

HYDROGEN SULFIDE

CAS number: 7783-06-4

Synonyms: Hydrosulfuric acid, hydrogen sulphide, stink damp, sulfur hydride, sulfureted hydrogen

Chemical formula: H₂S

Structural formula: —

Workplace exposure standard (amended)

TWA: 1 ppm (1.4 mg/m³)

STEL: 5 ppm (7 mg/m³)

Peak limitation: —

Notations: —

IDLH: 100 ppm

Sampling and analysis: The recommended value is quantifiable through available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 1 ppm (1.4 mg/m³) is recommended to protect for irritation effects and central nervous system (CNS) impairment in exposed workers.

A STEL of 5 ppm (7 mg/m³) is recommended to protect for acute irritation effects and CNS impairment in exposed workers.

Discussion and conclusions

Hydrogen sulfide is a colourless gas with a characteristic odour of “rotten eggs” occurring in the gases from stagnant bodies of water, crude petroleum and natural gas. Occupational exposure occurs principally from its presence in crude petroleum, natural gas, soil, and sewerage and as a by-product of chemical reactions in various industries.

The critical effects of exposure are irritation of the eyes and upper respiratory tract and ‘knockdown effect’ at high concentrations. The odour threshold ranges from approximately 0.0002 to 0.3 ppm. Volunteers exposed once at 5 ppm for two hours self-reported increases in ratings of odour intensity, irritation and unpleasantness. Eye irritation and effects on the cornea are reported at 5 ppm (ACGIH, 2018). Inhalation of 1,000 to 2,000 ppm can result in ‘knockdown’ collapse, unconsciousness and paralysis of the respiratory centre in the brain. A NOAEC of 10 ppm for nasal lesions is identified in rats and mice exposed for six hours per day for up to 90 days. Based on this same study, primary sources assign different recommendations.

The dose-response curve appears to start at 5 ppm based on evidence in humans and rats (ACGIH, 2018). A TWA of 1 ppm is recommended as derived by ACGIH (2018), presumably, by dividing the NOAEC of 10 ppm in rats by an uncertainty factor of 10 for interspecies difference. This TWA is recommended to protect for irritation effects and CNS impairment in exposed workers. Based on the

local irritation effects at 5 ppm and the potential for short-term peaks in exposure, a STEL of 5 ppm is recommended to protect for acute irritation effects and CNS impairment in exposed workers.

Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Not classified as a skin sensitiser or respiratory sensitiser according to the GHS.

There are insufficient data to recommend a skin notation.

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APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 10 ppm (14 mg/m³); STEL: 15 ppm (21 mg/m³)
ACGIH	2010	TLV-TWA: 1 ppm (1.4 mg/m³); TLV-STEL: 5 ppm (7 mg/m³)
<p>TLV-TWA and TLV-STEL recommended to minimise upper respiratory tract irritation and CNS impairment in exposed workers.</p> <p>Summary of data:</p> <p>TLV-TWA and TLV-STEL are stated as derived from human and animal data that showed similar qualitative and quantitative responses following single and repeated exposures; no specific derivation provided.</p> <p>TLV-STEL justified by evidence that peak exposures of 5 ppm may produce minor irritation and a brief change in oxygen uptake, but not expected to produce more serious effects on the respiratory, central nervous or cardiovascular systems.</p> <p>Human data:</p> <ul style="list-style-type: none"> • 'Rotten egg' odour threshold ranges ≈0.0002–0.3 ppm • Series of studies in exercising volunteers; 15–30 min exposures: <ul style="list-style-type: none"> ○ NOAEL 2 ppm ○ LOAEL 5 ppm; reduced oxygen uptake, increased blood lactate, decreased carbon dioxide output • Single 2 h exposure of 74 volunteers at 5 ppm resulted in observed increase in symptoms of anxiety and self-reported increases in ratings of odour intensity, irritation and unpleasantness • Olfactory fatigue reported at ≈150–200 ppm • Eye irritation and effects on cornea reported at 5 ppm • NOAEL of 5 ppm for olfactory lesions; prediction via computational fluid dynamics model from H₂S flux in rats' nose • Reported possible irritation of respiratory tract and pulmonary oedema >100 ppm • Inhalation of 1,000–2,000 ppm can result in 'knockdown' collapse, unconsciousness, paralysis of respiratory centre in brain and death; confined space hazard case reports. <p>Animal data:</p> <ul style="list-style-type: none"> • LC₅₀: 335–587 ppm (rats; 2–6 h) • Multiple reports of loss of consciousness and lethality at 1,000–2,000 ppm for short exposure periods in multiple animals • NOAEL of 10 ppm in male rats; 4 h exposure; reduction in lung cytochrome c oxidase activity • NOAEL of 10 ppm (i.e. NOAEC) in rats and mice for nasal lesions; 6 h/d for 70 or 90 d; ≥30 ppm produced nasal toxicity • Eye irritation of guinea pigs at 20 ppm; 11 x 30 min exposures. <p>Dose-response curve start at ≈5 ppm based on evidence in humans and rats. Insufficient data to recommend skin, sensitiser and carcinogenicity notations.</p>		

