The MAK-Collection for Occupational Health and Safety

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Toluene

MAK Value Documentation, supplement – Translation of the German version from 1998

MAK Commission[1,*]

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MAK value (1993)	**50 ml/m³ (ppm) ≙ 190 mg/m³**
Peak limitation (1985)	**Category II,2**
Absorption through the skin (1998)	**H**
Sensitization	**–**
Carcinogenicity	**–**
Prenatal toxicity (1993)	**Pregnancy Risk Group C**
Germ cell mutagenicity	**–**
BAT value (1995)	**1.0 mg/l blood or 3.0 mg *o*-cresol/l urine**
CAS number	108-88-3

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There are numerous studies available of the absorption of liquid toluene through the skin in humans. After contact with liquid toluene for 10 to 15 minutes, absorption through the skin of the hand or forearm was calculated to be in the range from 14 to 23 mg/cm² and hour. The toluene was determined at the site of application using a spectrophotometer and the difference between the applied amount and that remaining on the skin at the end of the exposure period was calculated. As the resulting internal exposure to toluene was not determined by means of biological monitoring, this study is limited by a methodical error, which probably led to a significant overestimation of the absorption rates (Dutkiewicz and Tyras 1968). An investigation in 5 male medical students, who dipped a hand up to the wrist into pure toluene for 30 minutes, yielded a much lower rate for percutaneous penetration (0.17 mg/cm² and hour) on the basis of the toluene concentration in blood (Sato and Nakajima 1978). In a study of Monster et al. (1993), the concentration of toluene in the exhaled air was determined while and after test persons washed both hands with toluene for 5 minutes (wearing breathing masks). It was calculated from the amount of exhaled toluene, that on average 34 mg of toluene was absorbed during the experiment. The penetration rate was 0.5 mg/cm² and hour.

After exclusively percutaneous exposure to a toluene concentration in the air of 600 ml/m³, in volunteers 0.9% of the amount absorbed by inhalation exposure only was absorbed via the skin (Riihimäki and Pfäffli 1978). Also calculations by Fiserova-Bergerova et al. (1990) indicate that the absorption of gaseous toluene via the skin is negligible. Exposure to an aqueous solution saturated with toluene does, however, have relevant skin-penetrating potential. The flux was calculated to be 0.69 mg/cm² and hour.

The percutaneous penetration of gaseous toluene leads to relatively low levels of internal exposure to toluene compared with those after inhalation exposure (at concentrations in the air at the level of the MAK value). However, the amount absorbed on the basis of the flux determined by Monster et al. (1993) after skin contact with liquid toluene for one hour via the hands and forearms (about 2000 cm²) is 1000 mg toluene. In comparison, after 8-hour inhalation exposure only at the level of the MAK value (190 mg toluene/m³, 10 m³ air volume, 60% absorption) 1100 mg toluene is absorbed. The level of percutaneous penetration is therefore so high that observation of the MAK value alone does not provide adequate protection. For this reason, toluene has been designated with an "H" (for substances which can be absorbed through the skin in toxicologically relevant amounts).

The basis for the change in the notation is the new data since the documentation from 1985 as well as the lowering of the MAK value to 50 ml/m³ (Greim 1996).

Notes

Competing interests

The established rules and measures of the Commission to avoid conflicts of interest (https://www.dfg.de/en/dfg_profile/statutory_bodies/senate/health_hazards/conflicts_interest/index.html) ensure that the content and conclusions of the publication are strictly science-based.

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