



UK Health
Security
Agency

Sulphur dioxide

Incident management

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

Thank you for visiting the compendium of chemical hazards. Please take our [short survey](#) to help us make improvements.

Contents

Main points.....	3
General.....	3
Health.....	3
Casualty decontamination at the scene.....	3
Environment.....	3
Hazard identification.....	4
Physicochemical properties.....	6
Reported effect levels from authoritative sources.....	7
Published emergency response guidelines.....	8
Exposure standards, guidelines or regulations.....	9
Health effects.....	10
Decontamination at the scene.....	12
Chemical specific advice.....	12
Disrobe.....	12
Improvised decontamination.....	13
Improvised dry decontamination.....	13
Improvised wet decontamination.....	13
Additional notes.....	14
Interim wet decontamination.....	14
Decontamination at the scene references.....	15
Clinical decontamination and first aid.....	16
Important notes.....	16
Clinical decontamination following surface contamination.....	16
Dermal exposure.....	16
Ocular exposure.....	17
Inhalation.....	18
Clinical decontamination and first aid references.....	18
About the UK Health Security Agency.....	19

Main points

General

Sulphur dioxide is a non-flammable, colourless gas with an 'irritating pungent odour'. It forms highly corrosive sulphurous acid when dissolved in water. It reacts exothermically with bases such as amines, amides, metal oxides and hydroxides. Explosions may occur from contact with sodium hydride, potassium chlorate, ethanol, ether, fluorine, chlorine trifluoride and chlorates. It attacks plastic.

Health

Sulphur dioxide dissolves in moisture on skin, eyes and mucous membranes on contact, causing corrosive damage.

Exposure to sulphur dioxide gas may cause irritation of the eyes and nose with sore throat, cough, chest tightness, headache, wheeze, tachycardia and confusion. Chemical pneumonitis, tachypnoea, dyspnoea and stridor may develop, followed by pulmonary oedema. Optic neuropathy has been reported following both acute and chronic inhalation. Exposure to moderate to high doses can cause corrosive damage to the respiratory tract.

Dermal exposure may cause corrosive damage, causing pain, blistering, ulceration and necrosis.

Ocular exposure may cause pain, watering, conjunctivitis, oedema and photophobia.

Casualty decontamination at the scene



Sulphur dioxide gas reacts with tissue moisture to form sulphurous acid, which is corrosive. Therefore, following disrobe, improvised wet decontamination should be considered.

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 sulphur dioxide

UN		1079	Sulphur dioxide	
EAC		2RE	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Where there is an immediate threat to people, spillages and decontamination run-off may be washed to drains with large quantities of water [note 2]. There may be a public safety hazard outside the immediate area of the incident [note 3].	
APP		B	Gas-tight chemical protective clothing with breathing apparatus [note 4]	
Hazards	Class	2.3	Toxic gases	
	Sub-risks	8	Corrosive substances	
HIN		268	Toxic gas, corrosive	

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 be warned to 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 250 m away from the incident.

Note 4: Chemical protective clothing should be gas tight conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. '[Dangerous Goods Emergency Action Code List](#)'. 2023 (viewed on 18 December 2024)

Table 2. The GB classification, labelling and packaging (CLP) regulation for sulphur dioxide

Hazard class and category	Press. Gas	Compressed gas	
	Skin Corr. 1B	Skin corrosion, category 1B	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
Hazard statement	H331	Toxic if inhaled	
	H314	Causes severe burns and eye damage	
Signal words	DANGER		

References

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed on 18 December 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	7446-09-5
Molecular weight	64.1
Formula	SO ₂
Common synonyms	Sulphurous oxide, sulphurous anhydride, sulphur oxide
State at room temperature	Colourless gas
Volatility	Vapour pressure = 3×10^3 mmHg at 25°C
Specific gravity	2.25 (air = 1) 1.4 (water = 1) at -10°C
Flammability	Non-flammable
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Soluble
Reactivity	Dissolves in water to form sulphurous acid, a corrosive liquid. Reacts exothermically with bases such as amines, amides, metal oxides and hydroxides. Explosions may occur from contact with sodium hydroxide, potassium chlorate, ethanol, ether, fluorine, chlorine trifluoride and chlorates. Attacks plastic.
Odour	Irritating pungent odour
Structure	O=S=O

References

World Health Organization. International Programme on Chemical Safety '[International Chemical Safety Card for sulphur dioxide](#)' ICSC 0074, 2006 (viewed on 18 December 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. '[PubChem Compound Summary for Sulfur Dioxide, CID 1119](#)' (viewed on 18 December 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
≥0.1-0.25	≥0.26-0.65	Increased airway resistance in asthmatics when exercising	a
0.54 - 1	1.6 - 2.8	Perception of odour and irritation of mucosa	b
1-8	2.6-20.8	Increased respiratory rate, cough, erythema of trachea and bronchi, sore throat in healthy individuals	a
1	2.9	Increased pulmonary resistance in healthy individuals	b
100	260	Immediately dangerous to life and health	a

