
Propyne-allene mixture (MAPP gas)

(CAS No: 59355-75-8)

Health-based Reassessment of Administrative Occupational Exposure Limits

Committee on Updating of Occupational Exposure Limits,
a committee of the Health Council of the Netherlands

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1 Introduction

The present document contains the assessment of the health hazard of propyne-allene mixtures (methylacetylene-propadiene mixtures or MAPP gas) by the Committee on Updating of Occupational Exposure Limits, a committee of the Health Council of the Netherlands. The first draft of this document was prepared by MA Maclaine Pont, M.Sc. (Wageningen University and Research Centre, Wageningen, the Netherlands).

In May 1999, literature was searched in the databases Medline, Toxline, and Chemical Abstracts, starting from 1966, 1981, and 1937, respectively, and using the following key words: MAPP gas, MAPP, 59355-75-8, 74-99-7, 463-49-0, methylacetylene, methyl acetylene, propyne, allylene, propadiene, allene, dimethylenemethane, 1-propyne, or 1,2-propadiene.

In July 2000, the President of the Health Council released a draft of the document for public review. No comments were received.

An additional search in Toxline and Medline in November 2003 did not result in information changing the committee's conclusions.

2 Identity

name	:	MAPP gas
synonyms	:	propyne-allene mixture; propyne, mixed with propadiene; methyl acetylene-propadiene mixture
molecular formula	:	mainly: C ₃ H ₄
structural formula	:	mainly: H ₃ C-C≡CH and H ₂ C=C=CH ₂
CAS number	:	59355-75-8

3 Physical and chemical properties

	MAPP	propyne	allene
molecular weight	:	40.06	40.06
boiling point	:	-37.8 to -20°C	-23°C
melting point	:	-136°C	-103°C
flash point	:	-	-
vapour pressure	:	-	-
		at 21°C: 520 kPa	at 20°C: 700 kPa
solubility in water	:	insoluble	poorly soluble
			insoluble
log P _{octanol/water}	:	-	-
		0.94 (experimental); 1.04 (estimated)	1.45 (experimental); 1.65 (estimated)
conversion factors (20°C, 101 kPa)	:	1 mg/m ³ = 0.60 ppm 1 ppm = 1.67 mg/m ³	1 mg/m ³ = 0.60 ppm 1 ppm = 1.67 mg/m ³

Data from ACG92, NLM03a, NLM03b, <http://esc.syrres.com>.

MAPP gas is a colourless gas with a strong characteristic, foul odour. MAPP gas contains 68-70% of a mixture of allene and propyne, the balance being paraffinic and olefinic C₃ and C₄ hydrocarbons (ACG92).

In a human volunteer study, a concentration of MAPP gas of 25 ppm (i.e., 42 mg/m³) was recognised by 3/5 subjects, and described as 'natural-gas like', 'faint', and 'not identifiable'. Most persons found concentrations of 100 and 1000 ppm (i.e., 167 and 1670 mg/m³) to have a characteristic odour and to be objectionable, respectively (Tor64).

4 Uses

MAPP gas is used as an industrial cutting fuel (ACG92).

5 Biotransformation and kinetics

The committee did not find data on the biotransformation and kinetics of MAPP gas or its components propyne and allene.

6 Effects and mechanism of action

Human data

Apart from an odour study in human volunteers (see Section 'Physical and chemical properties'), the committee did not find case reports or human studies on MAPP gas or its components propyne and allene.

Animal data

At concentrations of 10-15% or less (100,000-150,000 ppm or 167,000-ca. 250,000 mg/m³), propyne induced anaesthesia in rats and cats with cardiac irregularities and convulsive movements (Hen40).

The minimal toxic concentration in air for rats of a mixture containing 45% propyne, 25.6% allene, and other C₃-C₄ alkanes and olefines was 113,500 mg/m³ for acute exposure and 82,000 mg/m³ for chronic exposure. The exposure duration was not mentioned. The main toxic effects were liver damage and narcosis (Tim85).

Inhalation exposure to 42,000 ppm (ca. 71,000 mg/m³) propyne for 6 hours induced abnormal and unsteady gait, uncoordinated head movements, and anaesthesia in rats. Post-mortem examination revealed only effects on the lungs, including dark-red colouration, bronchial contraction, and alveolar haemorrhage in rats killed immediately after exposure. Animals observed for an additional 9 days were affected more severely, showing also bronchiolitis and pneumonitis (Hor57).

