UK Health Security Agency

Nitrobenzene

Incident management

Contents

Main points

General

Nitrobenzene is an oily, combustible, liquid with an almond-like odour

It reacts violently with strong oxidants, reducing agents and strong acids generating a fire and explosion hazard.

Nitrobenzene emits toxic fumes of nitrogen oxides when heated to decomposition.

Health

Nitrobenzene is highly toxic by ingestion, inhalation and skin absorption. It is well absorbed by all routes.

The primary health effect of nitrobenzene is methaemoglobinaemia (elevated MetHb), which reduces the ability of blood to transport oxygen around the body. Haemolysis (destruction of blood cells) may also occur, but is more likely in patients with G6PD deficiency.

Inhalation can cause coughing, wheezing, dyspnoea and respiratory distress.

Ingestion can cause nausea, vomiting and diarrhoea.

Pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia may follow eye contact, while skin contact may cause dermatitis

Systemic features may be delayed by 1-4 hours post-exposure. Features include headache, weakness, dizziness, ataxia, dyspnoea, tachycardia, drowsiness and methaemoglobinaemia.

Casualty decontamination at the scene

Following disrobe, improvised dry decontamination should be considered for an incident involving nitrobenzene, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

Environment

Inform the Environment Agency where appropriate

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

Hazard identification

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

UN		1662	Nitrobenzene
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**	6.1	Toxic substance 
	Sub-risks	–	–
HIN		60	Toxic or slightly toxic substance

Abbreviations

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

Note 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.

Reference

‘Dangerous Goods Emergency Action Code List’. National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. The Stationery Office (2023).
(Accessed March 2024)

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

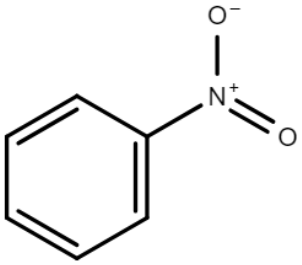
Hazard class and category	Carc. 2	Carcinogenicity, category 2	
	Repr. 1B	Toxic to reproduction, category 1B	
	Acute Tox. 3	Actute toxicity (inhalation, ingestion and dermal), category 3	
	STOT RE 1	Specific Target Organ Toxicity Repeated Exposure, category 1	
	Aquatic Chronic 3	Chronic hazard to the aquatic environment, category 3	
Hazard statement	H351	Suspected of causing cancer	
	H360F	May damage fertility	
	H301	Toxic if swallowed	
	H311	Toxic in contact with skin	
	H331	Toxic if inhaled	
	H372 (blood)	Causes damage to blood through prolonged or repeated exposure	
	H412	Harmful to aquatic life with long lasting effects	
Signal words	DANGER		

Reference

The Health and Safety Executive (HSE). ‘GB CLP Regulation’ (accessed March 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	98-95-3
Molecular weight	123
Formula	$C_6H_5NO_2$
Common synonyms	Nitrobenzol, benzene nitro-, essence of mibrane
State at room temperature	Oily yellow liqud
Vapour pressure	20 Pa at 20°C
Relative density	1.2 (Water = 1) 4.2 (Air = 1)
Flammability	Combustible
Lower explosive limit	1.8%
Upper explosive limit	40%
Water solubility	Very slightly soluble in water; 0.2g per 100ml water
Reactivity	Reacts violently with strong oxidants, reducing agents this generates a fire and explosion hazard, Reacts violently with strong acids and nitrogen oxides generating anexplosion hazard. Emits toxic fumes of nitrogen oxides when heated to decomposition.
Odour	Almond-like
Structure	

References

International Programme on Chemical Safety. International Chemical Safety Card entry for Nitrobenzene. ICSC 0065, 2006. World Health Organization: Geneva. (Accessed March 2024)

PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. PubChem Compound Summary for CID 7416, Nitrobenzene (Accessed March 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by ingestion

mL	Signs and symptoms
5-10	Fatal in the absence of medical intervention
g	
4.3-11	Unconsciousness, cyanosis, circulatory collapse, rapid and shallow breathing and tachycardia

Table 5. Exposure by inhalation

mg/m^3	ppm	Signs and symptoms
210-419	40-80	Slight symptoms after several hours of exposure

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

Reference

International Programme on Chemical Safety. Nitrobenzene. Environmental Health Criteria 230, 2003. World Health Organization: Geneva. (viewed March 2024)

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	Concentration				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	Data not available				
AEGL-2 [note 2]					
AEGL-3 [note 3]					

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.

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	0.2	1	No guideline specified	

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) (viewed March 2024)

Table 8. Public health standards and guidelines

UK drinking water standard	No guideline value specified
WHO guideline for drinking water quality	No guideline value specified
WHO air quality guideline	No guideline value specified

Health effects

Very toxic by inhalation, ingestion and skin absorption. Well absorbed by all routes. Nitrobenzene typically causes methaemoglobinaemia which may be delayed in onset and prolonged.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Cough, wheeze, dyspnoea and respiratory distress before systemic toxicity develops.
Ingestion	Nausea, vomiting and diarrhoea. Systemic features are common but may be delayed.
Dermal	Dermatitis.
Systemic (as a result of any of the above exposure routes)	Systemic toxicity may be delayed for 1-4 hours. Features include headache, weakness, dizziness, ataxia, dyspnoea, tachycardia, and drowsiness. Methaemoglobinaemia (elevated MetHb) may lead to severe clinical features. Patients with MetHb concentrations greater than 7-10% appear to have central and peripheral cyanosis (often grey peripheries and brownish mucous membranes). Blood drawn by venepuncture may appear dark brown in colour. Haemolysis can also occur; it is more likely in patients with G6PD deficiency. There may be the characteristic "bitter almond" odour on the patient's breath. However it is estimated that 20-40% of people are genetically unable to detect this odour.
Ocular	Pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia are possible.

Reference

TOXBASE. Nitrobenzene. April 2023 (viewed March 2023)

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.

Following disrobe, improvised dry decontamination should be considered for an incident involving nitrobenzene, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

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 more structured interventions such as Interim 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

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)
NHS England. 'Emergency Preparedness, Resilience and Response (EPRR): Guidance for the initial management of self-presenters from incidents involving hazardous materials.' (February 2019)
JESIP. 'Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials' (January 2023)

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

Carry out decontamination after resuscitation.

This should be performed in a well-ventilated area, preferably with its own ventilation system.

Avoid contaminating yourself with this product and wash any exposed area.

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 soap and copious amounts of water under low pressure for at least 10 to 15 minutes.

Pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears.

The earlier irrigation begins, the greater the benefit.

Dermal exposure

Decontaminate (as above) the patient following surface contamination.

If features of systemic toxicity are present manage as for ingestion/inhalation.

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 final conjunctival pH of 7.0 to 8.0. The conjunctivae may be tested with indicator paper. Retest 20 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 & inhalation

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

Gut decontamination (including activated charcoal) is unlikely to be of benefit following ingestion.

Monitor vital signs and check the capillary blood glucose.

Check and record pupil size.

Pulse oximetry is unreliable in the presence of methaemoglobinaemia.

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

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

For comprehensive advice on clinical first aid, clinicians should consult TOXBASE directly.

Clinical decontamination and first aid references

TOXBASE Nitrobenzene (viewed March 2024).
TOXBASE: 'Chemicals splashed or sprayed into 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.

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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