



Sodium Hypochlorite

Incident Management

Key Points

Fire

- non-combustible under normal conditions
- emits toxic fumes of chlorine and sodium oxide when heated to decomposition or mixed with other household cleaning products
- in the event of a fire involving sodium hypochlorite, use fine water spray and chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus

Health


- bleaches with a hypochlorite concentration greater than 10% are corrosive, while those with a concentration of less than 10% are irritants
- ingestion of any amount of an industrial strength bleach (over 10% sodium hypochlorite) may cause significant toxicity
- ingestion of small amounts of household bleach may cause only minimal features, while ingestion of large amounts may cause retrosternal pain, haematemesis, abdominal pain and tenderness, watery diarrhoea and possibly melaena
- household bleach may be irritating to the skin and eyes
- industrial strength bleach may cause corrosive damage and local effects by all routes and systemic effects following exposure by ingestion, inhalation or dermal contact

Environment



- dangerous for the environment; inform the Environment Agency where appropriate

Hazard Identification

Standard (UK) dangerous goods emergency action codes

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*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		–	–	
Hazards	Class	8	Corrosive substance	
	Sub-risks	–	–	
HIN		80	Corrosive or slightly corrosive material	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Chemical protective clothing with liquid-tight connections for whole body (Type 3) conforming to relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN 137</p> <p>Reference Dangerous Goods Emergency Action Code List. National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2015.</p>				

Classification, labelling and packaging (CLP)*

Hazard class and category	Skin Corr. 1B	Skin corrosion, category 1B	
	Aquatic Acute 1	Acute hazard to the aquatic environment, category 1	
Hazard statement	H314	Causes severe skin burns and eye damage	
	H400	Very toxic to aquatic life	
Supplementary hazard statement code	EUH031	Contact with acids liberates toxic gas	
Signal words	DANGER		
<p>* Implemented in the EU on 20 January 2009</p> <p>Reference European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. http://echa.europa.eu/information-on-chemicals/cl-inventory-database (accessed 12/2015).</p>			

Physicochemical Properties

CAS number	7681-52-9
Molecular weight	74
Formula	NaClO
State at room temperature	Typically exists as a solution in water
Volatility	Data not available
Specific gravity	14% aqueous solution: 1.2 at 20°C (water = 1)
Flammability	Non-combustible
Lower explosive limit	–
Upper explosive limit	–
Water solubility	Soluble in water
Reactivity	Solutions of sodium hypochlorite are storage hazards due to oxygen evolution. Strong oxidiser. Reacts with combustible and reducing materials. Solution is corrosive to aluminium
Reaction or degradation products	Decomposes on heating, on contact with acids and under the influence of light, generating fumes of sodium oxide and chlorides. Reacts to form explosive products with amines, ammonium salts, azidine and methanol
Odour	Disagreeable sweetish odour; faint odour of chlorine
References	
<p>Hazardous Substances Data Bank. Sodium hypochlorite. HSDB No. 748 (last revision date 05/03/2003). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 12/2015).</p> <p>International Programme on Chemical Safety. International chemical safety card entry for sodium hypochlorite (solution, active chlorine <10%). ICSC 0482, 1999. World Health Organization: Geneva.</p> <p>Sodium hypochlorite (HAZARDTEXT™ Hazard Management). In Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc, Greenwood Village CO, US. RightAnswer.com Inc, Midland MI, US. http://www.rightanswerknowledge.com (accessed 12/2012).</p>	

Reported Effect Levels from Authoritative Sources

Exposure by ingestion

%	Signs and symptoms	Reference
≤10%	<p>Irritant at this concentration, causing a burning sensation in the mouth and throat and thirst. 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 and dyspnoea</p> <p>May cause corrosive damage if large amounts are ingested (300 mL in adults; 100 mL in children)</p>	a
>10%	<p>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</p>	b
<p>These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values</p> <p>References</p> <p>a TOXBASE. Household bleach (<10% sodium hypochlorite) – features and management, 12/2013. http://www.toxbase.org (accessed 11/2015).</p> <p>b TOXBASE. Industrial bleach (>10% sodium hypochlorite) – features and management, 12/2010. http://www.toxbase.org (accessed 11/2015).</p>		

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	Data not available	
ERPG-2[†]		
ERPG-3[‡]		
<p>* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour</p> <p>[†] Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action</p> <p>[‡] Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects</p>		

Acute exposure guideline levels (AEGLs) (See Note)

	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	Data not available				
AEGL-2[†]					
AEGL-3[‡]					
<p>* Level of the chemical in air at or above which the general population could experience notable discomfort</p> <p>[†] 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</p> <p>[‡] Level of the chemical in air at or above which the general population could experience life-threatening health effects or death</p>					

Exposure Standards, Guidelines or Regulations

Occupational standards

Chlorine	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	Data not available			
WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit				

Public health guidelines (see note)

WHO provisional guideline values for drinking water	Chlorite: 0.7 mg/L Chlorate 0.7 mg/L
Air quality guideline	No guideline values specified
Soil guideline values and health criteria values	No guideline values specified
Note Sodium hypochlorite in solution slowly decomposes to form chlorate and chlorite ions	
Reference WHO. Guidelines for Drinking-water Quality, 4 th Edition, 2011. World Health Organization: Geneva.	

