Styrene

Incident management

Key Points

Fire

- Flammable
- Normally stable. Can react with oxygen, strong oxidisers or acids
- Emits toxic fumes of styrene oxide when heated to decomposition
- In the event of a fire involving styrene, use normal foam and normal fire kit with breathing apparatus

Health

- Toxic by inhalation, ingestion and dermal absorption
- Harmful and irritant
- Inhalation of styrene causes irritation of mucous membranes, coughing, wheezing pulmonary oedema, cardiac arrhythmias and coma
- Styrene inhalation may also lead to "styrene sickness", which includes headache, nausea, vomiting, weakness, fatigue, dizziness and ataxia
- Ingestion of styrene may lead to CNS depression
- Dermal exposure may result in irritation, itching and dermatitis. CNS depression may also occur

Environment

- Avoid release into the environment
- Inform Environment Agency of substantial incidents

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Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes[a]

UN		**2055**	Styrene monomer, stabilised	
EAC		**3Y**	Use normal foam. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses.	
APP		**-**		
Hazards	**Class**	**3**	Flammable liquid	
	Sub risks	**-**		
HIN		**39**	Flammable liquid, which can spontaneously lead to a violent reaction	

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

*Normal fire fighting clothing i.e. fire kit (BS EN 469), gloves (BS EN 659) and boots (HO specification A29 and A30) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

[a] Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

Chemical Hazard Information and Packaging for Supply Classification[a]

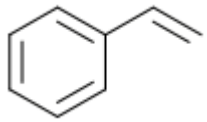
Classification	**F**	Flammable	
	Xn	Harmful	
	Xi	Irritant	
Risk phrases	**R10**	Flammable	
	R20	Harmful by inhalation	
	R36/38	Irritating to eyes, respiratory system and skin	
Safety phrases	**S2**	Keep out of the reach of children	
	S23	Do not breathe gas/fumes/vapour/spray (appropriate wording to be specified by the manufacturer)	

Specific concentration limits

Concentration	Classification
C ≥ 12.5 %	Xn; R20-36/38

[a] European Chemicals Bureau, Classification and Labelling, Annex I of Directive 67/548/EEC; http://ecb.jrc.it/classification-labelling/ (accessed 02/2007).

Physicochemical Properties

CAS number	100-42-5
Molecular weight	104
Empirical formula	C_8H_8
Common synonyms	Ethenylbenzene; Styrolene; Phenylethylene; Vinylbenzene
State at room temperature	Liquid
Volatility	Vapour pressure 6.4 mm Hg at 25°C. Styrene vapours are heavier than air at 25°C
Specific gravity	0.9 at 25°C (water = 1)
Flammability	Flammable liquid
Lower explosive limit	0.9%
Upper explosive limit	6.8%
Water solubility	Low solubility in water, 310mg L^{-1} at 20°C. Soluble in ethanol, benzene, acetone and ether
Reactivity	Normally stable when inhibited. Styrene polymerises slowly when uninhibited or at low inhibitor concentrations when at room temperature and on exposure to light and air. Can react with oxygen, strong oxidisers and strong acids
Reaction or degradation products	Emits toxic fumes of styrene oxide when heated to decomposition
Odour	Sweet
Structure	

References[a,b,c]

[a] Styrene (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 02/2007).
[b] The Merck Index (14th Edition). Entry 8860: Styrene, 2006.
[c] The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 7, 1999.

