UK Health Security Agency

Hydrogen sulphide
Incident management

This document provides information needed for response to a chemical incident, such as physicochemical properties, health effects and decontamination advice.

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Contents

Main points

General

Hydrogen sulphide has a strong rotton egg odour and is a colourless, flammable gas at room temperature. It reacts with strong oxidants, generating fire and explosion hazard. Heating may cause violent combustion or explosion.

Hydrogen sulphide decomposes on burning, producing sulphur oxides.

Attacks many metals and some plastics.

Health

Prolonged inhalation exposure causes respiratory tract irritation, with rhinitis, pharyngitis, bronchitis, dyspnoea and pulmonary oedema.

Systemic effects include vomiting, diarrhoea, headache, nystagmus, dizziness, agitation, drowsiness, tremor, muscular weakness, convulsions, tachycardia, and hypotension.

Inhalation of high concentrations rapidly leads to collapse, respiratory paralysis, coma, cardiac arrhythmias, and death.

Exposure to the eyes causes pain, blepharospasm, lacrimation, conjunctivitis, and photophobia.

Exposure to the skin can result in itching, pain, redness, and skin discolouration.

Casualty decontamination at the scene

Decontamination should not be necessary following exposure to hydrogen sulphide as it exists as a gas at room temperature. Hydrogen sulphide is stored as a liquid under pressure in cylinders. This liquid will rapidly volatilise if released, though it may cause thermal burns on contact with skin.

Environment

Inform the Environment Agency where appropriate and avoid release into the environment.

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes for hydrogen sulphide

UN		1053	Hydrogen sulphide	
EAC		2WE	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Substance can be violently or explosively reactive. There may be a public safety hazard outside the immediate area of the incident [note 2]	
APP		A(cf)	Fire kit with gas-tight chemical protective suit with breathing apparatus [note 3]. Liquefied flammable gas with a boiling point below -20°C.	
Hazards	**Class**	2.3	Toxic gases	
	Sub-risks	2.1	Flammable gases	
HIN		263	Toxic gas, flammable	

Abbreviations

UN = United Nations number.
EAC = emergency action code.
APP = additional personal protection.
HIN = hazard identification number.

Notes to Table 1

Note 1: Chemical protective clothing with liquid-tight connections for whole body (type 3) conforming to the relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus conforming to BS EN 137.

Note 2: In such cases due care must be exercised to avoid unnecessary pollution of surface and groundwaters and wherever possible control measures such as the sealing of drains should be employed.

Note 3: People should stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250m away from the incident.

Reference

‘Dangerous Goods Emergency Action Code List’. National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. The Stationery Office 2023

Table 2. The GB classification, labelling and packaging (CLP) regulation for hydrogen sulphide

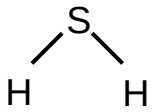
Hazard class and category	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gas, category 1	
	Acute Tox. 2	Acute toxicity (inhalation) category 2	
	Aquatic Acute 1	Acute hazard to the aquatic environment	
Hazard statement	H220	Extremely flammable gas	
	H330	Fatal if inhaled	
	H400	Very toxic to aquatic life	
Signal words	DANGER		

References

The Health and Safety Executive (HSE). 'GB CLP Regulation'. (viewed September 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	7783-06-4
Molecular weight	34
Formula	H_2S
Common synonyms	Dihydrogen sulphide
State at room temperature	Gas
Volatility	Vapour pressure = 1880 kPa at 20°C
Specific gravity	1.19 (air = 1)
Flammability	Extremely flammable. Gas/air mixtures are explosive.
Lower explosive limit	3.9%
Upper explosive limit	45.5%
Water solubility	Soluble in water: 0.5 g/100 mL water at 20°C
Reactivity	Heating may cause violent combustion or explosion. Reacts with strong oxidants, generating fire and explosion hazard. Decomposes on burning, producing sulphur oxides. Attacks many metals and some plastics.
Odour	Strong rotten egg odour
Structure	

References

International Programme on Chemical Safety. ‘International Chemical Safety Card entry for hydrogen sulphide’. ICSC 0165, World Health Organization 2017 (viewed September 2024)

PubChem Bethesda (MD): National Library of Medicine (US). ‘PubChem Compound Summary for CID 402, Hydrogen Sulfide’ National Center for Biotechnology Information 2004 (viewed September 2024)

Reported effect levels from authoritative sources

These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values.

