



Ethylene Glycol

Incident Management

Key Points

General

- liquid at room temperature, miscible with water
- odourless
- slightly combustible
- reacts with strong oxidants and strong bases
- emits acrid smoke and irritating fumes that are slightly hazardous when heated to decomposition

Health effects

- ingestion is the primary route of exposure
- initially there is apparent intoxication with alcohol (but no ethanol on breath)
- metabolic acidosis develops, followed by tachypnoea, coma, seizures, hypertension and convulsions
- if untreated, death from multi-organ failure usually occurs 24–36 hours after ingestion
- eye exposure may cause an immediate stinging and burning sensation with lacrimation

Casualty decontamination at the scene

- following disrobe, improvised dry decontamination should be considered for an incident involving ethylene glycol, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances

Environment


- hazardous to the environment; inform the Environment Agency where appropriate
- spillages and decontamination run-off should be prevented from entering watercourses

Hazard Identification

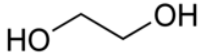
Standard (UK) dangerous goods emergency action codes

UN	Data not available		
EAC			
APP			
Hazards	Class		
	Sub-risks		
HIN			
UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number			

Classification, labelling and packaging (CLP)*

Hazard class and category	Acute Tox. 4	Acute toxicity (oral), category 3	
Hazard statement	H302	Harmful if swallowed	
Signal words	WARNING		
* Implemented in the EU on 20 January 2009			
Reference			
European Commission. Harmonised classification – Annex VI of Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. http://echa.europa.eu/information-on-chemicals/cl-inventory-database (accessed 03/2019).			

Physicochemical Properties

CAS number	107-21-1
Molecular weight	62
Formula	C ₂ H ₆ O ₂
Common synonyms	Ethane-1,2-diol, 1,2-ethanediol, mono ethyl glycol (MEG)
State at room temperature	Liquid
Volatility	Vapour pressure = 0.092 mmHg at 25°C
Specific gravity Vapour density	1.1 (water = 1) 2.1 (air = 1)
Flammability	Slightly combustible; combustible following preheating
Lower explosive limit	3.2%
Upper explosive limit	15.3%
Water solubility	Miscible with water
Reactivity	Reacts with strong oxidants and strong bases generating fire and explosion hazard
Reaction or degradation products	When heated to decomposition it emits acrid smoke and irritating fumes
Odour	Odourless
Structure	
References	
<p>Hazardous Substances Data Bank. Ethylene glycol. HSDB No. 5012 (last revision date 26/04/2012). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 03/2019).</p> <p>International Programme on Chemical Safety. International chemical safety card entry for ethylene glycol. ICSC 0270, 2018. World Health Organization: Geneva.</p>	

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
54	140	Reporting of respiratory tract irritation common	a
≥77	≥200	Intolerable, strong upper respiratory tract irritation (with burning sensation in trachea and burning cough)	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 Agency for Toxic Substances and Disease Registry. Toxicological profile for ethylene glycol, 2010.

Exposure by ingestion

g	Signs and symptoms	Reference
100 (approx 90 mL pure ethylene glycol)	Fatal dose in a 70 kg adult	a

This value gives an indication of levels of exposure that can cause adverse effects. It is not a health protective standard or guideline value

Reference
a TOXBASE. Ethylene glycol, 12/2016. <http://www.toxbase.org> (accessed 03/2019).

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	No data available	
ERPG-2†		
ERPG-3‡		
<p>* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour</p> <p>† Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action</p> <p>‡ Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects</p>		

Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	No data available				
AEGL-2†					
AEGL-3‡					
<p>* Level of the chemical in air at or above which the general population could experience notable discomfort</p> <p>† 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</p> <p>‡ Level of the chemical in air at or above which the general population could experience life-threatening health effects or death</p>					

Exposure Standards, Guidelines or Regulations

Occupational standards

Ethylene glycol		LTEL (8-hour reference period)		STEL (15-min reference period)	
		ppm	mg/m ³	ppm	mg/m ³
WEL	Particulate	–	10	–	–
	Vapour	20	52	40	104

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, 3rd Edition, 2018.