Health Effects

Major route of exposure

- ingestion, inhalation, skin and eye contact

Important notes

- bleaches with a hypochlorite concentration greater than 10% are corrosive, while those with a concentration less than 10% are irritants
- ingestion of any amount of an industrial strength bleach (over 10% sodium hypochlorite) may cause significant toxicity
- **check the concentration of the product and refer to industrial bleaches if appropriate**

Immediate signs or symptoms of acute exposure

Household bleach (<10% sodium hypochlorite)

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
Ingestion	<p>Most patients will have no more than minimal features of toxicity, unless a large amount of household bleach (<10% sodium hypochlorite) has been ingested</p> <p>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</p> <p>Occasionally there may be signs of pulmonary irritant effects such as cough, wheeze or dyspnoea</p> <p>Large amounts (more than 100 mL in a child or 300 mL in an adult of a household bleach (<10% sodium hypochlorite) 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</p> <p>Oesophageal and gastric stricture has been reported</p> <p>In severe cases, hypernatraemic, hyperchloraemic acidosis, metabolic acidosis, hypotension, coma, convulsions and cardiorespiratory arrest may occur. The gastrointestinal mucosa may become haemorrhagic, ulcerated and perforated. Shock may then occur</p> <p>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</p>
Dermal	Irritant. May cause allergic dermatitis
Ocular	Immediate pain, irritation, lacrimation and burning sensation. Transient corneal injury may result
<p>References</p> <p>TOXBASE. Bleach – liquid (sodium hypochlorite), 12/2010. http://www.toxbase.org (accessed 11/2015).</p> <p>TOXBASE. Household bleach (<10% sodium hypochlorite), 12/2010. http://www.toxbase.org (accessed 11/2015).</p>	

Industrial bleach (>10% sodium hypochlorite)

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 acute inhalation</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 airway disease</p> <p>Prolonged exposure may result in systemic effects</p>
Ingestion	<p>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</p> <p>Stridor and respiratory complications (including pneumonitis, pulmonary oedema, ARDS and pulmonary necrosis) can develop following aspiration of corrosive materials</p> <p>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</p> <p>Alkalis often damage the oesophagus. However, ingestion of large volumes can also involve the stomach and small intestines</p> <p>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</p> <p>Systemic features of corrosive ingestion may include circulatory collapse, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, haemolysis and disseminated intravascular coagulation (DIC)</p>

Dermal	<p>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</p> <p>Alkalis can directly damage tissue by the saponification of fats and the solubilisation of proteins and collagen. This causes liquefaction burns and necrosis with a softening of the tissues, which can further lead to deep tissue penetration and full thickness burns</p> <p>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</p> <p>Large or prolonged exposure may result in systemic effects</p>
Ocular	<p>Pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia may occur. Acidic and alkaline solutions may cause corneal burns</p> <p>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</p> <p>Aerosols sprayed directly into the eye may cause corneal damage</p>
<p>References</p> <p>TOXBASE. Bleach – liquid (sodium hypochlorite), 12/2010. http://www.toxbase.org (accessed 01/2016).</p> <p>TOXBASE. Industrial bleach (>10% sodium hypochlorite), 12/2010. http://www.toxbase.org (accessed 01/2016).</p> <p>TOXBASE. Corrosives – inhalation, 02/2012. http://www.toxbase.org (accessed 01/2016).</p> <p>TOXBASE. Skin decontamination – corrosives, 06/2010. http://www.toxbase.org (accessed 01/2016).</p> <p>TOXBASE. Chemicals splashed or sprayed into the eyes, 02/2014. http://www.toxbase.org (accessed 01/2016).</p>	

Decontamination at the Scene

Summary

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.

Household bleach (under 10% sodium hypochlorite) will cause skin irritation, while industrial strength bleach (over 10% sodium hypochlorite) is corrosive to the skin. This should be considered in the risk assessment when deciding on the most appropriate method of decontamination following disrobe.

Emergency services and public health professionals can obtain further advice from Public Health England (Centre for Radiation, Chemical and Environmental Hazards) 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, disrobe at the scene should be conducted by the casualty themselves and should be systematic to avoid transferring any contamination from clothing to the skin. Consideration should be given to ensuring the welfare and dignity of casualties as far as possible.

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.**

Improvised dry decontamination

- any available dry absorbent material can be used, such as kitchen towel, paper tissues (eg blue roll) and clean cloth
- exposed skin surfaces should be blotted and rubbed, starting with the face, head and neck and moving down and away from the body
- rubbing and blotting should not be too aggressive, or it could drive contamination further into the skin

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

Improvised wet decontamination

- 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 any available source of water such as taps, showers, fixed installation hose-reels and sprinklers
- when using water, it is important to try and limit the duration of decontamination to between 45 and 90 seconds and, ideally, to use a washing aid such as cloth or sponge
- improvised decontamination should not involve overly aggressive methods to remove contamination as this could 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 etc) 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
- 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/clothes
- 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

Interim wet decontamination

Interim decontamination is the use of standard fire and rescue service (FRS) equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

National Ambulance Resilience Unit. Joint Emergency Services Interoperability Programme (JESIP). Initial operational response to a CBRN incident. Version 1.0, September 2013.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Chemical incidents: planning for the management of self-presenting patients in healthcare settings. April 2015.

