FOREWORD INTRODUCTION

METHYL METHACRYLATE

CAS N°: 80-62-5

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	80-62-6
Chemical Name	Methyl methacrylate
Structural Formula	CH_2=CH(CH_3)-COOCH_3

RECOMMENDATIONS

The chemical is a candidate for further work.

SUMMARY CONCLUSIONS OF THE SIAR

Human Health

MMA is rapidly absorbed after oral or inhalatory administration. *In vitro* skin absorption studies in human skin indicate that MMA can be absorbed through human skin. After inhalation to rats 10 to 20% of the substance is deposited in the upper respiratory tract where it is metabolised by local tissue esterases.

Acute toxicity of MMA by the oral, dermal, and inhalative routes is low as judged by tests with different species: The oral LD50 for rats, mice, and rabbits is found to exceed 5000 mg/kg bw. Acute inhalation toxicity for rats and mice is described by LC50 values of > 25 mg/l/4 hours. Acute dermal toxicity is reported for rabbits to exceed 5000 mg/kg bw. Skin and respiratory irritation are reported for subjects exposed to monomeric MMA. The substance has been shown to produce severe skin irritation when tested undiluted on rabbit skin. There are indications from studies in animals that MMA can be irritating to the respiratory system. In contact with eyes MMA has shown only weak irritation of the conjunctivae. MMA has a moderate to strong sensitising potential in experimental animals**.** Cases of contact dermatitis have been reported for workers exposed to the monomeric chemical. There is no convincing evidence that MMA is a respiratory sensitizer in humans.

The lead effect caused by MMA is a degeneration of the olfactory region of the nose being the most sensitive target tissue. For this effect a NOAEC of 25 ppm (104 mg/m^3) in a two-year inhalation study in rats was identified but only slight effects on the olfactory tissues have been observed at 100 ppm. Concerning systemic effects, two different valid studies have been considered for identifying a N(L)OAEL. Due to different dose selections, different values for N(L)OEALs are available. The LOEALs and the NOEALs for female rats ranges between 400 and 500 ppm and from 100 to 250 ppm respectively. In subchronic inhalation studies systemic toxic effects were seen in rats >1000 ppm, respectively in mice >500 ppm, including degenerative and necrotic lesions in liver, kidney, brain, and atrophic changes in spleen and bone marrow. These effects were not seen in chronic studies up to 1000 ppm. Oral administration to rats resulted in a NOAEL of 200 mg/kg bw/d.

MMA has *in vitro* the potential for induction of mutagenic effects, especially clastogenicity. However, this potential is limited to high doses with strong toxic effects. Furthermore, the negative *in vivo* micronucleus test and the negative dominant lethal assay indicate that this potential is not expressed *in vivo*. There is no relevant concern on carcinogenicity of MMA in humans and

animals. Epidemiology data on increased tumour rates in exposed cohorts are of limited reliability and cannot be related to MMA as the solely causal agent.

MMA did not reveal an effect on male fertility when animals had been exposed to up to 9000 ppm. From the available developmental toxicity investigations, including an inhalation study according to OECD Guideline 414, no teratogenicity, embryotoxicity or fetotoxicity has been observed at exposure levels up to and including 2028 ppm (8425 mg/m^3). The available human data on sexual disorders in male and female workers cannot be considered to conclude on reproductive toxicity effects of MMA due to the uncertain validity of the studies.

Environment
In the European Union methyl methacrylate (hereafter referred to as MMA) is produced and isolated as chemical intermediate. According to industry statements for 1996, the total EU production capacity amounts to 610,000 t/a and the actual production volume to 470,000 t/a. Significant dynamics of the methacrylate-chemistry market are reported.

MMA is mainly used as an intermediate for the production of polymers. The most important polymer types are cast acrylic sheets and molding / extrusion compounds, besides emulsions, dispersions and solvent based polymers. Another significant use is the production of various methacrylate esters, which are subsequently used for polymer production. Minor amounts are distributed and used as monomer, e.g. in reactive resins, but even in these applications the MMA monomers eventually will be polymerized; the final polymerization step takes place at the site of use.

About 2/3 of the total production quantity are sold to customers and not processed at the production sites.

Releases of MMA to the environment are to be expected mainly during production and processing with waste water and exhaust gas as well as during the use of water based emulsion polymers, e.g. paints and varnishes.

Residual monomeric MMA-contents, which are the basis for release estimations from different polymeric products, are reported to range between 0.005 and 1.1 %.

Direct releases to agricultural or natural soil are not expected to a relevant extent.

