UK Health Security Agency

Acetic 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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Contents

Main points

General

Acetic acid is a colourless liquid with vinegar odour. It reacts violently with strong oxidisers causing fire and explosion hazard and attacks some forms of plastic, rubber, and coatings. Concentrated solutions may be flammable at higher temperatures.

Health

Acetic acid solutions up to 25% are irritant and more concentrated solutions are corrosive by inhalation, ingestion, contact with eyes and dermal contact.

Inhalation may cause irritation of the eyes and nose, sore throat, cough, chest tightness, headache, fever, wheeze, tachycardia. and confusion. Pulmonary oedema may take up to 36 hours to develop.

Ingestion may result in immediate pain with burning in the mouth, throat and stomach, vomiting, abdominal pain, haematemesis, and dyspnoea. Pain and oedema may make swallowing difficult.

Dermal contact may cause pain, blistering, ulceration, and necrosis.

Ocular exposure may lead to pain, watering, conjunctivitis, oedema, and photophobia

Casualty decontamination at the scene

Acetic acid solutions up to 25 % are irritant and more concentrated solutions are corrosive. Therefore, following disrobe, improvised wet decontamination should be considered.

Environment

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

Hazard identification

Table 1a. Standard (UK) dangerous goods emergency action codes for acetic acid, glacial or acetic acid solution, more than 80% acid, by mass

UN		2789	Acetic acid, glacial or acetic acid solution, more than 80% acid, by mass	
EAC		•2P	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. Where there is an immediate to people, spillages and decontamination run-off may be washed to drains with large quantities of water [note 2].	
APP		A(fl)	Fire kit with gas tight chemical protective suit with breathing apparatus [note 3]. Fire kit intended to protect against flammable liquid.	
Hazards	**Class**	8	Corrosive substances	
	Sub-risks	3	Flammable liquid	
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: In such cases due care must be exercised to avoid unnecessary pollution of surface and groundwaters and wherever possible control measures such as the sealing of drains should be employed.

Note 3: 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 18 October 2024)

Table 1b. Standard (UK) dangerous goods emergency action codes for acetic acid solution, more than 10% but not more than 80%, by mass

UN		2790	Acetic acid solution, more than 10% but not more than 80% acid, by mass	
EAC		•2R	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]. Where there is an immediate threat to people, spillages and decontamination run-off may be washed to drains with large quantities of water [note 2].	
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.

Note 2: In such cases due care must be exercised to avoid unnecessary pollution of surface and groundwaters and wherever possible control measures such as the sealing of drains should be employed.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. 2023 (viewed on 18 October 2024)

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

Hazard class and category	Flam. Liq. 3	Flammable liquid, category 3	
	Skin Corr. 1A	Skin corrosion, category 1A	
Hazard statement	H226	Flammable liquid and vapour	
	H314	Causes severe skin burns and eye damage	
Signal words	DANGER		

Table 2b. Specific concentration limits for acetic acid … %

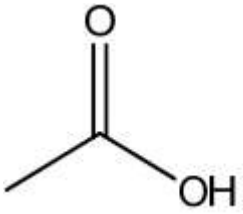
Concentration	Hazard class and category	Hazard statement	
C ≥ 90 %	Skin Corr. 1A	H314	Causes severe skin burns and eye damage
25 % ≤ C < 90 %	Skin Corr. 1B	H314	Causes severe skin burns and eye damage
10 % ≤ C < 25 %	Skin Irrit. 2	H315	Causes skin irritation
10 % ≤ C < 25 %	Eye Irrit. 2	H319	Causes eye irritation

References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 18 October 2024).

Physicochemical properties

Table 3. Physicochemical properties

CAS number	64-19-7
Molecular weight	60.05
Formula	CH_3COOH
Common synonyms	Acetic acid, ethanoic acid, acetic acid glacial, ethylic acid, vinegar
State at room temperature	Clear, colourless liquid.
Volatility	Vapour pressure = 15.7 mmHg at 25°C
Specific gravity	1.05 (water = 1) 2.10 (air = 1)
Flammability	Concentrated solutions may be flammable at higher temperatures.
Lower explosive limit	6.0%
Upper explosive limit	17%
Water solubility	Miscible
Reactivity	Acetic acid is a weak acid. Reacts violently with strong oxidants. This generates fire and explosion hazard. Reacts violently with strong bases, strong acids and many other compounds. Attacks some forms of plastic, rubber and coatings.
Odour	Pungent vinegar odour
Structure	