Source	Year set	Standard
DFG	2013	MAK: 5 ppm (7.07 mg/m³)
<p>MAK recommended to protect for effects in the respiratory tract, the nervous system including olfactory neurons and the cardiovascular system in exposed workers.</p> <p>Summary of additional data:</p> <ul style="list-style-type: none"> • Human data not suitable for derivation of MAK due to unclear dose-response relationship • Odour annoyance expected at 5 ppm; uncertainty on interference with occupational function • MAK based on NOAEL of 10 ppm in rats and mice; neurotoxic damage to the olfactory epithelium; local effect; same study reported by ACGIH (2018). 		
SCOEL	2007	TWA: 5 ppm (7 mg/m³); STEL: 10 ppm (14 mg/m³)
<p>TWA and STEL recommended to protect for irritation effects in exposed workers.</p> <p>Summary of data:</p> <ul style="list-style-type: none"> • TWA based on NOAEL of 10 ppm in rats and mice; factor of 2 for interspecies uncertainty • STEL of 10 ppm based on acute toxic effects such as eye irritation and unconsciousness, and short-term exposures can occur in industrial settings; no derivation information provided. 		
OARS/AIHA	NA	NA
No report.		
HCOTN	2006	TWA: 10 ppm (14 mg/m³)
TWA is based on NOAEL of 10 ppm in rats; lesions in the olfactory mucosa.		

Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ N.D.	• Human health tier I assessment.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? No

The chemical is not a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	NA
HCIS	NA
NICNAS	NA
EU Annex	NA

Source	Notations
ECHA	NA
ACGIH	NA
DFG	NA
SCOEL	NA
HCOTN	NA
IARC	NA
US NIOSH	NA

NA = not applicable (a recommendation has not been made by this Agency); — = the Agency has assessed available data for this chemical but has not recommended any notations

Skin notation assessment

Calculation

Insufficient data to assign a skin notation.

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	34.08
Conversion factors at 25°C and 101.3 kPa:	1 ppm = Number mg/m ³ ; 1 mg/m ³ = Number ppm
This chemical is used as a pesticide:	<input type="checkbox"/>
This chemical is a biological product:	<input checked="" type="checkbox"/>
This chemical is a by-product of a process:	<input checked="" type="checkbox"/>
A biological exposure index has been recommended by these agencies:	<input type="checkbox"/> ACGIH <input type="checkbox"/> DFG <input type="checkbox"/> SCOEL

Workplace exposure standard history

Year	Standard
Click here to enter year	

References

American Conference of Industrial Hygienists (ACGIH®) (2018) TLVs® and BEIs® with 7th Edition Documentation, CD-ROM, Single User Version. Copyright 2018. Reprinted with permission. See the [TLVs® and BEIs® Guidelines section](#) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2013) Hydrogen sulfide – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2007) Recommendation from the Scientific Committee on Occupational Exposure Limits for hydrogen sulphide. SCOEL/SUM/124.

Health Council of the Netherlands (HCOTN) (2006) Hydrogen sulphide. Health-based recommended occupational exposure limit in the Netherlands. The Hague: Health Council of the Netherlands; publication no. 2006/07OSH.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (ND) Hydrogen Sulfide. Human health tier I assessment – IMAP report.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – hydrogen sulfide.

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