Reference

a. Agency for Toxic Substances and Disease Registry (ATSDR). '[Toxicological Profile for Sulfur Dioxide](#)' 1998 (viewed 18 December 2024)

b. World Health Organization. International Programme on Chemical Safety. '[Environmental Health Criteria 8 Sulfur Oxides and Suspended Particulate Matter](#)' EHC8 1979 (viewed 18 December 2024)

Table 5. Exposure to eyes

ppm	mg/m ³	Signs and symptoms	Reference
10	26	Eye irritation	a

Reference

a. Agency for Toxic Substances and Disease Registry (ATSDR). '[Toxicological Profile for Sulfur Dioxide](#)' 1998 (viewed 18 December 2024)

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
AEGL-1 [note 1]	0.20	0.20	0.20	0.20	0.20
AEGL-2 [note 2]	0.75	0.75	0.75	0.75	0.75
AEGL-3 [note 3]	30	30	30	19	9.6

Notes to Table 6

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.

Reference

US Environmental Protection Agency (EPA). '[Acute Exposure Guideline Levels – Sulfur dioxide](#)' 2024. (viewed on 18 December 2024)

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	0.5	1.3	1	2.7

Abbreviations

WEL = workplace exposure limit.

LTEL = long-term exposure limit.

STEL = short-term exposure limit.

Reference

Health and Safety Executive (HSE). '[EH40/2005 Workplace Exposure Limits Fourth Edition](#)' 2020 (viewed on 18 December 2024)

Table 8. Public health standards and guidelines

Drinking water standard	No value specified
WHO guideline for drinking water quality	No value specified
UK indoor air quality guideline	No value specified
WHO indoor air quality guideline	No value specified
WHO air quality guideline	24-hour average: 40 µg/m ³

Reference

World Health Organization global air quality guidelines. [Particulate matter \(PM2.5 and PM10\), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide](#) 2021 (viewed on 18 December 2024)

Health effects

A highly toxic gas, exposure can occur through inhalation, dermal contact and ocular contact. It can dissolve in moisture on skin, eyes and mucous membranes to form sulphurous acid, a corrosive liquid at higher concentrations.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	<p>Irritation of eyes and nose with sore throat, cough, chest tightness, headache, fever, wheeze, tachycardia and confusion. Chemical pneumonitis, tachypnoea, dyspnoea and stridor due to laryngeal oedema may follow. Pulmonary oedema with increasing breathlessness, wheeze, hypoxia and cyanosis may take up to 36 hours to develop. Optic neuropathy has been reported following both acute and chronic inhalation. Chronic inhalation can result in occupational bronchitis.</p> <p>In serious cases, corrosive damage to the mucous membranes of both the upper and lower respiratory tract occurs. Severe inhalation injuries may result in persistent hoarseness, pulmonary fibrosis and chronic obstructive pulmonary disease.</p> <p>Prolonged exposure may result in systemic effects.</p>
Skin	<p>Sulphurous acid (formed when sulphur dioxide dissolves in moisture on the skin) may cause pain, blistering, ulceration and necrosis. These burns may be self-limiting and superficial with the destruction of the surface epithelium and sub mucosa forming a leathery crust which limits the spread of the product. More concentrated and corrosive acids may produce deep burns that lead to systemic absorption.</p>
Ocular	<p>Pain, watering, conjunctivitis, oedema and photophobia may occur. Acidic solutions may cause corneal burns and limbal ischaemia (whitening/blanching around the edge of the cornea where it meets the sclera).</p>

Reference

National Poisons Information Service (NPIS). TOXBASE '[Sulphur dioxide](#)' 2024 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE '[Corrosives - inhalation](#)' 2020 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Chemicals splashed or sprayed into the eyes - features and clinical management’](#) 2020 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Skin decontamination - corrosives’](#) 2020 (viewed on 18 December 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.

Sulphur dioxide gas reacts with tissue moisture to form sulphurous acid, which is corrosive. Therefore, following disrobe, improvised wet decontamination should be considered (see below for details).

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, Climate and Environmental Hazards Directorate using the 24-hour chemical hotline number: 0344 892 0555.

Disrobe

The disrobe process is highly effective at reducing exposure to HAZMAT/CBRN material when performed within 15 minutes of exposure.

Therefore, disrobe must be considered the primary action following evacuation from a contaminated area.

Where possible, disrobing should be conducted at the scene and by the casualty themselves. Disrobing should be systematic to prevent transfer of contaminant from clothing to skin. Clothing should not be pulled over the head if possible.

