A chronic-duration inhalation MRL was not derived for hydrogen sulfide.

*Oral*

- No acute-, intermediate-, or chronic-duration oral MRLs were derived for hydrogen sulfide.

### Health Effects

*Respiratory*

- Nasal symptoms, sore throat, cough, and dyspnea has been observed in humans exposed to hydrogen sulfide.
- Impaired lung function has been observed in asthmatics.
- Damage to the nasal olfactory epithelium appears to be the most sensitive respiratory effect in animals.

*Neurological*

- Exposure to high levels of hydrogen sulfide results in unconsciousness followed by apparent recovery, colloquially referred to as knockdown. Some individuals report permanent or persistent neurological effects after the apparent recovery.
- Impaired performance on neurological tests has been observed in animals exposed to lower concentrations of hydrogen sulfide.

### Children's Health

- It is not known if children are more susceptible to hydrogen sulfide poisoning than adults.