UK Health Security Agency

Copper

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

Copper is an odourless solid which is non-combustible in bulk form but flammable in powder form.

Copper reacts with strong oxidants such as chlorates, bromates and iodates generating an explosion hazard.

Health

The main exposure routes are ingestion, inhalation of dusts or fumes and dermal contact.

Inhalation of copper fumes may cause metal fume fever; symptoms include cough, mild hypertension, tachycardia, sweating, dyspnoea, sore throat, chest tightness, headache, fever, rhinitis, tiredness, myalgia and arthralgia.

Ingestion may result in gastrointestinal upset, including abdominal pain, nausea, vomiting and diarrhoea.

Dermal exposure can cause mild irritation to the skin.

Eye contact can cause irritation and prolonged contact can cause serious eye damage, including corneal necrosis and opacification.

Casualty decontamination at the scene

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

Environment

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

Hazard identification

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

UN		No values specified
EAC		
APP		
Hazards	**Class**	
	Sub-risks	
HIN		

Abbreviations

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

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

Hazard class and category	No values specified
Hazard statement	
Signal words	

Physicochemical properties

Table 3. Physicochemical properties

CAS number	7440-50-8
Molecular weight	63.55
Empirical formula	Cu
Common synonyms	Copper powder
State at room temperature	Solid
Volatility	Vapour pressure = non-volatile
Specific gravity	8.9 (water = 1)
Flammability	Non-combustible in bulk form, powder form flammable
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Insoluble in water
Reactivity	Mixtures with acetylenic compounds, ethylene oxide and azides are shock sensitive. Reacts with strong oxidants such as chlorates, bromates and iodates. This generates explosion hazard. Reacts more rapidly in powdered or granular form.
Reaction or degradation products	Solid pieces are very slowly oxidized by air to give a green basic carbonate.
Odour	Odourless

References

World Health Organization. International Programme on Chemical Safety. 'International chemical safety card entry for Copper' ICSC 0240, 2016 (viewed on 29 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. 'PubChem Compound Summary for CID 23978, Copper' (viewed on 29 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by ingestion

mg/kg	Signs and symptoms	Reference
140	Mean fatal dose of various copper salts	a
mg		
10–15	May cause nausea, vomiting and diarrhoea (copper salts)	a

Table 5. Exposure by inhalation to fresh copper fume

mg/m^3	Signs and symptoms	Reference
>0.1	Metal fume fever	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. World Health Organization. International Programme on Chemical Safety. 'Poisons Information Monograph Copper and Copper Salts' G002, 1990 (viewed on 29 October 2024)

b. World Health Organization. 'Environmental Health Criteria Copper' EHC 200, 1998 (viewed on 29 October 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]	No values specified				
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/m^3**	**ppm**	**mg/m^3**
WEL	No value specified	0.2 (copper fume (as Cu)) 1 (copper and compounds: dusts and mists (as Cu))	No value specified	2 (copper and copper compounds: dusts and mists (as Cu))

Abbreviations

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

References

Health and Safety Executive (HSE). 'EH40/2005 Workplace Exposure Limits Fourth Edition' 2020 (viewed on 29 October 2024)

Table 8. Public health standards and guidelines

Drinking water standard	2 mg/L
WHO guideline for drinking water quality	2 mg/L (2000 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

References

The Private Water Supplies (England) Regulations 2016 and The Private Water Supplies (Wales) Regulations 2017 (viewed on 22 October 2024)

The Water Supply (Water Quality) Regulations 2018 (Water, England and Wales) (viewed on 22 October 2024)

World Health Organization. 'Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addendum' 2022 (viewed on 22 October 2024)

