UK Health Security Agency

Styrene

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

Styrene is a flammable, colourless liquid.

Styrene can form explosive peroxides. Styrene may polymerise due to warming, under the influence of light, oxidants, oxygen and peroxides generating a fire and explosion hazard.

Reacts violently with strong acids and strong oxidants. Attacks rubber, copper and copper alloys.

Health

Styrene can cause systemic effects by all routes of exposure.

Systemic toxicity causes central nervous system effects named “styrene sickness”, which includes headache, ataxia, fatigue, weakness and dizziness. In severe cases, progressive loss of consciousness leading to coma, pulmonary oedema and cardiac arrhythmias may occur.

Inhalation of styrene causes irritation of mucous membranes, coughing and wheezing.

Gastrointestinal upset may occur following ingestion.

Dermal exposure can cause irritation, itching, dermatitis and erythematous papular dermatitis.

Styrene is irritating to the eyes.

Casualty decontamination at the scene

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

Environment

Inform the Environment Agency where appropriate.

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.

Hazard identification

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

UN		2055	Styrene monomer, stabilized	
EAC		3Y	Use normal foam, i.e., protein-based foam that is not alcohol resistant. Wear normal fire kit 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		–	–	
Hazards	**Class**	3	Flammable liquids and desensitised liquid explosives	
	Sub-risks	–	–	
HIN		39	Flammable liquid, which can spontaneously lead to violent reaction	

Abbreviations

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

Note to Table 1

Note 1: Normal firefighting clothing is appropriate i.e., self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3- Hazmat and structural firefighting or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. 2023. (viewed on 28 October 2024)

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

Hazard class and category	Flam. Liq. 3	Flammable liquid, category 3	
	Repr. 2	Reproductive toxicity, category 2	
	Acute Tox. 4	Acute toxicity (inhalation), category 4	
	STOT RE 1	Specific target organ toxicity repeated exposure, category 1	
	Skin Irrit. 2	Skin corrosion/irritant, category 2	
	Eye Irrit. 2	Eye irritant, category 2	
Hazard statement	H226	Flammable liquid and vapour	
	H361(d)	Suspected of damaging the unborn child	
	H332	Harmful if inhaled	
	H372 (hearing organs)	Causes damage to the hearing organs through prolonged or repeated exposure	
	H315	Causes skin irritation	

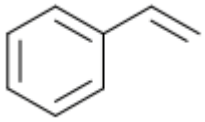
	H319	Causes serious eye irritation
Signal words	DANGER	

Reference

The Health and Safety Executive (HSE). ‘GB CLP Regulation’ (viewed on 28 October 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	100-42-5
Molecular weight	104.2
Formula	$C_6H_5CHCH_2$
Common synonyms	Ethylbenzene, vinylbenzene, phenylethylene, styrol
State at room temperature	Colourless to yellow oily liquid
Volatility	Vapour pressure = 6.4 mmHg at 25°C
Relative density	(Water = 1) 0.91 (Air = 1) 3.6
Flammability	Flammable liquid
Lower explosive limit	0.9%
Upper explosive limit	6.8%
Water solubility	Insoluble
Reactivity	Can form explosive peroxides. May polymerise due to warming, under the influence of light, oxidants, oxygen and peroxides generating a fire and explosion hazard. Reacts violently with strong acids and strong oxidants. Attacks rubber, copper and copper alloys.
Odour	Sweet smell
Structure	

References

World Health Organization International Programme on Chemical Safety. 'International Chemical Safety Card entry for styrene'. ICSC 0073, 2006 (viewed on 28 October 2024)

PubChem Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-.'PubChem Compound Summary for CID 7501, Styrene' (viewed on 28 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation

mg/m^3	ppm	Signs and symptoms	Reference
371	87	Vestibular impairment (1-hour exposure)	a
210-840	50-200	Eye, nose and lip irritation. Dizziness, headache, drowsiness, lack of concentration, lightheadedness and fatigue. (1-3hr exposure)	b
2520-3360	600-800	Strong immediate irritation of the eyes and respiratory tract	b
µg/L			
905		Throat and adverse GI effects including abdominal pain	c

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. Agency for Toxic Substances and Disease Registry (ATSDR).'Toxicological Profile for Styrene' 2010 (viewed 28 October 2024).

b. International Programme on Chemical Safety (IPCS). Environmental Health Criteria: 26 1983 (viewed on 28 October 2024)

c.National Poisons Information Service (NPIS) TOXBASE. 'Styrene' 2023 (viewed on 28 October 2024)

Published emergency response guidelines

Table 5. Interim acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	20	20	20	20	20
AEGL-2 [note 2]	230	160	130	130	130
AEGL-3 [note 3]	1900 [note 4]	1900 [note 4]	1100 [note 4]	340	340

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.

Note 4: The lower explosive limit (LEL) = 9,000 ppm. The AEGL value is >10% of the LEL therefore safety considerations against the hazard of explosions must be taken into account at these concentrations.

Reference

US Environmental Protection Agency (EPA) ‘Acute Exposure Guideline Levels’ (viewed on 28 October 2024)

Exposure standards, guidelines or regulations

Table 6. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	**mg/m³**	**ppm**	**mg/m³**
WEL	100	430	250	1080

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 28 October 2023)

Table 7. Public health standards and guidelines

Drinking water standard	No guideline value specified
WHO guideline for drinking water quality	20 µg/L
WHO air quality guideline	No guideline value specified

References

World Health Organization. 'Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addendum' 2022 (viewed on 28 October 2024)

Health effects

Can cause toxicity by ingestion, inhalation and skin contact.

Both the vapour and liquid are irritating to mucous membranes, eyes, skin and the respiratory tract. Exposure to high concentrations causes central nervous system depression.

Table 8. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Readily causes systemic toxicity as styrene is quickly absorbed. Irritation of the mucous membranes, dyspnoea, cough, wheeze, and pulmonary oedema may occur.
Ingestion	GI upset and irritation to the throat may occur. Systemic toxicity may occur.
Dermal	Irritation, itching, dermatitis and erythematous papular dermatitis have been reported. As styrene is absorbed via the skin, systemic toxicity including CNS depression is possible.
Ocular	Styrene is an eye irritant. Systemic toxicity is possible.
Systemic features	Systemic toxicity causes central nervous system effects named “styrene sickness”, which includes headache, ataxia, fatigue, weakness, and dizziness. In severe cases, progressive loss of consciousness leading to coma, pulmonary oedema, and cardiac arrhythmias may occur.

Reference

National Poisons Information Service (NPIS) TOXBASE. ‘Styrene’ 2023 (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.

Following disrobe, improvised dry decontamination should be considered for an incident involving styrene 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 (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

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 Interoperablility 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 soap and copious amounts of 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.

For systemic toxicity manage as per inhalation.

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 7.0 to 8.0. The conjunctivae may be tested with indicator paper. Retest 20 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 discussed urgently with an ophthalmologist.

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

Ingestion

Maintain a clear airway and ensure adequate.

The beneft of gastic decontamination using activated charcoal is uncertain. See TOXBASE for further advice in this.

Monitor vital signs and 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.

Inhalation

Maintain a clear airway and ensure adequate ventilation.

Remove from source of exposure.

Administer oxygen to achieve adequate oxygenation.

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. 'Styrene' 2023 (viewed on 28 October 2024)

National Poisons Information Service (NPIS) TOXBASE: 'Chemicals splashed or sprayed into eyes – features and management' 2020 (viewed on 28 October 2024)

National Poisons Information Service (NPIS) TOXBASE 'skin decontamination - irritants' 2019 (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.

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