

GDCh-Advisory Committee  
on Existing Chemicals (BUA)

## **Methyl Vinyl Ketone**

BUA Report 233

(June 2001)



S. Hirzel

Wissenschaftliche Verlagsgesellschaft 2003

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on Existing Chemicals (BUA, Status June 2001)

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# **Methyl Vinyl Ketone**

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on Existing Chemicals

GDCh-Beratergremium  
für Altstoffe (BUA)



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## **Preface**

The Advisory Committee on Existing Chemicals, BUA for short, was established in May 1982 to help the German federal government cope with the large task of dealing with existing chemicals. In an agreement between federal government, scientific community, and the chemical industry, it was associated with the German Chemical Society (GDCh, Gesellschaft Deutscher Chemiker) to ensure objective work, carried out in accordance with scientific principles. Since the beginning of 2001 the BUA has been composed of a new constellation of cooperating scientists from the research areas of chemistry, chemical analysis, monitoring, toxicology, primary and secondary exposition, aquatic and terrestrial toxicology as well as the fate and behaviour of compounds in water, soil, air. In addition the BUA is supported by experts within the national government agencies and the German Chemical Industry Association (Verband der Chemischen Industrie (VCI)).

No other national or international body has dealt with the ecological and health-related effects of so many existing chemicals as the BUA. Upon the recommendation of the national government, since 2000, the BUA has participated as Peer-Review-Group in the pilot phase of the evaluation of ICCA-compounds (ICCA= International Council of Chemical Associations) and, in addition, acts as the national 'Contact Point' in this OECD existing chemicals program. The goal of the initiative is, on the one hand to create a more expansive database to evaluate the HPV chemicals and on the other to screen these chemicals for potential hazards.

In 1997 BUA began an additional national project, which also selects and assesses existing chemicals with a lower production volume in the range of 100 - 1000 tonnes/year. Comprehensive reports are published on chemicals suspected of having a hazardous potential. If the data available for substance assessment are insufficient, the gaps in knowledge are documented and, if necessary, investigations recommended. On the national level, the BUA has produced comprehensive reports on about 300 substances and carried out preliminary evaluation and classification (priority setting) for approximately 200 more. Publication of the process leading to priority setting, in addition to the BUA reports, lends transparency to the Committee's work.

Moreover, BUA is increasingly addressing scientific questions and problems such as "endocrine disruptors", selection criteria for "persistent organic pollutants" (POPs), "risk assessment of substances in soils", "evaluation criteria for the marine sector" and "safety factors within the framework of toxicological risk assessment". The aim of BUA is to develop assessment concepts, determine data gaps, point out the need for further research and, last but not least, also to reduce information deficits in the general population.

Weihenstephan, April 2001

Helmut Greim  
BUA Chairman



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# **BUA Report on Methylvinylketon**

## **Summary**

### **Ecological Aspect**

Less than 500 tonnes of methyl vinyl ketone (MVK) are produced annually by the German manufacturer. Another known European manufacturer in Switzerland produces < 1000 t/yr. There are no data available on imports to Germany.

In Germany, the sole producer processes methyl vinyl ketone as vinyl lactate exclusively within the company. The Swiss producer uses the entire amount internally for synthesizing vitamin A. The use in making vinyl resin is also described in the literature.

Following pretreatment when necessary, wastewater from production and processing is directed to the company's own wastewater treatment plants, where the methyl vinyl ketone is eliminated mainly by stripping. In Switzerland, about 5 kg MVK/operation day enter the wastewater treatment plant, the effluent of which no longer contains any detectable amounts of methyl vinyl ketone. Atmospheric emissions are not expected because of the exhaust gas combustion at the production and processing sites. Resulting wastes are also incinerated.

Direct applications of methyl vinyl ketone as a component of a soil disinfectant or in automobile varnish formulations are described in the literature. However, it is not known whether they are permitted in Germany. Thus, in that case, no statements can be made about an emission into the environment.

