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Safety Data Sheet

1. PRODUCT IDENTIFICATION

Name **Styrene Monomer**
Synonyms **ethenylbenzene, phenylethene, vinylbenzene, cinnamene, & others**
CAS# **100-42-5**
EC# **202-851-5**
Product Uses **manufacture of polymers & co-polymers of styrene**

2. HAZARDS

Quick Guide: flammable liquid, heavy vapour may travel, distant ignition and flashback are possible, slightly irritating to skin, severe eye irritant; equivocal human carcinogen (leukaemia)

Canada – WHMIS **B 2, D 2A**
Key: ***B 2*** *– Flash Point <38°C,* ***B 3*** *– Flash Point >38°C & <93°C*
D 1 *– Immediately Toxic,* ***D 2*** *– Chronic Toxicity*
C *– Oxidising Substance,* ***E*** *– Corrosive,* ***F*** *– Reactive Substance*

U.S.A. – HMIS **Health – 2, Fire – 3, Reactivity – 1**
Key: ***0****=minimal,* ***1****=slight,* ***2****=moderate,* ***3****=serious,* ***4****=severe*

3. COMPOSITION

	%	TWAEV / TLV mg/m^3	LD_{50} (mg/kg) ORAL	LD_{50} (mg/kg) SKIN	LC_{50} ppm INHALATION
Styrene	>99%	20 / 85	316	not known	2235

4. FIRST AID

SKIN: Wash with soap & plenty of water. Remove contaminated clothing and do not reuse until thoroughly laundered.
EYES: Wash eyes with plenty of water, holding eyelids open. Seek medical assistance promptly if there is irritation.
INHALATION: Remove from contaminated area promptly. ***CAUTION: Rescuer must not endanger himself!*** If breathing stops, administer artificial respiration and seek medical aid promptly.
INGESTION: Give plenty of water to dilute product. Do not induce vomiting (NOTE below). Keep victim quiet. If vomiting occurs, lower victim's head below hips to prevent inhalation of vomited material. Seek medical help promptly.

Inadvertent inhalation of vomited material may seriously damage the lungs. The danger of this is greater than the risk of poisoning through absorption of this relatively low-toxicity substance. The stomach should only be emptied under medical supervision, and after the installation of an airway to protect the lungs.

5. FIRE FIGHTING & FLAMMABILITY

Flash Point	31°C / 88°F (closed cup)
Autoignition Temperature	490°C / 914°F
Flammable Limits	0.9% – 6.8%
Combustion Products	carbon monoxide, nitrogen oxides, aldehydes & peroxides
Firefighting Precautions	foam, dry chemical, water fog, water spray only, product floats on water – water jet may spread flames; firefighters must wear SCBA
Static Charge Accumulation	accumulates a static charge on agitation or pumping

Please ensure that this MSDS is given to, and explained to people using this product.

6. ACCIDENTAL RELEASE MEASURES

Summer Fire Potential: Above 30°C blanket spill with foam as a precaution against accidental ignition; take extreme care to avoid sparks – do not operate (turn on OR off) electrical appliances near spill, unless explosion proof.

Leak Precaution	dyke to control spillage and prevent environmental contamination
Handling Spill	ventilate contaminated area; recover free liquid with suitable pumps; absorb residue on an inert sorbent, sweep & pick up using plastic or aluminium shovel, & store in closed containers for recycling or disposal

7. HANDLING & STORAGE

Store below 29°C (84°F) in a cool, dry environment, away from sources of ignition, heat and oxidising agents. Use non-sparking bronze or aluminium hand tools. All electrical and mechanical equipment (including lighting, switchgear and forklift trucks) used with or around this product must be explosion-proof. *Storage beyond 3 months is not recommended. After one month in storage check the titre of inhibitor* (4-*tert*-butyl catechol – CAS# 98-29-3 – maintain at 10-50ppm) *weekly and replenish as necessary.* Check storage tank pressure vents to ensure these are free of polymerised material. Tank ventilation is mandatory; the inhibitor is ineffective in the absence of oxygen!

This product retains a static charge on agitation or transfer from one container to another. Ground or electrically bond both the source container and the receiving container, and transfer pump before transferring contents. Avoid splashing by ensuring that the product nozzle is below the surface in the receiving container.

Avoid breathing product vapour. Use with adequate ventilation. If dealing with a spill, and ventilation is impossible or impractical, wear a suitable respirator with an organic vapour cartridge.

Never cut, drill, weld or grind on or near this container. Avoid contact with skin and wash work clothes frequently. An eye bath and safety shower must be available near the workplace.

