



UK Health
Security
Agency

Formic acid

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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Main points

General

Formic acid has a pungent, penetrating odour and is flammable when exposed to heat or flame. It reacts violently with strong bases and oxidants, generating fire and explosion hazards, and attacks plastics and metals. It emits toxic fumes of carbon monoxide when heated to decomposition or when in contact with strong acids.

Health

Inhalation may cause irritation of the eyes and nose with sore throat, cough, chest tightness, headache, fever, wheeze, tachycardia, and confusion.

Ingestion may cause immediate pain with burning of the mouth, throat and stomach, drooling, difficulty swallowing, abdominal pain, vomiting, haematemesis and dyspnoea. Other symptoms in severe cases can include haemorrhagic or hypovolaemic shock and airway obstruction from laryngeal and/or epiglottic oedema.

Exposure to the skin may cause pain, blistering, ulceration, necrosis and burns.

Exposure to the eye may cause pain, watering, conjunctivitis, oedema, photophobia, corneal burns and limbal ischaemia.

Casualty decontamination at the scene

Following disrobe, improvised wet decontamination should be considered for an incident involving formic acid, due to its corrosive properties.



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 and surface and groundwaters.

Hazard identification

Table 1a. Standard (UK) dangerous goods emergency action codes for formic acid, with more than 85% acid by mass

| | | | | |
|----------------|------------------|-------|---|---|
| UN | | 1779 | Formic acid, with more than 85% acid by mass | |
| EAC | | •2W | Use alcohol-resistant foam but, if not available, fine water spray can be used. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Substance can be violently or explosively reactive. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters. | |
| APP | | A(fl) | Gas-tight chemical protective suit with breathing apparatus [note 2]. Fire kit intended to protect against flammable liquid | |
| Hazards | Class | 8 | Corrosive substances |  |
| | Sub-risks | 3 | Flammable liquids and desensitised liquid explosives |  |
| HIN | | 83 | Corrosive or slightly corrosive substance, flammable (flash-point between 23°C and 60°C inclusive) | |

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

Notes to Table 1a


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.

Note 2: Normal fire kit in combination with gas-tight chemical protective clothing conforming to BS EN 943 part .2 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 14 November 2024)

Table 1b. Standard (UK) dangerous goods emergency action codes for formic acid, with not less than 10% but not more than 85% acid by mass

| | | | | |
|----------------|------------------|------|--|---|
| UN | | 3412 | Formic acid, with not less than 10% but not more than 85% acid by mass | |
| EAC | | •2X | Use alcohol-resistant foam but, if not available, fine water spray can be used. 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 substances |  |
| | Sub-risks | - | - | |
| HIN | | 80 | Corrosive or slightly corrosive substance | |

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.


Notes to Table 1b

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 14 November 2024)

Table 1c. Standard (UK) dangerous goods emergency action codes for formic acid, with not less than 5% but less than 10% acid by mass

| | | | | |
|----------------|------------------|------|---|--|
| UN | | 3412 | Formic acid, with not less than 5% but less than 10% acid by mass | |
| 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 substances |  |
| | Sub-risks | - | - | |
| HIN | | 80 | Corrosive or slightly corrosive substance | |

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

Notes to Table 1c

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 14 November 2024)

Table 2a. The GB classification, labelling and packaging (CLP) regulation for formic acid


| | | | |
|----------------------------------|---------------|---|---|
| Hazard class and category | Skin Corr. 1A | Skin corrosion, category 1A |  |
| Hazard statement | H314 | Causes severe skin burns and eye damage | |
| Signal words | DANGER | | |

Table 2b. Specific concentration limits for formic acid

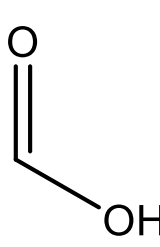
| Concentration | Hazard class and category | Hazard statement | |
|----------------------|---------------------------|------------------|---|
| $C \geq 90\%$ | Skin Corr. 1A | H314 | Causes severe skin burns and eye damage |
| $10\% \leq C < 90\%$ | Skin Corr. 1B | H314 | Causes severe skin burns and eye damage |
| $2\% \leq C < 10\%$ | Skin Irrit. 2 | H315 | Causes skin irritation |
| $2\% \leq C < 10\%$ | Eye Irrit. 2 | H319 | Causes serious eye irritation |

References

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed on 14 November 2024).

Physicochemical properties

Table 3. Physicochemical properties

| | |
|---|--|
| CAS number | 64-18-6 |
| Molecular weight | 46.025 |
| Formula | CH ₂ O ₂ |
| Common synonyms | Hydrogen carboxylic acid, formylic acid, aminic acid, methanoic acid |
| State at room temperature | Colourless fuming liquid |
| Volatility | Vapour pressure = 35 mmHg at 20°C, slightly volatile |
| Specific gravity | 1.2 (water = 1) 1.6 (air = 1) |
| Flammability | Flammable when exposed to heat or flame |
| Lower explosive limit | 18% |
| Upper explosive limit | 51% |
| Water solubility | Miscible with water |
| Reactivity | Reacts violently with oxidants and strong bases generating fire and explosion hazard. Attacks many plastics and metals. Aluminium reduces formic acid with incandescence. Incompatible with sulphuric acid. Forms explosive reaction with furfuryl alcohol and hydrogen peroxide |
| Reaction or degradation products | Decomposes on heating and on contact with strong acids to liberate carbon monoxide |
| Odour | Pungent, penetrating odour |
| Structure |  |