Table 4. Exposure by inhalation

ppm	mg/m^3	Signs and symptoms	Reference
2	2.8	Bronchial constriction in asthmatic individuals	a
3.6	5	Increased eye complaints	a
20	28	Fatigue, loss of appetite, headache, irritability, poor memory, dizziness	a
50	70	Severe damage to eye tissue (exposure of an hour or more)	b
100	140	Olfactory paralysis	b
320-530	450-750	Pulmonary oedema	c
500	700	Potentially fatal (rapid respiratory failure)	d, a
530-1,000	750-1,400	Strong CNS stimulation, hyperpnoea followed by respiratory arrest	c
800	1,112	Lethal concentration for 50% of an exposued human population for 5 minutes exposure (LC_{50})	d
1,000-2,000	1,400-2,800	Immediate collapse with respiratory paralysis	c

References

a. Air Quality Guidelines for Europe. ‘World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition’, World Health Organization 2000

b. International Programme on Chemical Safety (IPCS). ‘Hydrogen sulfide. Concise International Chemical Assessment Document 53’, World Health Organization 2003

c. Scientific Committee on Occupational Exposure Limits (SCOEL). ‘Recommendation from the Scientific Committee on Occupational Exposure Limits for Hydrogen Sulphide’. European Union 2007

d. Health and Safety Executive (HSE). ‘Managing hydrogen sulphide detection offshore’. 2009 (Viewed September 2024)

Table 5. Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	0.75	0.60	0.51	0.36	0.33
AEGL-2 [note 2]	41	32	27	20	17
AEGL-3 [note 3]	76	59	50	37	31

Notes to Table 5

Note 1: Level of the chemical in air at or above which the general population could experience notable discomfort.

Note 2: Level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape.

Note 3: Level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

Level of distinct odour awareness = 0.01ppm

Reference

US Environmental Protection Agency (EPA) ‘Acute Exposure Guideline Levels’ (viewed September 2024)

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	**mg/m³**	**ppm**	**mg/m³**
WEL	5	7	10	14

Abbreviations

WEL = workplace exposure limit.
LTEL = long-term exposure limit.
STEL = short-term exposure limit.

Reference

HSE. 'EH40/2005 Workplace Exposure Limits' . Fourth Edition 2020

Table 8. Public health standards and guidelines

WHO guideline for drinking water quality	It is unlikely that a person would consume a harmful dose of hydrogen sulphide from drinking-water, hence a health-based guideline value has not been derived for this compound. Taste and odour threshold estimated to be between 0.05 and 0.1 mg/L.
WHO air quality guideline	0.15 mg/m^3 with an averaging time of 24 hours. Concentrations should not be allowed to exceed 7 µg/m^3, with a 30-minute averaging period, to prevent odour annoyance to the exposed population.

Reference

'Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addendum' World Health Organization 2022

'Air Quality Guidelines for Europe, European Series, No. 91, 2nd Edition' World Health Organization 2000

Health effects

Inhalation is the most likey route of exposure.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Prolonged exposure causes respiratory tract irritation, with rhinitis, pharyngitis, bronchitis, dyspnoea and pulmonary oedema. Systemic effects include vomiting, diarrhoea, headache, nystagmus, dizziness, agitation, drowsiness, tremor, muscular weakness, convulsions, tachycardia, and hypotension. Inhalation of high concentrations leads rapidly to collapse, respiratory paralysis, cyanosis, convulsions, coma, cardiac arrhythmias, and death within minutes. Severe acute exposures have been associated with long-term neurological impairment including microsmia, psychomotor slowing, extrapyramidal signs and deficits in memory and executive/planning functioning.
Eyes	Severe damage to the eye may occur. Initial features may include pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia. Severe features may include corneal burns, iritis, anterior and posterior synechia, corneal opacification, cataracts, glaucoma and retinal atrophy. Injury to the eye should be considered an ophthalmic emergency. Injury to the eyelid may result in features described under dermal exposure.
Dermal	Pain, itching, redness and skin discolouration may occur. Exposure to the compressed liquid may cause frostbite injury.

Reference

TOXBASE. Hydrogen sulphide 2024 (viewed September 2024)

Decontamination at the scene

Chemical specific advice

The approach used for decontamination at the scene will depend upon the incident, location of the casualties and the chemicals involved. Therefore, a risk assessment should be conducted to decide on the most appropriate method of decontamination.

Decontamination should not be necessary following exposure to hydrogen sulphide as it exists as a gas at room temperature. Hydrogen sulphide is stored as a liquid under pressure in cylinders; this liquid will rapidly volatilise if released, though it may cause thermal burns on contact with skin.

