UK Health Security Agency

Sodium hypochlorite

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

Sodium hypochlorite exists in solution at room temperature. It has a sweetish faint odour of chlorine.

It is non-combustible under normal conditions. Mixing hypochlorite bleach with other household cleaners can produce corrosive gases.

Health

Household bleach (under 10% sodium hypochlorite) typically exists as a solution in water and is a strong oxidiser. Decomposes on heating and on contact with acids and under the influence of light, this produces toxic and corrosive gases including chlorine.

It is a mild to moderate irritant which does not cause tissue damage unless ingested in large amounts. Bleaches with a hypochlorite concentration greater than 10% are corrosive.

Ingestion of any amount of an industrial strength bleach (over 10% sodium hypochlorite) may cause significant toxicity.

Alkaline solutions can damage all layers of the eyes and should be considered an ophthalmic emergency.

Casualty decontamination at the scene

Sodium hypochlorite can cause skin irritation and corrosion. Therefore, following disrobe, improvised wet decontamination should be considered.

Environment

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

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains andsurface and groundwaters.

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes for hypochlorite solutions

UN		1791	Hypochlorite solution	
EAC		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.	
APP		-	-	
Hazards	**Class**	8	Corrosive substance	
	Sub-risks	-	-	
HIN		80	Corrosive or slightly corrosive material	

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.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. ‘Dangerous Goods Emergency Action Code List’ 2023 (viewed on 07 October 2024)

Table 2a. The GB classification, labelling and packaging (CLP) regulation for sodium hypochlorite, solution Cl active at varying concentrations

Hazard class and category	Skin Corr. 1B	Skin corrosion, category 1B	
	Eye Dam. 1	Serious eye damage, category 1	
	Aquatic Acute 1	Acute hazard to the aquatic environment, category 1	
	Aquatic Chronic 1	Chronic hazard to the aquatic environment, category 1	
Hazard statement	H314	Causes severe skin burns and eye damage	
	H318	Causes serious eye damage	
	H400	Very toxic to aquatic life	
	H410	Very toxic to aquatic life with long lasting effects	
Supplementary hazard statement code	EUH031	Contact with acids liberates toxic gas	
Signal words	DANGER		

Table 2b. Specific concentration limits for sodium hypochlorite, solution Cl active at varying concentrations

Concentration	Hazard statement	
C ≥ 5%	EUH031	Contact with acids liberates toxic gas

References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 07 October 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	7681-52-9
Molecular weight	74
Formula	NaClO
Common synonyms	-
State at room temperature	Typically exists as a solution in water
Volatility	2 to 2.5 kPa at 20°C
Specific gravity	1.1 (water=1) (5.5% aqueous solution) 1.2 (water=1) (14% aqueous solution)
Flammability	Non-combustible
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Soluble in water
Reactivity and reactivity or degradation products	Solutions of sodium hypochlorite are storage hazards due to oxygen evolution. Strong oxidiser. Reacts with combustible and reducing materials generating a fire and explosion hazard. Can also react violently with acids. Attacks many metals including copper. Decomposes on heating and on contact with acids and under the influence of light, this produces toxic and corrosive gases including chlorine. Will liberate chloramines if mixed with ammonia.
Odour	Disagreeable sweetish odour; faint odour of chlorine.

References

International Labour Organization (ILO). 'International chemical safety card entry for sodium hypochlorite (solution, active chlorine <10%). ICSC 0482' 2017. World Health Organization (viewed on 07 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information 2024, 'PubChem Compound Summary for CID 23665760, Sodium Hypochlorite' (viewed 07 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by ingestion

%	Signs and symptoms	Reference
≤ 6%	Most patients will have no more than minimal features of toxicity, unless a large amount has been ingested. Small amounts cause a burning sensation in the mouth and throat and thirst. Nausea, retching, vomiting, diarrhoea, and haematemesis may occur, but are unlikely to be severe. Large amounts (> 5mL/kg of household bleach) may cause corrosive damage.	a
> 6%	Corrosive at this concentration, causing a burning sensation in the mouth, throat and stomach. Abdominal pain, vomiting, haematemesis and dyspnoea. Difficulty swallowing due to pain and oedema.	b

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

References

a.National Poisons Information Service. TOXBASE ‘Household bleach (6% sodium hypochlorite or less)’ 2021. (viewed on 07 October 2024).

b. National Poisons Information Service. TOXBASE ‘Bleach >6% Sodium hypochlorite’ 2023. (viewed on 07 October 2024).