Clothing stuck to the casualty by the contaminant should not be forcefully removed, as this risks causing further harm.

Consideration should be given to ensuring the welfare and dignity of casualties as far as possible. Immediately after decontamination the opportunity should be provided to dry and dress in clean robes or clothes.

Improvised decontamination

Improvised decontamination is an immediate method of decontamination prior to the use of specialised resources. This should be performed on all contaminated casualties unless medical advice is received to the contrary. Improvised dry decontamination should be considered for an incident involving chemicals unless the agent appears to be corrosive or caustic.

Unprotected first responders and members of the public should not approach casualties incapacitated by exposure to administer improvised decontamination, as they may be exposed to contaminants and become a casualty themselves.

Important note: Improvised decontamination should continue until a more structured intervention, such as an Interim Operational Response is conducted, or Specialist Operational Response are present.

Improvised dry decontamination

Any available dry absorbent material can be used such as kitchen towel, paper tissues (for example blue roll) and clean cloth.

Exposed skin surfaces should be blotted first and then rubbed, starting with the face, head, and neck, and moving down and away from the body.

Blotting and rubbing should not be too aggressive, as it could drive contamination further into the skin.

Casualties should also blow their nose to remove contaminants from the nasal cavities.

All waste material arising from decontamination should be left in situ, and ideally bagged, for disposal at a later stage.

Improvised wet decontamination

Wet decontamination should be used if contamination with a caustic chemical substance is suspected.

Wet decontamination may be performed using copious amounts of water from any available source such as taps, showers, water bottles, fixed installation hose-reels and sprinklers to gently rinse the affected skin. Other natural sources of water may be considered unless this creates greater risks to the individuals affected. Wet wipes or baby wipes may be used as an effective alternative.

Improvised decontamination should not involve overly aggressive methods to remove contamination as this could further damage affected tissues and drive the contamination further into the skin.

Where appropriate, seek professional advice on how to dispose of contaminated water and prevent run-off going into the water system.

Additional notes

Following improvised decontamination, remain cautious and observe for signs and symptoms in the decontaminated person and in unprotected staff.

If water is used to decontaminate casualties this may be contaminated, and therefore hazardous, and a potential source of further contamination spread.

All materials (paper tissues and so on) used in this process may also be contaminated and, where possible, should not be used on new casualties.

The risk from hypothermia should be considered when disrobe and any form of wet decontamination is carried out.

People who are contaminated should not eat, drink or smoke before or during the decontamination process and should avoid touching their face.

When vulnerable people are affected by a hazardous substance, they may need additional support to remove themselves, their clothing or the substance.

Casualties should remain in the area and should not leave to seek care at a hospital, as this presents a contamination risk. Further care will be administered on site by the appropriate emergency services.

Interim wet decontamination

Interim decontamination is the use of standard Fire and Rescue Service equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

Home Office. [‘Initial operational response to a CBRN incident’](#) Version 2.0 2015 (viewed on 18 December 2024)

National Health Service England. [‘Emergency Preparedness, Resilience and Response \(EPRR\): Guidance for the initial management of self-presenters from incidents involving hazardous materials’](#) 2019 (viewed on 18 December 2024)

Joint Emergency Service Interoperability Programme. [‘Initial Operational Response \(IOR\) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’](#) 2024 (viewed on 18 December 2024)

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.

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.

Note: Alkalis in particular may penetrate deeply within a few minutes.

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 crystalloid (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 intervals 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 and treating clinicians should have a low threshold for establishing a protected airway.

Monitor vital signs and check the capillary blood glucose.

Check and record pupil size.

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

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

For comprehensive clinical advice, consult [TOXBASE](#) directly.

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE '[Sulphur dioxide](#)' 2024 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE '[Corrosives - ingestion](#)' 2022 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE '[Corrosives - inhalation](#)' 2020 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE '[Chemicals splashed or sprayed into the eyes - features and clinical management](#)' 2020 (viewed on 18 December 2024)

National Poisons Information Service (NPIS). TOXBASE '[Skin decontamination - corrosives](#)' 2020 (viewed on 18 December 2024)

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](#).

This document from the UKHSA Radiation, Chemicals, Climate and Environmental Hazards Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

© Crown copyright 2024

First published: October 2015

Health Effects, Decontamination at the Scene & Clinical Decontamination and First Aid update: November 2016

Full document update: December 2024

For queries relating to this document, please contact chemcompendium@ukhsa.gov.uk or enquiries@ukhsa.gov.uk

Publishing reference: GOV-18026



You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence v3.0. To view this licence, visit [OGL](#). Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.



UKHSA supports the Sustainable Development Goals