Public health guidelines

Drinking water standard	No guideline values specified
Air quality guideline	No guideline values specified

Health Effects

Major route of exposure

- ingestion is the main route of exposure
- inhalation and skin absorption are not serious hazards

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Ingestion	<p>After a brief period of inebriation due to the intoxicating effect of ethylene glycol itself, metabolic acidosis develops, followed by tachypnoea, coma, seizures, hypertension, the appearance of pulmonary infiltrates and oliguric renal failure. If untreated, death from multi-organ failure usually occurs 24–36 hours after ingestion</p> <p>Stage 1: 30 minutes to 12 hours after ingestion Symptoms include apparent intoxication with alcohol (but no ethanol on breath), nausea, vomiting and haematemesis, coma and convulsions (often focal). Nystagmus, ataxia, ophthalmoplegia, papilloedema, hypotonia, hyporeflexia, myoclonic jerks, tetanic contractions and cranial nerve palsies (II, V, VII, VIII, IX, X and XII) may occur. Metabolic acidosis develops</p> <p>Stage 2: 12 to 24 hours after ingestion Symptoms include increased respiratory rate, sinus tachycardia, hypertension, pulmonary oedema and congestive cardiac failure</p> <p>Stage 3: 24 to 72 hours after ingestion Symptoms including flank pain, renal angle tenderness, acute tubular necrosis, hypocalcaemia (as a consequence of calcium complexing with oxalate), calcium oxalate monohydrate crystalluria, hyperkalaemia and hypomagnesaemia may develop. Calcium oxalate monohydrate crystalluria is diagnostic and hypocalcaemia is frequent. Leucocytosis is a common, but non-specific finding. Severe metabolic acidosis, hyperkalaemia, seizures and coma carry a poor prognosis</p>
Ocular	Eye exposure may cause an immediate stinging and burning sensation with lacrimation
<p>Reference TOXBASE. Ethylene glycol, 12/2016. http://www.toxbase.org (accessed 03/2019).</p>	

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 ethylene glycol unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

Emergency services and public health professionals can obtain further advice from Public Health England (Centre for Radiation, Chemical and Environmental Hazards) using the 24 hour chemical hotline number: 0344 892 0555.

General advice on disrobe and decontamination

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, disrobe at the scene should be 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 (e.g. 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

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 etc) 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/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 people individually.

Detailed information on clinical management can be found on TOXBASE – www.toxbase.org.

Important note

- there are antidotes available for the treatment of ethylene glycol poisoning. Further information is available on TOXBASE. **Early treatment with an antidote will prevent the production of toxic metabolites, severe acidosis and renal failure. Delay in commencing treatment with an antidote will result in a more severely poisoned patient**
- **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

- 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
- pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears

Dermal exposure

- decontaminate (as above) the patient following surface contamination
- other supportive measures as indicated by the patient's clinical condition

Ocular exposure

- if symptomatic, immediately irrigate the affected eye thoroughly

- for patients at home, use lukewarm tap water, trickled into the eye or in a small cup held over the eye socket; an eye dropper is an alternative
- in hospital, 1,000 mL 0.9% saline at room temperature by an infusion bag with a giving set is appropriate, irrigate for 10–15 minutes
- 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

Inhalation

- ensure a clear airway and adequate ventilation
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- maintain a clear airway and ensure adequate ventilation
- monitor vital signs and check capillary blood sugar
- perform a 12 lead ECG in patients who require assessment
- other supportive measures as indicated by the patient's clinical condition

Antidotes

There are antidotes available for the treatment of ethylene glycol poisoning. Further information is available on TOXBASE. Early administration of antidotes will minimise further metabolism of ethylene glycol and the development of clinical and metabolic complications.

Health effects and decontamination references

TOXBASE	http://www.toxbase.org (accessed 03/2019)
TOXBASE	Ethylene glycol, 12/2016
TOXBASE	Eye irritants, 01/2016
TOXBASE	Ethylene glycol – features and management, 12/2016
TOXBASE	Skin decontamination – irritants, 01/2018

This document from the PHE Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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