H_2S Hydrogen Sulfide Fact Sheet

Concentration Exposure/Irritation Limits[1]:

- Exposure Limits (TWA) = 10 ppm (OSHA & NIOSH) 1 ppm = 1.4 mg/m^3
- IDHL = 100 ppm IP = 10.46 eV
- 10-minute exposure = 20-50 ppm (with no other measurable exposure during 8-hour shift)
- Eye irritation begins at 10-20 ppm

Threshold Concentrations[2]:

- Odor Threshold = 0.00047 ppm (0.47 ppb)
- Detection Threshold = N/A
- Recognition Threshold = 0.0047 ppm (4.7 ppb)

Characteristics: Colorless; strong rotten egg odor; quickly acclimatize to H_2S and temporarily lose the ability to detect H_2S; heavier than air.

Summary: Hydrogen sulfide is typically produced in the wastewater treatment industry, the gas industry and volcanic gases. In liquids, hydrogen sulfide is typically oxidized to less toxic sulfates, but can be reduced in gaseous form to sulfur dioxide and elemental sulfur. The following are reactions that can occur with oxygen as a co-reactant. Note that while these reactions spontaneously occur, the equilibrium point and the rate of reaction depend on the specific kinetics and conditions of the reaction.

Oxidation of Hydrogen Sulfide with simple Oxygen:

$H_2S_{(g)} + 5/2\ O_{2(g)} \rightarrow H_2O_{(l)} + SO_4^{2-}{}_{(aq)}$	$\Delta G° = -985$ kJ/mol[3]
$H_2S_{(g)} + 3/2\ O_{2(g)} \rightarrow H_2O_{(g)} + SO_{2(g)}$	$\Delta G° = -495$ kJ/mol
$H_2S_{(g)} + ¾\ O_{2(g)} \rightarrow H_2O_{(g)} + ¾\ S_{(s)} + ¼\ SO_{2(g)}$	$\Delta G° = -270$ kJ/mol
$H_2S_{(g)} + ½\ O_{2(g)} \rightarrow H_2O_{(g)} + S_{(s)}$	$\Delta G° = -195$ kJ/mol
$H_2S_{(g)} + ½\ O_{2(g)} \rightarrow H_2O_{(g)} + ⅛\ S_{8(g)}$	$\Delta G° = -189$ kJ/mol

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Definitions:

- OSHA – Occupational Safety and Health Administration.
- AIHA – American Industrial Hygiene Association.
- PEL – Permissible Exposure Limit, OSHA standards.
- REL – Recommended Exposure Limit, NIOSH standards.
- TWA – Time Weighted Average, usually based on an 8 (OSHA) or 10 (NIOSH) hour workday.
- ST – Short-term Exposure Limit, usually a 15-minute TWA not to be exceeded during workday.
- C – Ceiling value, not to be exceeded at any time.
- IDLH – Immediately Dangerous to Life and Health.
- Odor threshold - the concentration at which ANIMALS respond to the odor 50% of the time.
- Detection threshold - the concentration at which 50% of a human panel identifies the presence of an odor without being able to characterize it.
- Recognition threshold - the concentration at which 50% of a human panel can identify the odor.
- PPM – parts per million.
- PPB – parts per billion
- IP – Ionization Potential.

Note: Sometimes "Odor" threshold is used when "Detection" threshold is meant.

References

1. NIOSH Pocket Guides at http://www.cdc.gov/niosh/npg/default.html; OSHA Chemical Data at http://www.osha.gov
2. The Science of Smell Part , Iowa State University, May 2004: http://www.extension.iastate.edu/Publications/PM1963A.pdf
3. ΔG° = Free energy of the reaction, calculated at standard conditions (room temperature and pressure). A negative free energy indicates that the reaction is spontaneous (i.e. will occur naturally); however, it does not indicate the rate of reaction (e.g. the reaction may not occur fast enough to be observed). The free energies are calculated per mole of the first listed reactant.