Published emergency response guidelines

Table 5 Acute exposure guideline levels (AEGLs)

	Concentration				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	No values specified				
AEGL-2 [note 2]					
AEGL-3 [note 3]					

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.

Exposure standards, guidelines or regulations

Table 6. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	**mg/m³**	**ppm**	**mg/m³**
WEL	No values specified			

Abbreviations

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

Table 7. Public health standards and guidelines

Drinking water standard	No value specified
WHO provisional guideline for drinking water quality	Chlorite: 0.7 mg/L (700 µg/L) Chlorate 0.7 mg/L (700 µg/L)
UK indoor air quality guideline	No value specified
WHO indoor air quality guideline	No value specified
WHO air quality guideline	No value specified

Reference

World Health Organization. ‘Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addendum’ 2022 (viewed on 07 October 2024)

Health effects

Bleaches with a hypochlorite concentration greater than 6% are corrosive, while those with a concentration less than 6% are irritants.

Ingestion of any amount of an industrial strength bleach (over 6% sodium hypochlorite) may cause significant toxicity.

Check the concentration of the product and refer to industrial bleaches if appropriate.

Table 8a. Signs or symptoms of acute exposure to household bleach (6% sodium hypochlorite or less)

Route	Signs and symptoms
Inhalation	With normal use, household bleach is not a respiratory hazard. Corrosive gases may be produced when mixing bleach with other household cleaning products (mixing with an acid will liberate chlorine and oxides of sulphur; mixing with ammonia will liberate chloramines), inhalation of which may result in pulmonary irritation or chemical pneumonitis.
Ingestion	Most patients will have no more than minimal features of toxicity, unless a large amount of household bleach (<6% sodium hypochlorite) has been ingested. Small amounts cause a burning sensation in the mouth and throat, and thirst. The oropharynx may look mildly inflamed, but burns are unlikely. Nausea, retching, vomiting, diarrhoea and haematemesis may occur, but are unlikely to be severe. Occasionally there may be signs of pulmonary irritant effects such as cough, wheeze or dyspnoea. Large amounts may cause retrosternal pain due to corrosive oesophagitis, haematemesis, abdominal pain and tenderness, watery diarrhoea, and possibly melaena. Repeated vomiting may lead to glottal contamination with subsequent oedema and difficulty in breathing. Oesophageal and gastric stricture has been reported. In severe cases, hypernatraemic, hyperchloraemic acidosis, metabolic acidosis, hypotension, tachycardia, coma, convulsions and cardiorespiratory

Route	Signs and symptoms
	arrest may occur. The gastrointestinal mucosa may become haemorrhagic, ulcerated and perforated. Shock may then occur. There is a greater risk of pulmonary involvement after a large ingestion, which may lead to pulmonary oedema (may take up to 36 hours to develop), with increasing breathlessness, wheeze, hypoxia and cyanosis. Acute respiratory distress syndrome (ARDS) has occurred after bleach ingestion.
Eyes	Immediate pain, irritation, lacrimation and burning sensation. Transient corneal injury may result.
Dermal	Irritant. May cause allergic dermatitis.

Reference

National Poisons Information Service. TOXBASE '[Household bleach (6% sodium hypochlorite or less)]' 2021. (viewed on 07 October 2024).

Table 8b. Signs or symptoms of acute exposure to household bleach (>6% sodium hypochlorite)

Route	Signs and symptoms
Inhalation	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 acute inhalation. 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. Prolonged exposure may result in systemic effects.
Ingestion	Ingestion of corrosives can cause immediate pain, with burning in the mouth, throat and stomach. This may be followed by abdominal pain, vomiting, haematemesis, and dyspnoea. Pain and oedema may make swallowing difficult, causing drooling. Haemorrhagic or hypovolaemic shock and airway obstruction from laryngeal and/or epiglottic oedema are features of severe cases. Stridor and respiratory complications (including pneumonitis, pulmonary