Groups of 24 rats, 12 guinea pigs, 3 rabbits, and one dog of each sex were exposed to 0, 1000, or 5000 ppm (0, 1670, 8350 mg/m³) of MAPP gas, 7 hours/day, 5 days/week, for 16 weeks. There were no adverse effects on either sex of any species exposed to 1000 ppm as determined by growth, mortality, body and organ weight, clinical and biochemical determinations, urinalysis, haematological examination, and gross and microscopic examination. In the 5000-ppm groups, the only effect observed was a decrease in body weights in male guinea pigs (by 16%; p<0.01), in the absence of macroscopic or microscopic changes (Tor64).

Twenty male albino rats and 2 male and 2 female dogs were exposed to 0 or 28,700 ppm (ca. 48,000 mg/m³) propyne, 6 hours/day, 5 days/week, for 6 months. The rats and the dogs showed marked salivation, excitability, and muscular fasciculation during exposure. The animals recovered rapidly upon

discontinuation of exposure. In the course of the experiment, 8 rats died (40%). The body weight of the remaining rats was decreased. The dogs lost weight during the first 6 weeks, but attained their initial weight thereafter and then continued to gain weight. Upon autopsy, the dogs did not show any macroscopic or microscopic changes in the lungs. In the surviving rats, only the lungs were affected being distended and showing dark-red colouration, oedema, haemorrhages, and pulmonary irritation (Hor57).

Mutagenicity and genotoxicity

Propyne was negative when tested under gas exposure conditions in *S. typhimurium* strains TA98, TA100, TA1535, and TA1537 both with and without metabolic activation. Under these conditions, the compound was found positive when tested in *E. coli* strain WP2 *uvrA* both in the presence and absence of a metabolic activation system (Ara94).

7 Existing guidelines

The current administrative occupational exposure limit (MAC) for MAPP gas in the Netherlands is 1800 mg/m³ (1000 ppm), 8-hour TWA.

Existing occupational exposure limits for MAPP gas in some European countries and in the USA are summarised in the annex.

8 Assessment of health hazard

The committee did not find data on the kinetics of MAPP gas or its components. The committee did not find data from case reports or epidemiological studies in humans exposed to MAPP gas or from studies on the carcinogenicity or reproduction toxicity of MAPP gas or its main components.

In a subchronic inhalation study with MAPP gas in which rats, guinea pigs, rabbits, and dogs were exposed 6 hours/day, 5 days/week, for 16 weeks, no effects were observed at 1670 mg/m³ (1000 ppm). At 8350 mg/m³ (5000 ppm), the only effect observed was a decrease in body weight in male guinea pigs (Tor64). Repeated exposure to propyne, one of the main components of MAPP gas, for 6 months at ca. 48,000 mg/m³ (28,700 ppm) resulted in mortality in 8/20 rats, but not in 4 dogs, in nervous system (transient) and body weight effects in both species, and in lung damage in rats (Hor57).

The critical effect is the decrease in body weight in male guinea pigs at 8350 mg/m³ (5000 ppm). The committee takes the NOAEL of 1670 mg/m³ as a

starting point for deriving a health-based recommended occupational exposure limit (HBROEL). For the extrapolation to a HBROEL, an overall assessment factor of 3 is applied, accounting for intraspecies variation. The committee deems a factor for interspecies variation not necessary since the NOAEL was found in 4 different species. Thus, applying this factor of 3 and the preferred-value approach, a health-based occupational exposure limit of 500 mg/m³ (300 ppm) is recommended for propyne-allene mixtures (MAPP gas).

The committee recommends a health-based occupational exposure limit for propyne-allene mixtures of 500 mg/m³ (300 ppm), as an 8-hour time-weighted average (TWA).

References

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Annex

Occupational exposure limits for MAPP gas in various countries.

country - organisation	occupational exposure limit		time- weighted average	type of exposure limit	note ^a	reference ^b
	ppm	mg/m ³				
the Netherlands - Ministry of Social Affairs and Employment	1000	1800	8 h	administrative		SZW04
Germany - AGS	-	-				TRG03
- DFG MAK-Kommission	-	-				DFG03
Great Britain - HSE	-	-				HSE02
Sweden	-	-				Swe00
Denmark	1000	1800	8 h			Arb02
USA - ACGIH	1000	-	8 h	TLV		ACG04
	1250	-	15 min	STEL		
- OSHA	1000	1800	8 h	PEL		ACG03
- NIOSH	1000	1800	10 h	REL		ACG03
	1250	2250	15 min	STEL		
European Union - SCOEL	-	-				EC04

^a S = skin notation; which means that skin absorption may contribute considerably to body burden; sens = substance can cause sensitisation.

^b Reference to the most recent official publication of occupational exposure limits.