MMA has a water solubility of 16 g/l, a vapour pressure of 42 hPa , and a log Pow of 1.83. The environmental behavior of MMA is determined by its range of 1.1 - 9.7 hours atmospheric half life and moderate volatility. MMA is readily biodegradable. Hydrolysis is not significant at neutral and acidic pH, but increases in the upper pH range. The average K_p value of 1.0 l/kg indicates no relevant adsorption onto sediment or soil. Based on the physico-chemical properties of MMA, the air and to a much lower extent the hydrosphere are the preferred target compartments for distribution and neither relevant bioaccumulation nor geoaccumulation are expected. In waste water treatment plants 89.2 % of the substance are estimated to be removed predominately by biodegradation.

For fish, only two relevant results from acute tests are currently available. For *Lepomis macrochirus*, a 96h LC_{50} of 191 mg/l is reported, for the rainbow trout *Oncorhynchus mykiss* a LC_{50} of > 79 mg/l and a 96h NOEC of 40 mg/l.

For invertebrates acute and long-term studies on *Daphnia magna* had been conducted. The most

relevant EC value is 21d NOEC = 37 mg/l; the acute study reports 48h EC_{50} = 69 mg/l.

The most relevant study on algae has examined *Selenastrum capricornutum* according to OECD-guideline 201. The highest test concentration of 110 mg/l caused growth inhibition below 50 %, the NOEC was 110 mg/l for growth rate and 49 mg/l for biomass as endpoints.

Based on these data there is a moderate hazard concern to aquatic organisms. For derivation of the **P**redicted **N**o **E**ffect **C**oncentration (PNEC) the lowest valid effect concentration, i.e. 37 mg/l from the long-term daphnid test, is divided by an assessment factor of 50 as proposed in the TGD for the present data basis: $PNEC_{aqua}$ = 740 µg/l.

It is not possible to derive a PNEC for the atmospheric compartment due to the lack of experimental data.

Data on effects to terrestrial organisms are not available. In an indicative risk assessment for the soil compartment, the aquatic PNEC of 740 µg/l can be used and compared to the concentration in soil pore water.

Exposure
No information.

NATURE OF FURTHER WORK RECOMMENDED

This substance has been agreed in the European Union Risk Assessment Program under Regulation EEC/793/93 with the following conclusion: There is a need for limiting the risks; risk reduction measures which are already being applied shall be taken into account:

A potential risk to the local aquatic environment is identified from wet polymerization processes by downstream users of monomeric MMA (default calculations for generic site and four out of 29 known sites). Although an improvement of exposure data would be possible for the wet polymerization scenarios, e.g. by performing effluent measurements, it is concluded that a sufficient and appropriate data basis cannot be acquired within an acceptable time frame and with acceptable efforts. Additionally, due to the dynamic methacrylate market, significant year-to-year variations of MMA tonnages used at individual sites hamper reliable PEC estimations.

On the effects side of the risk assessment data improvement would be possible because an assessment factor of 50 is used for the PNEC derivation and it might be possible to lower the PNEC by further testing, i.e. the assessment factor can be lowered to 10 if a long-term fish test is performed. But regarding the locally limited risks that are identified due to the specific scenario this kind of data improvement is not proposed by the rapporteur.

It is concluded, that local risk reduction measures have to be considered, if the MMA processing capacity exceeds 5000 t/a at one single site. It should be noted, that waste water reutilization / recycling systems are applied by some known polymerization sites, avoiding any significant MMA emission to hydrosphere. Sites applying such advanced process engineering would not require further consideration of risk reduction measures.

There is a need to limit the risks of MMA concerning skin sensitization and respiratory tract irritation at several workplaces in the chemical industry, industrial area and skilled trade and during use of casting resins. For inhalation exposure scenarios, systemic toxicity gives additional rise to concern.

SIDS PROFILE SUMMARY

CAS NO: 80-62-6		SPECIES	PROTOCOL	RESULTS
PHYSICAL-CHEMICAL				
2.1	Melting Point		N.A.	-48 ^{0}C
2.2	Boiling Point		N.A.	100 - 101 ^{0}C (at 101.3 kPa)
2.3	Relative density		N.A.	0.944 at 20 ^{0}C
2.4	Vapour Pressure		N.A.	36 – 47 hPa at 20 ^{0}C
2.5	Partition Coefficient (Log Pow)		shake-flask	1.38 at 20 ^{0}C
2.6 A.	Water Solubility		N.A.	16 g/l at 20 ^{0}C
B.	pH			at ^{0}C
	pKa			
2.12	Oxidation: Reduction Potential			mV
ENVIRONMENTAL FATE AND PATHWAY				
3.1.1	Photodegradation		Calculated	In air $T_{1/2}$ = 1.1 – 9.7 hours
3.1.2	Stability in Water			$T_{1/2}$ = ca. 4 years at pH 7 2.4 hours at pH 11
3.2	Monitoring Data			no data
3.3	Transport and Distribution		Calculated (Fugacity Level 1 type)	In Air 84.2 % In Water 15.6 % In Soil/Sediment 0.14% In Biota < 0.1 %
3.5	Biodegradation		OECD 301, 301D, modified 301, and expert judgement	readily biodegradable
ECOTOXICOLOGY				
4.1	Acute/Prolonged Toxicity to Fish	*Lepomis macrochirus*	US EPA	LC_{50} (72 hr) = 264 mg/l, LC_{50} (96 hr) = 191 mg/l
		Oncorhynchus mykiss	US EPA	LC_{50} (96 hr) = > 79 mg/l NOEC (96 hr) = 40 mg/l
4.2	Acute Toxicity to Aquatic Invertebrates (*Daphnia)*	*Daphnia magna*	US EPA	EC_{50} (48 hr) = 69 mg/l
4.3	Toxicity to Aquatic Plants e.g. Algae	*Selenastrum capricornutum*	OECD 201	EC_{50} (96 hr) = 170 mg/l NOEC (96 hr) = 100 mg/l
4.5.2	Chronic Toxicity to Aquatic Invertebrates (*Daphnia*)	Daphnia magna	OECD 202	NOEC (21 d) = 37 mg/l
4.6.1	Toxicity to Soil Dwelling Organisms			not available
4.6.2	Toxicity to Terrestrial Plants			not available
(4.6.3)	Toxicity to Other Non-Mammalian Terrestrial Species (Including Birds)			not available