Clinical Decontamination and First Aid

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

Detailed information on clinical management can be found on TOXBASE – www.toxbase.org.

Household bleach (under 10% sodium hypochlorite)

Important note

- ambulance staff, paramedics and emergency department staff treating chemically contaminated casualties should be equipped with appropriate personal protective equipment (PPE)

Dermal exposure

- damage to intact skin is highly unlikely
- remove all contaminated clothing
- wash the skin with tepid water until it no longer feels soapy
- apply a soothing cream if there is any residual skin irritation
- 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 (eg oxybuprocaine, amethocaine or similar); **however, do not delay irrigation if local anaesthetic is not immediately available**
- immediately irrigate the affected eye thoroughly with 1,000 mL 0.9% saline (eg by an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given. Irrigate for 10–15 minutes irrespective of initial conjunctival pH. Aim for a final conjunctival pH of 7.5–8.0. The conjunctivae may be tested with indicator paper. Retest 20 minutes after irrigation and use further irrigation if necessary
- 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 referred urgently to an ophthalmologist**
- other supportive measures as indicated by the patient's clinical condition

Inhalation

- maintain a clear airway and ensure adequate ventilation
- give oxygen if required
- perform a 12 lead ECG
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- treatment is unlikely to be required if only small amounts of household bleach have been ingested (less than 100 mL in a child; less than 300 mL in an adult). Give a small glass of milk to drink
- all patients who have any signs of corrosive injury (hypersalivation, difficulty swallowing, retrosternal pain or haematemesis) or pulmonary irritation (coughing, wheeze or dyspnoea) need to be referred to hospital
- maintain a clear airway and ensure adequate ventilation
- gastric lavage should not be undertaken due to the increased risk of aspiration
- monitor blood pressure, pulse, cardiac rhythm and respiratory rate
- other supportive measures as indicated by the patient's clinical condition

Industrial bleach (over 10% sodium hypochlorite)

Important note

- 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

Clinical decontamination following surface contamination

- carry out decontamination after resuscitation
- this should be performed in a well-ventilated area, preferably with its own ventilation system
- do **not** apply neutralising chemicals as heat produced during neutralisation reactions may cause thermal burns and increase injury
- 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 10–15 minutes, or until the pH of the skin is normal (pH of the skin is 4.5–6, although it may be closer to 7 in children, or after irrigation). **The earlier irrigation begins, the greater the benefit**

- pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears

Dermal exposure

- decontaminate (as above) the patient following surface contamination
- do **not** apply neutralising chemicals as heat produced during neutralisation reactions may cause thermal burns and increase injury
- following decontamination, recheck the pH of affected areas after a period of 15–20 minutes and repeat irrigation if abnormal; burns with strong solutions may require irrigation for several hours or more
- once the pH is normal and stabilised, treat as for a thermal injury
- burns totalling more than 15% of body surface area in adults (more than 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 (eg oxybuprocaine, amethocaine or similar); **however, do not delay irrigation if local anaesthetic is not immediately available**
- immediately irrigate the affected eye thoroughly with 1,000 mL 0.9% saline (eg by an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given. Irrigate for 10–15 minutes irrespective of initial conjunctival pH. Aim for a final conjunctival pH of 7.5–8.0. The conjunctivae may be tested with indicator paper. Retest 20 minutes after irrigation and use further irrigation if necessary
- 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 referred urgently to an ophthalmologist**
- other supportive measures as indicated by the patient's clinical condition

Inhalation

- maintain a clear airway and ensure adequate ventilation
- give oxygen if required
- perform a 12 lead ECG

- other supportive measures as indicated by the patient's clinical condition

Ingestion

- **maintain airway and establish haemodynamic stability**
- in severely affected patients critical care input is essential. Urgent assessment of the airway is required. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction
- do **not** attempt gastric lavage
- do **not** give neutralising chemicals as heat produced during neutralisation reactions may increase injury
- monitor blood pressure, pulse and oxygen saturation
- perform a 12 lead ECG
- other supportive measures as indicated by the patient's condition

Clinical decontamination and first aid references

TOXBASE	http://www.toxbase.org (accessed 01/2016)
TOXBASE	Bleach – liquid (sodium hypochlorite), 12/2010
TOXBASE	Household bleach (<10% sodium hypochlorite), 12/2010
TOXBASE	Household bleach – skin contact, 07/2013
TOXBASE	Household bleach (<10% sodium hypochlorite) – features and management, 12/2013
TOXBASE	Industrial bleach (>10% sodium hypochlorite), 12/2010
TOXBASE	Corrosives – inhalation, 02/2012
TOXBASE	Corrosives – ingestion, 08/2013
TOXBASE	Skin decontamination – corrosives, 06/2010
TOXBASE	Chemicals splashed or sprayed into the eyes, 02/2014

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