UK Health Security Agency

Copper

Incident management

Contents

Main points ... 3
General ... 3
Health ... 3
Casualty decontamination at the scene ... 3
Environment ... 3
Hazard identification ... 4
Physicochemical properties ... 5
Reported effect levels from authoritative sources ... 6
Published emergency response guidelines ... 7
Exposure standards, guidelines or regulations ... 8
Health effects ... 9
Major route of exposure ... 9
Decontamination at the scene ... 11
Disrobe ... 11
Improvised decontamination ... 11
Improvised dry decontamination ... 12
Improvised wet decontamination ... 12
Additional notes ... 12
Interim wet decontamination ... 13
Decontamination at the scene references ... 13
Clinical decontamination and first aid ... 14
Important notes ... 14
Clinical decontamination following surface contamination ... 14
Dermal exposure ... 14
Ocular exposure ... 14
Ingestion ... 15
Inhalation ... 15
Clinical decontamination and first aid references ... 16

Main points

General

Copper is a reddish-brown metal that is present in the Earth’s crust. It is non-combustible, except in powder form.

Copper reacts violently with acetylene, ammonium nitrate, bromates, chlorates, iodates, chloride, ethylene oxide, sodium azide and potassium oxide.

Health

Main exposure routes are ingestion or inhalation of dusts and fumes, or dermal contact Inhalation may cause metal fume fever; symptoms include cough, dyspnoea, sore throat, chest tightness, headache, fever, rigors, myalgia and arthralgia.

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

Dermal exposure to molten copper causes burns.

Copper foreign bodies can cause serious eye damage.

Casualty decontamination at the scene

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

Environment

Inform the Environment Agency where appropriate.

Hazard identification

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

UN		Data not available
EAC		
APP		
Hazards	**Class**	
	Sub-risks	
HIN		

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

Hazard class and category	Aquatic Chronic 2	Chronic hazards to the aquatic environment, category 2	
Hazard statement	H411	Toxic to aquatic life with long lasting effects	
Signal words	No signal word required		

Reference

The Health and Safety Executive (HSE). GB CLP Regulation (viewed in February 2022)

Physicochemical properties

Table 3. Physiochemical properties of copper

CAS number	7440-50-8
Molecular weight	63.546
Empirical formula	Cu
Common synonyms	–
State at room temperature	Solid
Volatility	Vapour pressure = 1 mmHg at 1628°C, non-volatile
Specific gravity	8.9 (water = 1)
Flammability	Non-combustible, except in powder form
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Insoluble
Reactivity	Copper ignites on contact with chlorine, chlorine trifluoride, fluorine (above 121°C) and hydrazinium nitrate (above 70°C). Reacts violently with acetylene, ammonium nitrate, bromates, chlorates, iodates, chloride, ethylene oxide, hydrazine mononitrate, hydrazoic acid, sodium azide and potassium oxide. Molten copper explodes on contact with water
Reaction or degradation products	Becomes dull when exposed to air. In moist air gradually becomes coated with green basic carbonate. May decompose upon heating to form corrosive and/or toxic fumes
Odour	Odourless

References

International Programme on Chemical Safety. ‘International chemical safety card entry for cadmium. ICSC 0020, 2005’. World Health Organization (WHO) Geneva

PubChem. Bethesda (MD). National Library of Medicine (US), National Center for Biotechnology Information 2004-. ‘PubChem Compound Summary for CID 23978, Copper’ (viewed February 2022)

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 (there is considerable variability in individual sensitivity to copper)	a
mg		
10 to 15	May cause nausea, vomiting and diarrhoea (copper salts)	a

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

Reference

a. International Programme on Chemical Safety. ‘Poisons Information Monograph (Group Monograph) G002, Copper and Copper Salts’ (1990). WHO

Table 5. Exposure by inhalation

ppm	mg/m^3	Signs and symptoms	Reference
>0.04	>0.1	Metal fume fever	a
These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values.			

Reference

a. International Programme on Chemical Safety ‘Environmental Health Criteria 200: Copper’ (1998) WHO

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	**30 min**	**60 min**	**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	Not given	0.2 (fume) 1 (dusts and mists, as Cu)	Not given	2 (dusts and mists, as Cu)

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

Table 8. Public health standards and guidelines

Drinking water standard	2 mg/L
WHO air quality guideline	Data not available

References

The Water Supply (Water Quality) Regulations 2018 (Water, England and Wales) 2018

The Private Water Supplies (England) Regulations 2016 and The Private Water Supplies (Wales) Regulations 2017

Health effects

Major route of exposure

Ingestion, inhalation of fumes or dust or by dermal absorption.

Table 9. Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation of copper fumes can cause metal fume fever. Symptoms include cough, mild hypertension, tachycardia, sweating, dyspnoea, sore throat, chest tightness, headache, fever, rhinitis, tiredness, myalgia and arthralgia. Rarely, pulmonary oedema has been reported.
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 onlyGI upset. Copper salts are potent emeics 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	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	Irritant to the eye. May cause corneal necrosis and opacification if crystals remain in the conjunctival sac.

References

TOXBASE. Copper, June 2020 (viewed February 2022).
TOXBASE. Copper salts - features and management, April 2020 (viewed February 2022).
TOXBASE. Polymer and metal fume fever, June 2019 (viewed February 2022).

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 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 (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.

Disrobing at the scene should be, where possible, 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 (for example 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.

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

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 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.

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.

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

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)

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.

Clinical decontamination following surface contamination

Remove all contaminated clothing.

Wash the contaminated area thoroughly with soap and water.

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 (for example, 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 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 8. The conjunctivae may be tested with indicator paper. Retest 20 minutes 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.

Refer for ophthalmological assessment if there is doubt regarding the management of corneal damage.

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

Ingestion

Gut decontamination is contraindicated.

A small glass of water or milk may be of some symptomatic benefit.

Perform 12 lead ECG.

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

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

Inhalation

Administer supplemental oxygen by face-mask if there is evidence of respiratory distress.

Monitor vital signs and check the capillary blood glucose.

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

Clinical decontamination and first aid references

TOXBASE (viewed February 2022).
TOXBASE Copper compounds (2022).
TOXBASE Copper salts - features and management (2022).
TOXBASE Chemicals splashed or sprayed into the eyes. (2016).
TOXBASE Skin decontamination – irritants (2020).
TOXBASE Polymer and metal fume fever - features and management (2019).

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 heath secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

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