Health effects

Exposure can occur via ingestion, inhalation of fumes or dust or by dermal absorption.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation of copper fumes can cause metal fume fever. Onset of symptoms typically occurs 4 to 10 hours after exposure and can include cough, mild hypertension, tachycardia, sweating, dyspnoea, sore throat, chest tightness, headache, fever, rhinitis, tiredness, myalgia and arthralgia. Symptoms are generally self-limiting and last for 12 to 48 hours. Rarely, pulmonary oedema has been reported. A rare more severe variant of the condition has been described where features including dyspnoea and hypoxia develop within minutes to 2 hours following exposure.
Ingestion	**Metallic copper** Ingestion of copper-contaminated water causes nausea, vomiting, abdominal pain and diarrhoea. Symptoms usually resolve rapidly when exposure ceases. Gastrointestinal mucosal burns with subsequent stricture formation has followed ingestion of molten copper. **Copper salts** Ingestion of very small amounts (a few milligrams) is likely to cause only GI upset. Copper salts are potent emetics and the absence of spontaneous vomiting suggests that only a small amount has been ingested and toxicity is unlikely. Larger ingestions, particularly of water-soluble salts, causes a metallic taste within minutes followed by abdominal pain and diarrhoea. Secretions and vomit may be blue/green. Irritation of the gastrointestinal tract will occur, which may be corrosive. Hypotension, cardiac arrhythmias, renal failure, methaemoglobinaemia, intravascular haemolysis (usually manifest 24 to 48 hours post-poisoning), rhabdomyolysis, hepatic injury, coma, convulsions and death may occur. Severe gastrointestinal irritation may result in haematemesis and/or melaena

	with hypovolaemic shock.
Dermal	**Copper salts** Mild irritant to intact skin. Systemic copper uptake may result from repeated application to broken skin. Exposure to copper-contaminated water can cause blue/green skin, discolouration of hair and of pre-existing skin lesions. Contact dermatitis has been reported. Systemic features are possible after exposure of copper salts to burned or broken skin.
Ocular	**Copper salts** Irritant to the eye. May cause corneal necrosis and opacification if crystals remain in the conjunctival sac.

References

National Poisons Information Service (NPIS). TOXBASE 'Copper' 2020 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Copper (metal) ingestion - features and management' 2020 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Copper salts - features and management' 2020 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Metal fume fever' 2024 (viewed on 22 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.

Following disrobe, improvised dry decontamination should be considered for an incident involving copper unless casualties are demonstrating obvious signs 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, 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 more structured interventions such as Interim or Specialist Operational Response are present.

Improvised dry decontamination

Improvised dry decontamination should be considered for an incident involving copper unless casualties are demonstrating obvious signs of chemical burns or skin irritation.

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 22 October 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 22 October 2024)

Joint Emergency Service Interoperability Programme. 'Initial Operational Response (IOR) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials' 2024 (viewed on 22 October 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.

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 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.

Treat symptomatically.

If systemic features are present, then treat as per ingestion.

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

Ocular exposure

If present, remove contact lenses.

Anaesthetise the eye with a topical local anaesthetic (such as oxybuprocaine, amethocaine or similar). If local anaesthetic is not available irrigate the affected eye immediately.

Immediately irrigate the affected eye thoroughly with 1000 mL 0.9% saline or equivalent crystalloid (for example via an infusion bag with a giving set) for a minimum of 10-15 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 15 to 30 minutes intervals after irrigation and use further irrigation if necessary. 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.

Ingestion

Gut decontamination (including activated charcoal) is contraindicated.

A small glass of water or milk may be of some symptomatic benefit if vomiting has not occurred.

Monitor vital signs, cardiac rhythm and check capillary blood glucose.

Check and record pupil size.

Perform 12 lead ECG in all patients who require assessment.

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

Inhalation

Remove from exposure and administer supplemental oxygen by face-mask if there is evidence of respiratory distress.

Monitor vital signs, cardiac rhythm and check capillary blood glucose.

Check and record pupil size.

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

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE 'Copper' 2020 (viewed on 22 October 2024)
National Poisons Information Service (NPIS). TOXBASE 'Copper (metal) ingestion - features and management' 2020 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Copper salts - features and management' 2020 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Metal fume fever' 2024 (viewed on 22 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'Chemicals splashed or sprayed into the eyes - features and clinical management' 2020 (viewed on 22 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, Climate and Environmental Hazards Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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