8. EXPOSURE CONTROL & PERSONAL PROTECTION

Ontario TWAEV	35ppm / 85mg/m^3	**Ontario STEL**	100 / 420mg/m^3
ACGIH TLV	20ppm / 85mg/m^3		
OSHA PEL	100ppm / 420mg/m^3		
Ventilation	mechanical ventilation may be required to control airborne titre to regulated limits		
Hands	"Viton" gloves recommended – *other types may also protect; consult supplier to confirm suitability*		
Eyes	safety glasses with side shields; a face shield may also be appropriate – *always protect the eyes*		
Clothing	wear impermeable (above) apron, boots, & long sleeves if there is any danger of splashing,		

9. PHYSICAL PROPERTIES

Odour & Appearance	clear, colourless or pale yellow liquid with a sweet floral odour at low concentration, but *sharp, penetrating & disagreeable at high concentration*
Odour Threshold	0.15ppm
Vapour Pressure	4.5mmHg / 0.6kPa (20°C / 68°F)
Evaporation Rate (*Butyl Acetate = 1*)	not known – *similar to stoddart solvent*
Vapour Density (air = 1)	3.6
Boiling Range	145°C / 293°F
Freezing Point	-31°C / -23°F
Specific Gravity	0.906 (20/20°C)
Water Solubility	300mg per litre (20°C / 68°F)
Also soluble in	most organic solvents
Viscosity	0.75centipoise (20°C / 68°F)
pH	none – (*does not liberate hydrogen ions when dissolved*)
Conversion Factor	1ppm = 4.25mg/m^3
Molecular Weight	104grams per mole

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10. REACTIVITY

Dangerously Reactive With	strong oxidising agents;
Also Reactive With	polymerises in presence of alkali metals, ferric or aluminium chloride, graphite, peroxides & strong acids; may corrode copper & copper alloys & grey cast iron
Stability	stable in the presence of appropriate inhibitors; polymerises gradually between 30°C / 86°F and 65°C / 149°F and rapidly above 95°C / 203°F.
Decomposes in Presence of	air – to form explosive peroxides
Decomposition Products	apart from Hazardous Combustion Products – styrene oxide
Sensitive to Mechanical Impact	no

11. TOXICITY

Effects, Acute Exposure

Skin Contact	moderately irritating if not removed promptly
Skin Absorption	yes; no toxic effects likely by this route
Eye Contact	appears severely irritating in humans with no permanent damage; vapour irritating above 375ppm
Inhalation	may irritate above 200ppm; central nervous depression (nausea & headache) at 375ppm; at 800ppm, immediate irritation, drowsiness, dizziness, weakness, intoxication
Ingestion	not known – probably causes central nervous depression similar to inhalation (above)

Effects, Chronic Exposure

General	prolonged exposure may cause dermatitis & skin cracking; weak evidence shows subtle changes in balance & vision; minor changes in liver enzymes have been detected, but not linked to disease
Sensitising	not considered a sensitiser in humans or animals
Carcinogen/Tumorigen	not classified a tumorigen or a carcinogen in humans by ACGIH; IARC classifies it as a "*possible human carcinogen*"
Reproductive Effect	no known effect in humans or animals
Mutagen	no known effect on humans or animals
Synergistic With	toxicity enhanced by simultaneous exposure to organic solvents, *including ethyl alcohol*
LD_{50} (oral)	2650, 5000, 6600 & 8000mg/kg (rat), 316, 660 & 906mg/kg (mouse), 5000-8000mg/kg (rat)
LD_{50} (skin)	no data available
LC_{50} (inhalation)	2425, 2770 & 5650ppm (rat), 2235, 1960 & 4940ppm (mouse)

12. ECOLOGICAL INFORMATION

Bioaccumulation	styrene is metabolised or eliminated (4 days in mammals); cannot bioaccumulate
Biodegradation	biodegrades readily & rapidly in the presence of oxygen; landfill – 60, 70 & 87% in 28 days
Abiotic Degradation	reacts with atmospheric hydroxyl radicals; estimated ½-life in air is 3 – 9 hours (*several tests*)
Mobility in soil, water	almost insoluble in water; low mobility in soil and water
Aquatic Toxicity	
LC_{50} (Fish, 96hr)	64.7mg/litre (Carassius auratus), 74.8mg/litre (Lebistes reticulatus), 25.1mg/litre (Lepomis macrochirus), 29-59mg/litre (Pimephelas promelas), 9mg/litre (Cyprinodon variegatus) & others
EC_{50} (Crustacea, 48hr)	52mg/litre (Artemia salina), 4.7, 23 & 182mg/litre (Daphnia magna),
EC_{50} (Algae)	0.72 & 1.4mg/litre (Selenastrum capricornutum)
EC_{50} (Bacteria)	5.5mg/litre (Photobacterium phosphoreum)
EC_{10} (Bacteria)	223mg/litre (Pseudomonas putida)

