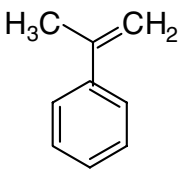
α-Methyl styrene

MAK value (1980)	**100 ml/m^3 (ppm)** **490 mg/m^3**
Peak limitation (1997)	**Category I**
Absorption through the skin	**–**
Sensitization	**–**
Carcinogenicity	**–**
Prenatal toxicity	**–**
Germ cell mutagenicity	**–**
BAT value	**–**
Synonyms	AMS isopropenylbenzene 1-methyl-1-phenylethylene 1-phenyl-1-methylethylene 2-phenylpropene
Chemical name (CAS)	(1-methylethenyl)-benzene
CAS number	98-83-9
Structural formula	
Molecular formula	C_9H_{10}
Molecular weight	118.19
Melting point	–23°C
Boiling point	123°C
Density at 20°C	0.908 g/cm^3
Vapour pressure at 20°C	3 hPa
1 ml/m^3 (ppm) ≙ 4.84 mg/m^3	**1 mg/m^3 ≙ 0.207 ml/m^3 (ppm)**

The MAK value for α-methyl styrene of 100 ml/m^3 which was valid until 1997 was established in 1980 in analogy to the TLV value at the time. The present document is based on a review of the toxicological data for α-methyl styrene by the American Conference of Governmental Industrial Hygienists (ACGIH 1992).

1 Toxic Effects and Mode of Action

α-Methyl styrene is a polymerizable, colourless liquid, which is used as the monomer in the production of plastics and synthetic resins. It has a pungent, unpleasant odour, which is first perceived at concentrations of about 0.3 ml/m^3 (Amoore and Hautala 1983). The critical effect is the irritation of the skin and mucous membranes. In man, irritation of the eyes was observed from concentrations of about 200 ml/m^3. In high concentrations α-methyl styrene is hepatotoxic and nephrotoxic in animals.

α-Methyl styrene was not found to be mutagenic in the *Salmonella* mutagenicity test, but leads to a marginal increase in the incidence of SCE (sister chromatid exchange). The assumed metabolite, α-methyl styrene oxide, however, was found to be mutagenic.

2 Toxicokinetics and Metabolism

There are no data available for the toxicokinetics of α-methyl styrene, and only few data for its metabolism. Atrolactic acid, the methyl derivative of mandelic acid, was detected in the urine of man after inhalation exposure and in the urine of rats and dogs after oral administration (no further details) (Bardodej and Bardodejova 1970). α-Methyl styrene is thought to be metabolized to a small extent to α-methyl styrene oxide (Rosman *et al*. 1986). Studies of dermal irritation with rabbits yielded no evidence of the absorption of toxic amounts of α-methyl styrene via the skin (Wolf *et al*. 1956).

3 Effects in Man

Volunteers who were exposed for a short time to α-methyl styrene concentrations of 600 ml/m^3 or more complained about the unpleasant odour and severe irritation of the mucous membranes of the eyes and nose. At 200 ml/m^3 the eye irritation was only slight, the odour, however, was regarded as a nuisance. α-Methyl styrene concentrations of 100 ml/m^3 were perceived clearly, but without any great discomfort (Wolf *et al*. 1956).

4 Animal Experiments and *in vitro* Studies

4.1 Acute toxicity

There are no data available for short-term inhalation exposure to α-methyl styrene.

α-Methyl styrene is of low acute oral toxicity. The LD_{50} in rats was given as 4900 mg/kg body weight (Wolf *et al*. 1956).

4.2 Subacute, subchronic and chronic toxicity

Groups of 10–25 rats, 5–10 guinea pigs, 1–2 rabbits and 1–2 monkeys, usually of both sexes, were exposed to α-methyl styrene vapour in concentrations of 200 and 600 ml/m^3, rats and guinea pigs additionally to 800 and 3000 ml/m^3, for 7 hours a day on 5 days a week for up to 7 months. Deaths occurred among the rats and guinea pigs at 3000 ml/m^3 and in the rabbits at 600 ml/m^3. Adverse effects such as delayed growth and increased liver and kidney weights were observed after 600 and 800 ml/m^3. A NOAEL (no observed adverse effect level) of 200 ml/m^3 was determined for all species investigated (Wolf *et al*. 1956). No details of the histopathology were given.

4.3 Local effects on skin and mucous membranes

Application (no further details) for 2 to 4 weeks (10 to 20 applications) of undiluted α-methyl styrene to the rabbit ear or to shaved rabbit skin under a bandage led to moderate to severe irritation and slight necrosis. Only slight irritation was observed in the rabbit eye after instillation of 2 drops of α-methyl styrene (Wolf *et al*. 1956).

4.4 Genotoxicity

α-Methyl styrene in concentrations up to 3333 µg/plate yielded negative results in the *Salmonella* mutagenicity test (with pre-incubation) with the strains TA100, TA1535, TA97 and TA98 (Zeiger *et al*. 1992). α-Methyl styrene is probably metabolized to a small extent to α-methyl styrene oxide, which was found to be mutagenic in the *Salmonella* strain TA100 without metabolic activation. The mutagenic effects were more pronounced than those of styrene oxide (Rosman *et al*. 1986).

In human lymphocytes *in vitro*, α-methyl styrene induced a marginal increase (to less than twice the control value) in the incidence of SCE, which was found to be significant ($p < 0.05$) only at 0.33 mM (Norppa and Vainio 1983).

There are no studies available on the carcinogenicity of α-methyl styrene.

5 Manifesto (MAK value/classification)

The critical effect after exposure to α-methyl styrene seems to be the irritative effect on the mucous membranes. There are, however, few data available. While volunteers found concentrations of 200 ml/m^3 still to be unpleasant, 100 ml/m^3 was tolerated without great discomfort. As after long-term studies with various species including rhesus monkeys the NOAEL for systemic toxicity was found to be 200 ml/m^3, the provisional retention of the MAK value of 100 ml/m^3 is justified. However, urgently required are further studies of the irritative and systemic effects of α-methyl styrene and—in view of the neurotoxic effects of styrene and the mutagenic effects of styrene oxide and α-methyl styrene oxide—also studies of the neurotoxic and mutagenic effects of α-methyl styrene. Because of its irritative effects, α-methyl styrene has been classified in Peak limitation category I.

Designation with an "H" (for substances which can be absorbed in dangerous amounts through the skin) is not necessary.

6 References

ACGIH (American Conference of Governmental Industrial Hygienists) (1992) *Documentation of the threshold limit values and biological exposure indices, α-methyl styrene*, ACGIH, Cincinnati, OH

Amoore JE, Hautala E (1983) Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. *J Appl Toxicol 3*: 272–290

Bardodej Z, Bardodejova E (1970) Biotransformation of ethyl benzene, styrene, and alpha-methylstyrene in man. *Am Ind Hyg Assoc J 31*: 206–209

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