People who are processed through improvised decontamination should subsequently be moved to a safe location, triaged and subject to health and scientific advice. Based on the outcome of the assessment, they may require further decontamination.

Emergency services and public health professionals can obtain further advice from the UK Health Security Agency (UKHSA) Radiation, Chemicals and Environment Directorate using the 24-hour chemical hotline number: 0344 892 0555.

Clinical decontamination and first aid

Clinical decontamination is the process where trained healthcare professionals, using purpose-designed decontamination equipment, treat contaminated persons individually.

Detailed information on clinical management can be found on TOXBASE.

Important notes

Once body surface contaminants have been removed or if your patient was exposed by ingestion or inhalation, the risk that secondary care givers may become contaminated is very low. Secondary carers should wear standard hospital PPE as a precaution against secondary contamination from vomit and body fluids.

If the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves.

The area should be well ventilated.

For comprehensive clinical advice consult TOXBASE directly.

Clinical decontamination following surface contamination

Avoid contaminating yourself.

Carry out decontamination after resuscitation. This should be performed in a well-ventilated area, preferably with its own ventilation system.

Contaminated clothing should be removed, double-bagged, sealed and stored safely.

Decontaminate open wounds first and avoid contamination of unexposed skin. Any particulate matter adherent to skin should be removed and the patient washed with copious amounts of water under low pressure for at least 10 to 15 minutes, or until pH of skin is normal (pH of the skin is 4.5 to 6 although it may be closer to 7 in children, or after irrigation). The earlier irrigation begins, the greater the benefit.

Pay special attention to skin folds, fingernails and ears.

Dermal exposure

Decontaminate (as above) the patient following surface contamination.

Following decontamination, recheck pH of affected areas after a period of 15 to 20 minutes and repeat irrigation if abnormal. Burns with strong solutions may require irrigation for several hours or more. Attention should be paid to avoiding hypothermia during prolonged irrigation with cool fluids.

Once the pH is normal and stabilised, treat as per a thermal injury.

Burns totalling more than 15% of body surface area in adults (>10% in children) will require standard fluid resuscitation as for thermal burns.

Moderate/severe chemical burns should be reviewed by a burns specialist.

Other supportive measures as indicated by the patient’s clinical condition.

Ocular exposure

Remove contact lenses if present.

Anaesthetise the eye with a topical local anaesthetic (for example, oxybuprocaine, amethocaine or similar). However, do not delay irrigation if local anaesthetic is not immediately available.

Immediately irrigate the affected eye thoroughly with 1,000mL 0.9% saline or equivalent crytalloid (for example, by an infusion bag with a giving set) for a minimum of 10 to 15 minutes irrespective of initial conjunctival pH. A Morgan Lens may be used if anaesthetic has been given.

Aim for a neutral conjunctival pH of 7 to 7.2. The conjunctivae may be tested with indicator paper. Retest at 15 to 30 minutes after irrigation and use further irrigation if necessary.

Any particles lodged in the conjunctival recesses should be removed.

Repeated instillation of local anaesthetics may reduce discomfort and help more thorough decontamination. However, prolonged use of concentrated local anaesthetics is damaging to the cornea.

Patients with corneal damage, those who have been exposed to strong acids or alkalis and those whose symptoms do not resolve rapidly should be discussed urgently with an ophthalmologist.

Other supportive measures as indicated by the patient's clinical condition.

Inhalation

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

In severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction.

Children are at increased risk of airway obstruction.

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

Perform a 12-lead ECG in all patients who require an assessment.

Other supportive measures as indicated by the patient's clinical condition.

Ingestion

Maintain airway and established haemodynamic stability.

In severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction.

Children are at increased risk of airway obstruction.

Do not attempt gastric lavage. Do not give neutralising chemicals as heat produced during neutralisation reactions may increase injury.

Monitor vital signs and cardiac rhythm; check the capillary blood glucose.

Perform a 12-lead ECG in all patients who require assessment.

Other supportive measures as indicated by the patient's clinical condition.

Clinical decontamination and first aid references

TOXBASE. Hydrochloric acid (Hydrogen chloride 2020 (viewed September 2024)

TOXBASE. Corrosives – ingestion 2022

TOXBASE. Corrosives – inhalation 2020

TOXBASE. Skin decontamination – Corrosives 2020

TOXBASE. Chemicals sprayed and splashed into the eyes – features and management 2020

About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation health secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

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