Route	Signs and symptoms
	oedema, acute respiratory distress syndrome (ARDS), and pulmonary necrosis) can develop following aspiration of corrosive materials. The presence of oropharangeal burns does not correlate well with the presence of oesophageal injuries, but generally more extensive oral burns are associated with multiple site involvement.Gastric or oesophageal perforation may occur in the early stages of severe cases. Stricture formation is a potential late complication, usually occurring between 2 weeks and 2 months post-exposure, although it may not be clinically apparent for several years. Severe injury can cause pyloric stenosis and a small, scarred, immobile stomach. Alkalis often damage the oesophagus. However, ingestion of large volumes can also involve the stomach and small intestines. Ulceration may be sufficiently severe to cause perforation, with complications including mediastinitis, pneumonitis, and cardiac injury. The depths of the burns are usually much greater with alkalis, and may continue to develop some time after exposure. Systemic features of corrosive ingestion may include circulatory collapse, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, haemolysis, and disseminated intravascular coagulation (DIC).
Eyes	Pain, watering, conjunctivitis, oedema, and photophobia may occur. Acidic and alkaline solutions may cause corneal burns. Alkaline solutions in particular may penetrate all layers of the eye, causing iritis, anterior and posterior synechiae, corneal opacification, cataracts, glaucoma, and retinal atrophy. Alkali burns to the eyes should be considered an ophthalmic emergency. Aerosols sprayed directly into the eye may cause corneal damage.
Dermal	Symptoms are more likely to occur following direct contact with solid or liquid corrosive materials, although features can also occur through contact with corrosive gases and fumes. Alkalis can directly damage tissue by the saponification of fats and the solubilisation of proteins and collagen. This causes liquefaction burns and

Route	Signs and symptoms
	necrosis with a softening of the tissues, which can further lead to deep tissue penetration and full thickness burns. Dermal alkali injuries may be initially painless, leading to a delay in treatment. Alkali injuries can also progress over several hours and it can be difficult to assess the extent of the resulting burn due to quickly developing skin discolouration. Recurring skin breakdown over extended periods after the initial injury may complicate and delay recovery. Large or prolonged exposure may result in systemic effects

Reference

National Poisons Information Service. TOXBASE 'Bleach >6% Sodium hypochlorite' 2023 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Corrosives – inhalation' 2020 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Corrosives – ingestion' 2022 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Skin decontamination – corrosives' 2020 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Chemicals splashed or sprayed into the eyes' 2020 (viewed on 07 October 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.

Sodium hypochlorite can cause skin irritation and corrosion. Therefore, following disrobe, improvised wet decontamination should be considered.

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.

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 carried out, 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.

Water should only be used for decontamination where casualty signs and symptoms are consistent with exposure to caustic or corrosive substances such as acids or alkalis.

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 July 2015 (viewed on 07 October 2024)

NHS England. 'Emergency Preparedness, Resilience and Response (EPRR): Guidance for the initial management of self-presenters from incidents involving hazardous materials.' February 2019. (viewed on 07 October 2024)

JESIP. 'Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials' June 2024. (viewed on 07 October 2024)

Clinical decontamination and first

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

The normal use, household bleach is NOT a respiratory hazard. Corrosive gases may be produced when mixing bleach with other household cleaning products (mixing with an acid will liberate chlorine and oxides of sulphur. Mixing with ammonia will liberate chloramines), inhalation of which may result in pulmonary irritation.

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

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.

NB 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 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 lodges 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.

Ingestion of household bleach (<6% sodium hypochlorite)

Maintain a clear airway and ensure adequate ventilation.

Gut decontamination (including activated charcoal) is contraindicated. Gastric lavage should not be undertaken due to the increased risk of aspiration.

Treatment is unlikely to be required if only small amounts have been ingested (less than 5 mL/kg in an adult or a child).

Monitor vital signs and check the capillary blood glucose.

Check and record pupil size.

If the patient has signs of corrosive injury or has ingested a large amount see the section below.

Ingestion of bleach containaing >6% sodium hypochlorite

Maintain airway and establish 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.

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.

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 check 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.

Clinical decontamination and first aid references

National Poisons Information Service. 'Bleach – liquid (chlorine based bleaches)' 2021 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Household bleach (6% sodium hypochlorite)' 2021 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Corrosives – inhalation' 2020 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE 'Corrosives – ingestion' 2022 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE ‘Skin decontamination – corrosives’ 2020 (viewed on 07 October 2024)

National Poisons Information Service. TOXBASE ‘Chemicals splashed or sprayed into the eyes’ 2020 (viewed on 07 October 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 and Environment Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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

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