13. DISPOSAL

Waste Disposal	**do not flush to sewer**, may be incinerated in approved facility
Containers	**Drums** should be reused. Recondition and pressure test by a licensed reconditioner prior to re-use. **Pails** must be vented and thoroughly dried prior to crushing and recycling. **IBCs** (intermediate bulk containers): polyethylene bottle must be pressure tested & recertified at 30 months. Replace at 60 months (5yrs). Steel containers must be inspected, pressure tested & recertified every 5 years. ***Never cut, drill, weld or grind on or near this container, even if empty***

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14. TRANSPORT CLASSIFICATION

Canada TDG	**PIN**	**UN-2055**
AND	**Shipping Name**	**styrene monomer, stabilised**
U.S.A. 49 CFR	**Class**	**3**
	Packing Group	**III**
ERAP Required		**NO**

EMERGENCY INFORMATION

Canada	**Call CANUTEC (collect)**	**(613) 996-6666**
U.S.A.	**Call CHEMTREC**	**(800) 424-9300**

15. REGULATIONS

Canada DSL	**on inventory**
U.S.A. TSCA	**on inventory**
Europe EINECS	**on inventory**
Europe Classification	**Flammable** **Harmful**
Europe Risk Phrases	**R:10, 20, 36/38 –** *Flammable. Harmful by inhalation. Irritating to eyes & skin.*
Europe Safety Phrases	**S: 23 –** *Do not breathe vapour.*

Immediately Dangerous to Life or Health: 700 ppm

Acceptable Daily Intakes: In ADI of 0.133 mg/kg/day was calculated on the basis of the available chronic toxicity data /for rats/. [REF-222, p.765]

OSHA Standards: Permissible Exposure Limit: Table Z-2 8-hr Time Weighted Avg: 100 ppm. Permissible Exposure Limit: Table Z-2 Acceptable Ceiling Concentration: 200 ppm. Permissible Exposure Limit: Table Z-2 Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. Concentration: 600 ppm. Maximum Duration: 5 minutes in any 3 hours.

NIOSH Recommendations: Recommended Exposure Limit: 15 Min Short-Term Exposure Limit: 100 ppm (425 mg/cu m). Recommended Exposure Limit: 10 Hr Time-Weighted Avg: 50 ppm (215 mg/cu m).

Threshold Limit Values: 8 hr Time Weighted Avg (TWA): 20 ppm; 15 min Short Term Exposure Limit: 40 ppm. Styrene monomer is not classifiable as a human carcinogen. Biological Exposure Index (BEI): Determinant: mandelic acid plus phenylglyoxylic acid in urine; Sampling Time: end of shift; BEI: 400 mg/g creatinine. The determinant is nonspecific, since it is also observed after exposure to other chemicals. Biological Exposure Index (BEI): Determinant: styrene in venous blood; Sampling Time: end of shift; BEI: 0.2 mg/L. The biological determinant is an indicator of exposure to the chemical, but the quantitative interpretation of the measurement is ambiguous. These determinants should be used as a screening test if a quantitative test is not practical, or as a confirmatory test if the quantitative test is not specific and the origin of the determinant is in question.

Atmospheric Standards: This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Styrene is produced, as an intermediate or a final product, by process units covered under this subpart. Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Styrene is included on this list.

Federal Drinking Water Standards: EPA 100 ug/l

Federal Drinking Water Guidelines: EPA 100 ug/l

Sate Drinking Water Guidelines: Arizona 140 ug/l; ine 140 ug/l

Clean Water Act Requirments: Styrene is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1000 lb or 454 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b).

FDA Requirements: Styrene is an indirect food additive for use only as a component of adhesives. Styrene is a food additive permitted for direct addition to food for human consumption as a synthetic flavoring substance and adjuvant in accordance with the following conditions: a) they are used in the minimum quantity required to produce their intended effect, and otherwise in accordance with all the principles of good manufacturing practice, and 2) they consist of one or more of the following, used alone or in combination with flavoring substances and adjuvants generally recognized as safe in food, prior-sanctioned for such use, or regulated by an appropriate section in this part.

16. OTHER INFORMATION

Prepared for Megaloid Laboratories by Peter Bursztyn, (705) 734-1577
*Data from **RTECS**, **HSDB** (Haz. Substance Data Base), **Cheminfo** (CCOHS), **IUCLID** Datasheets (ESIS – European Chem. Substance Info. System), & others.*
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