Although emissions of methyl vinyl ketone from combustion processes and mainly from motor vehicle traffic have been cited extensively in the literature, the quantities of these emissions cannot be estimated. Methyl vinyl ketone is continuously formed for a short time in the atmosphere by the photooxidative degradation of isoprene. Moreover, it has been detected in low concentrations as a natural component of the volatile organic emissions (VOC) of various plant parts, foodstuffs and beverages as well as in the sweat and urine of male deer and in the urine of domestic mice.

In the atmosphere, methyl vinyl ketone can be rapidly degraded photolytically and photochemically. At an assumed OH-radical concentration of  $5 \cdot 10^5$  molecules/cm<sup>3</sup>, the half-life for the reaction with OH-radicals is calculated to be 20.5 hours; the reaction with NO-radicals and ozone is of secondary importance, especially at night.

The high toxicity of methyl vinyl ketone to the inoculum hinders its biodegradation. Methyl vinyl ketone is classified as not readily biodegradable. In the hydrolysis under standard conditions, a half-life of 4 days was determined at pH 7, whereby methyl vinyl ketone is supposedly not degraded but adsorbs water.

No bio- or geoaccumulation is expected based on the physical properties. A calculation of the distribution according to Mackay Level 1 shows the atmosphere (64 %) and the hydrosphere (35.8 %) to be the target compartments.

Relevant to the evaluation of the effectiveness of methyl vinyl ketone against bacteria, a nominal 16h EC<sub>10</sub> value of 2.4 mg/l was found for *Pseudomonas putida* according to DIN Guideline 38412/8, and a nominal 40h ICG<sub>50</sub> value of 2.17 mg/l was determined for *Tetrahymena pyriformis* in the cell-multiplication inhibition test. A nominal 96h EC<sub>50</sub> value of 0.13 mg/l was found for the alga *Selenastrum capricornutum* regarding its biomass, and 24h and 48h EC<sub>0</sub> values of 0.25 mg/l and 0.125 mg/l, respectively, were found with respect to the swimming inability of *Daphnia magna*. A 24h germination test with the mould *Cladosporium cladosporioides* with methyl vinyl ketone showed an almost complete, yet reversible, suppression of spore germination as of 0.2 mg/l.

### Toxicological Aspect

There are no studies available on the metabolism or mode of action of methyl vinyl ketone. It is severely toxic after acute oral, dermal, and inhalative application. Cases of death occur already after an 1h inhalation of  $100 \text{ ml/m}^3$ ; the critical effect is the formation of pulmonary edemas. With oral administration, the lowest  $\text{LD}_{50}$  value lies at  $22 \text{ mg/kg}$  body weight. The  $\text{LD}_{50}$  value with dermal application of methyl vinyl ketone ranges from  $0.01$  to  $0.05 \text{ ml/kg b.w.}$  Furthermore, local effects occur through the irritating effect on the stomach, as well as on the skin, resulting in edemas and necroses. Initial irritating effects already occur at a low dosage of  $1 \text{ mg/kg b.w.}$  after oral application, at  $0.005 \text{ ml/kg b.w.}$  after dermal application for 24 hours and after 15 minutes of inhalation of  $300 \text{ ml/m}^3$ . Methyl vinyl ketone likewise shows a high toxicity after repeated inhalation. Effects on the upper respiratory tract of the rat occur at a dosage of  $0.5 \text{ ml/m}^3$  for 13 weeks (6 hours/day, 5 days/week). The same exposure causes changes in the liver weight and the blood counts of mice. Studies on the repeated application of methyl vinyl ketone in other application forms are not available. The target organs of the systemic effects of methyl vinyl ketone are the central nervous system, the kidney, and the liver. Other possible effects are disturbances to the blood circulatory system through hyperemia and edema in the internal organs. The substance is sensitizing in animal tests. A 90-day study resulted in effects on the testes, epididymis, and sperm count of male rats, which are supposedly attributed to the decrease in body weight; the mice and female rats showed no effects. Based on the existing studies on various strains of *Salmonella typhimurium* and *Escherichia coli*, a clear conclusion cannot be drawn regarding mutagenicity of methyl vinyl ketone. Various *in vitro* studies infer that methyl vinyl ketone shows GSH-binding activity; moreover, methyl vinyl ketone can increase GSH-transferase activity.

Data are unavailable on the carcinogenic effect and the toxic effect on development.