Threshold Toxicity Values

EXPOSURE VIA INHALATION		
ppm	**mg m^{-3}**	**SIGNS AND SYMPTOMS**
100	**420**	Irritation of mucous membranes, eyes and upper respiratory tract
200	**840**	Irritating to eyes and nose, central nervous system effects, drowsiness, nausea, disturbed balance, tendency of impairment of reaction time
350	**1488**	Marked effects on central nervous system and definite impairment of coordination and motor function
600 - 800	**2520 - 3360**	Strong immediate irritation of eyes and respiratory tract

Reference[(a)]

[a] International Programme on Chemical Safety, Environmental Health Criteria 26: Styrene, 1983.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values[a]

	Listed value (ppm)	Calculated value (mg m^{-3})
ERPG-1*	50	213
ERPG-2**	250	1065
ERPG-3***	1000	4260

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
*** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

Interim Acute Exposure Guideline Levels (AEGLs)[b]

	ppm				
	10 min	**30 min**	**60 min**	**4 hr**	**8 hr**
AEGL-1†	20	20	20	20	20
AEGL-2††	230	160	130	130	130
AEGL-3†††	1900◊	1900◊	1100◊	340	340

† The level of the chemical in air at or above which the general population could experience notable discomfort.
†† The 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.
††† The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

Lower Explosive Limit (LEL) = 9000 ppm
◊ ≥ 10 % LEL

[a] American Industrial Hygiene Association (AIHA). Emergency Response Planning Guideline Values and Workplace Environmental Exposure Level Guides Handbook, Fairfax, VA, 2005.
[b] U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, http://www.epa.gov/oppt/aegl/pubs/chemlist.htm (accessed 02/2007).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL[a]	LTEL(8 hour reference period): 100 ppm (430 mg m^{-3})
	STEL(15 min reference period): 250 ppm (1080 mg m^{-3})

Public health guidelines

DRINKING WATER QUALITY GUIDELINE[b]	0.02 mg L^{-1}
AIR QUALITY GUIDELINE[c]	0.26 mg m^{-3} (weekly average) 70 μg m^{-3} as a 30 minute average (based on odour threshold)
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline value specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

[a] Health & Safety Executive. EH40/2005 Workplace Exposure Limits 2005. The Stationery Office, London, 2005.
[b] Guidelines for Drinking-Water Quality. 3rd Edition. Volume 1. Recommendations. WHO. Geneva. 2004.
[c] Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.

Health Effects

Major route of exposure[(a)]

- Toxic by inhalation, ingestion and dermal absorption.

Immediate Signs or Symptoms of Acute Exposure

- Inhalation causes irritation of mucous membranes, coughing and wheezing. Inhalation by workers has been reported to cause "styrene sickness", the features of which include headache, nausea, vomiting, weakness, fatigue, dizziness and ataxia. May cause progressive loss of consciousness leading to coma. Pulmonary oedema and cardiac arrhythmias may occur.
- Ingestion can cause CNS depression as styrene is absorbed via the GI tract.
- Dermal exposure may cause irritation, itching, dermatitis and erythematous papular dermatitis have been reported. As styrene is absorbed via the skin, CNS depression is possible.

TOXBASE - http://www.toxbase.org
[a] TOXBASE: Styrene, 2005.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Flammability warning: prevent exposure to all sources of ignition such as naked flames, electrical equipment, oxidising chemicals and the smoking of tobacco products.

Dermal exposure[(a)]

- Remove patient from exposure.
- The patient should remove all clothing and personal effects.
- Double-bag soiled clothing and place in a sealed container clearly labelled as a biohazard.
- Gently blot away any adherent liquid from the patient.
- Wash hair and all contaminated skin with copious amounts of water (preferably warm) and soap for at least 10-15 minutes. Decontaminate open wounds first and avoid contamination of unexposed skin.
- Pay special attention to skin folds, axillae, ears, fingernails, genital areas and feet.
- Observe for six hours after exposure.

Ocular exposure[(b)]

- Remove patient from exposure.
- Remove contact lenses if present and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.

Inhalation[(c)]

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give high flow oxygen to symptomatic patients.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ingestion[(a)]

- Ensure a clear airway and adequate ventilation.
- Observe for at least 4 hours after ingestion.
- Apply other supportive measures as indicated by the patient's clinical condition.

TOXBASE - http://www.toxbase.org
[a] TOXBASE: Skin decontamination – solvents, 1996.
[b] TOXBASE: Chemicals splashed or sprayed into the eyes, 2007.
[c] TOXBASE: Styrene, 2005.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.