References

World Health Organization. International Programme on Chemical Safety '[International Chemical Safety Card entry for Formic acid](#)' ICSC 0485, 1997 (viewed on 14 November 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. '[PubChem Compound Summary for CID 7855, Formic acid](#)' (viewed on 04 November 2024)

Reported effect levels from authoritative sources

Table 4. Dermal exposure to formic acid

| % | Signs and symptoms | Reference |
|-----|--------------------|-----------|
| >10 | Strongly corrosive | a |

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. European Food Safety Authority (EFSA) Panel on Additives and Products or Substances used in Animal Feed (FEEDAP). '[Scientific opinion on the safety and efficacy of formic acid when used as a technological additive for all animal species](#)' 2014 (viewed on 14 November 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 | No values specified | | | | |
| AEGL-2 | | | | | |
| AEGL-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/m ³ | ppm | mg/m ³ |
| WEL | 5 | 9.6 | No values specified | |

Abbreviations

WEL = workplace exposure limit.

LTEL = long-term exposure limit.

STEL = short-term exposure limit.

Reference

Health and Safety Executive (HSE). '[EH40/2005 Workplace Exposure Limits Fourth Edition](#)' 2020 (viewed on 14 November 2024)

Table 7. Public health standards and guidelines

| | |
|---|--------------------|
| Drinking water standard | No value specified |
| WHO guideline for drinking water quality | No value specified |
| UK indoor air quality guideline | No value specified |
| WHO indoor air quality guideline | No value specified |
| WHO air quality guideline | No value specified |

Health effects

Corrosive by inhalation, ingestion, dermal, and eye contact.

Table 8. Signs or symptoms of acute exposure

| 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.</p> <p>Pulmonary oedema with increasing breathlessness, wheeze, hypoxia and cyanosis may take up to 36 hours to develop.</p> <p>Optic neuropathy has been reported following both acute and chronic 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 cause systemic effects.</p> |
| Ingestion | <p>Immediate pain with burning in the mouth, throat and stomach, which may be followed by abdominal pain, vomiting, haematemesis and dyspnoea. Pain and oedema may make swallowing difficult, causing drooling.</p> <p>Acids can damage the stomach causing ulceration, necrosis, haemorrhage and perforation. In severe cases extensive areas of the gastrointestinal tract may be involved. 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>Systemic effects include hypovolaemic shock, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, severe electrolyte imbalances, haemolysis and disseminated intravascular coagulation (DIC).</p> |

| Route | Signs and symptoms |
|---------------|---|
| | Ingestion of products containing concentrated formic acid is associated with significant mortality, especially in the context of bowel perforation and trachea-oesophageal fistula. A significant proportion of survivors develop oesophageal strictures. |
| Eyes | Eye contact may cause pain, watering, conjunctivitis, oedema and photophobia. Acidic solutions may cause corneal burns and limbal ischaemia. |
| Dermal | Acids (including gaseous and fumes) may cause pain, blistering, ulceration and necrosis These burns may develop, which can be self-limiting and superficial with the destruction of the surface epithelium and sub-mucosa forming a leathery crust which limits the spread of the product. Large or prolonged exposure may result in systemic effects. |

References

National Poisons Information Service (NPIS). TOXBASE '[Formic acid](#)' 2024 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE '[Corrosives - ingestion](#)' 2022 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE '[Corrosives – inhalation](#)' 2020 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE '[Skin decontamination – corrosives](#)' 2020 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE '[Chemicals splashed or sprayed into the eyes - features and management](#)' 2020 (viewed on 14 November 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.

Formic acid is a corrosive substance. Therefore, following disrobe, improvised wet decontamination should be considered (see below for details).

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 intervention, such as an Interim Operational Response is conducted, 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.

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 14 November 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 14 November 2024)

Joint Emergency Service Interoperability Programme. [‘Initial Operational Response \(IOR\) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’](#) 2024 (viewed on 14 November 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.

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.

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. 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 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.

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.

Carry out 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 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.

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.

Carry out other supportive measures as indicated by the patient's clinical condition.

Ingestion

Maintain a clear airway and ensure adequate ventilation.

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 and treating clinicians should have a low threshold for establishing a protected airway.

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.

Consider the use of water or milk (maximum initial volume = 100 to 200 mL in an adult; 2 mL/kg in a child) as diluents for symptomatic benefit early after corrosive ingestion provided the patient does not have swallowing or breathing problems (*but caution is necessary following large ingestions where mucosal damage / perforation may have already developed*).

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

Carry out 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 and treating clinicians should have a low threshold for establishing a protected airway.

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.

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE [‘Formic acid’](#) 2024 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Corrosives - ingestion’](#) 2022 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Corrosives – inhalation’](#) 2020 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Skin decontamination – corrosives’](#) 2020 (viewed on 14 November 2024)

National Poisons Information Service (NPIS). TOXBASE [‘Chemicals splashed or sprayed into the eyes - features and clinical management’](#) 2020 (viewed on 14 November 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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First published: October 2015

Health Effects, Decontamination at the Scene and Clinical Decontamination and First Aid sections update: November 2016

Full document update: November 2024

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

Publishing reference: GOV-17725



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