CAS NO: 80-62-6		SPECIES	PROTOCOL	RESULTS
TOXICOLOGY				
5.1.1	Acute Oral Toxicity	rat mouse rabbit	- - -	LD_{50} = 8420 – 10 000 mg/Kg LD_{50} = 5200 mg/Kg LD_{50} = 5800 – 6550 mg/Kg
5.1.2	Acute Inhalation Toxicity	rat mouse	- -	LC_{50} = 7093 ppm (29.8 mg/l) (4h) LC_{50} ~ 33 mg/l (3h)
5.1.3	Acute Dermal Toxicity	rabbit	-	LD_{50} = 5000 - 7500 mg/Kg
5.2.1	Skin Irritation	rabbit	-	severe irritant
5.2.2	Eye Irritation	rabbit	OECD 405	slightly irritant
5.3	Sensitisation	guinea pig	OECD 406	sensitising
5.4	Repeated Dose Toxicity			
	– oral (d.w.)	rat	-	104 wk NOEL: > 2000 ppm
	– inhalation	rat	OECD 453	104 wk NOAEC for local effects on the resp. tract: 25 ppm (0.1 mg/l) 104 wk NOAEC for systemic effects on the resp. tract: 100 ppm (0.4 mg/l)
	– inhalation	mouse	OECD 412	14 wk NOAEC = 1000 ppm
5.5	Genetic Toxicity In Vitro			
A.	Bacterial Test	S. typhim.	OECD 471	TA 1535, 1537, 97, 98, 100: negative
	(Gene mutation)			(with and without metabolic activation)
B.	Non-Bacterial In Vitro Test			
	– Chromosomal aberrations	CHO cells	OECD 473	Positive (with and without metabolic activation)
		mouse lymphoma cells	OECD 473	Positive (with and without metabolic activation)
	– Gene mutation	L5178Y cells	OECD 476	positive (with metabolic activation) negative (without metabolic activation)
5.6	Genetic Toxicity In Vivo			
	– Micronucleus assay	mouse	OECD 474	negative
	– Dominant lethal assay	mouse	OECD 478	negative
5.7	Cancerogenicitiy	rat	OECD 451	No treatment related tumors
		mouse	OECD 451	No treatment related tumors
5.8	Toxicity to Reproduction			
	– inhalation	mouse	-	NOAEC = 9000 ppm
5.9	Developmental Toxicity/ Teratogenicity			
	– inhalation	rat	OECD 414	NOAEC > 2028 ppm (teratogenicity)
5.11	Experience with Human Exposure			Irritation of skin and of respiratory tract. Sensitisation of skin

RISK ASSESSMENT

2-Methyl-2-propenoic acid, methyl ester (Methyl methacrylate)

CAS-No.: 80-62-6

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Information on the rapporteur

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This document is the final draft of the RAR of Methyl methacrylate.

The Comprehensive Risk Assessment Report **Methyl methacrylate**, was circulated for the first time in July 1997 and was discussed preliminarily at the Technical Meeting in October 1997.

The Risk Assessment, Human Health, was discussed in depth at the Technical Meeting in September / October 1998, the Environment section was discussed in depth at the Technical Meeting in December 1998.

The last visit discussion was in March 1999 (Human Health) and in June 1999 (Environment).

At the Technical Meeting in July 2000 the report was discussed as Final Draft.

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NOTE

The complete report of the risk assessment on methyl methacrylate can be found at European Chemical Bureau (ECB) website: http://ecb.jrc.it/existing-chemicals/

In addition, the extract from IUCLID data base for methyl methacrylate can be found in the annex of this publication.