References

World Health Organization. International Programme on Chemical Safety. International Chemical Safety Card entry for Acetic acid . ICSC 0363, 2010. (viewed on 18 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. 'PubChem Compound Summary for CID 176, Acetic acid' (viewed on 18 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation of vapours

ppm	mg/m^3	Signs and symptoms	Reference
<10	<24.5	Eye irritation	a
25	61.3	Eye, nose and throat irritation- tolerable	a
50	122.5	Eye, nose and throat irritation- intolerable	a

Table 5. Dermal and eye exposure

% Solution	Signs and symptoms	Reference
>80	Severe burns	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. National Institute for Occupational Safety and Health (NIOSH), Occupational Health Guidelines for Chemical Hazards, Acetic Acid, Revised Guideline. 1992(viewed on 18 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/m³**	**ppm**	**mg/m³**
WEL	10	25	20	50

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 18 October 2024)

Table 8. 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

Acetic acid is corrosive (acid) but at the concentration found in vinegar it is likely to be irritant rather than corrosive. Solutions up to 25% are irritant and more concentrated solutions are corrosive by inhalation, ingestion, contact with eyes and dermal contact. The information provided below relates to concentrated solutions.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	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 both acute and chronic inhalation. 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. Prolonged exposure may result in systemic effects
Ingestion	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. Haemorrhagic or hypovolaemic shock and airway obstruction from laryngeal and/or epiglottic oedema are features of severe cases. Stridor and respiratory complications (including pneumonitis, pulmonary oedema, ARDS and pulmonary necrosis) can develop following aspiration of corrosive materials. The presence of oropharyngeal 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

Route	Signs and symptoms
	years. Severe injury can cause pyloric stenosis and a small, scarred, immobile stomach. Ulceration may be sufficiently severe to cause perforation with complications including mediastinitis, pneumonitis and cardiac injury. Acids tend to damage the stomach with ulceration, necrosis, haemorrhage and perforation. However, in severe cases, extensive areas of the gastrointestinal tract may be involved. Systemic features following corrosive ingestion may include hypovolaemic shock, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, severe electrolyte imbalances, haemolysis and disseminated intravascular coagulation (DIC).
Eyes	Pain, watering, conjunctivitis, oedema and photophobia may occur. Acidic solutions may cause corneal burns and limbal ischaemia (whitening/blanching around the edge of the cornea where it meets the sclera). Aerosols sprayed directly into the eye may cause corneal damage.
Dermal	Acids generally produce rapid symptoms. Symptoms are more likely to occur following direct contact with solid or liquid corrosive materials although features can also occur via contact with corrosive gases and fumes. Acids may cause pain, blistering, ulceration and necrosis. These burns may 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.

Reference

National Poisons Information Service (NPIS). TOXBASE ‘acetic acid’ 2020 (viewed on 28 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.

Acetic acid solutions up to 25 % are irritant and more concentrated solutions are corrosive. 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 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

Wet decontamination should be used if contamination with a caustic chemical substance is suspected.

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 2015 (viewed on 28 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 28 October 2024)

Joint Emergency Service Interoperability Programme. 'Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials' 2024 (viewed on 28 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.

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.

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 skin folds, fingernails and ears.

Dermal exposure

Decontaminate (as above) the patient following surface contamination.

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. Attention should be paid to avoiding hypothermia during prolonged irrigation with cool fluids.

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 (e.g. 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 crystalloid (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 15-30 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 referred urgently to an ophthalmologist.

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

Ingestion

Maintain airway and establish haemodynamic stability.

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 check cardiac rhythm. Check the capillary glucose.
Consider the use of water or milk (maximum initial volume = 100-200 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.

Other supportive measures as indicated by the patient's 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 check capillary glucose.

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 'acetic acid' 2020 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'chemicals splashed or sprayed into the eyes - features and clinical management' 2020 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'skin decontamination - irritants' 2019 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'corrosives - ingestion' 2022 (viewed on 28 October 2024)

National Poisons Information Service (NPIS). TOXBASE 'corrosives - inhalation' 2020 (viewed on 28 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 and Environment Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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

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