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1,2-Epoxypropane – Addendum for evaluation of EKA

Assessment Values in Biological Material – Translation of the German version from 2013

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EKA (2012)[a)]

The following correlation between external and internal exposure was established:

Air		Erythrocyte fraction of whole blood
1,2-Epoxypropane		*N*-(2-Hydroxypropyl)valine
[ml/m³]	[mg/m³]	[pmol/g globin]
0.5	1.2	600
1.0	2.4	1300
2.5	6.0	3200

Sampling time: not fixed[b)]

BAR (2011)

10 pmol *N*-(2-Hydroxypropyl)valine/g globin[c)]
Sampling time: not fixed[b)]

25 µg 2-Hydroxypropyl mercapturic acid/g creatinine[c)]
Sampling time: end of exposure or end of shift; for long-term exposures: at the end of the shift after several previous shifts

MAK value (2012) **2 ml/m³ ≙ 4.8 mg/m³**

Absorption through the skin –

Carcinogenicity (2012) Category 4

a) for the current correlation see Bader (2021)
b) changed to "sampling time: after exposure for at least 3 months" in 2016 (DFG 2016)
c) evaluated for non-smokers

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Re-evaluation

1,2-Epoxypropane [75-56-9] was evaluated in 2011, and two biological reference values (BAR) were derived (translated in Bader et al. 2016). In the present Addendum, the data available for the derivation of exposure equivalents for carcinogenic substances (EKA) are evaluated.

Exposure and effects

Relationship between external and internal exposure

Various studies are available on the relationship between external and internal exposure (Bader et al. 2016). The most comprehensive measurements of 1,2-epoxypropane in air and of the corresponding haemoglobin adduct *N*-(2-hydroxypropyl)valine (HPV) in blood were published by Boogaard et al. (1999). In one part of their study with a total of 27 workers exposed to 1,2-epoxypropane during maintenance shutdown of a styrene and 1,2-epoxypropane plant, the external exposure on working days was determined by personal air sampling (n = 15). In 89 of 112 measurements (80%) the concentration of airborne 1,2-epoxypropane during a workshift was below the detection limit of 0.2 mg/m³ (0.08 ml/m³) of the method applied. The mean value was 0.8 ± 0.2 mg/m³ (0.33 ± 0.08 ml/m³), and 10 mg/m³ (4.1 ml/m³) was determined as the maximum value. Prior to the maintenance activities, the mean HPV concentrations in blood were 40.2 ± 8.0 pmol/g globin (median: 24.4 pmol/g globin). After the shutdown, an average of 45.3 ± 8.0 pmol/g globin was found (median: 45.7 pmol/g globin, n = 19).

From the results of the air measurements, Boogaard et al. (1999) calculated, for a total of 13 workers, a cumulative external exposure and correlated their results with the individual differences in HPV concentrations before and after the shutdown. By linear regression analysis, a relationship according to the equation

$$\textbf{HPV [pmol/g globin]} = \textbf{1.06 (0.14}^{a}\textbf{)} \times \textbf{1,2-epoxypropane in air [mg/m}^3 \times \textbf{h]}$$

was obtained, where $r^2 = 0.672$ (Boogaard 2002) and P = 0.0004 ([a] standard error).

Taking accumulation and the lifetime of erythrocytes into account (Boogaard 2002), a daily 8-hour exposure to 1 ml 1,2-epoxypropane/m³ results in an adduct concentration of approximately 1300 pmol/g globin.

Evaluation of EKA

From their investigations, Boogaard et al. (1999) derived a quantitative relationship between the concentrations of airborne 1,2-epoxypropane and *N*-(2-hydroxypropyl)valine in blood, which can be used as a basis for establishing an EKA correlation. Accordingly, the following exposure equivalents are obtained:

Air		Erythrocyte fraction of whole blood
1,2-Epoxypropane		*N*-(2-Hydroxypropyl)valine
[ml/m³]	[mg/m³]	[pmol/g globin]
0.5	1.2	600
1.0	2.4	1300
2.5	6.0	3200

Owing to the long half-life of the adduct level, there is no fixed sampling time required.

Note: The sampling time was changed to "after exposure for at least 3 months" in 2016 (DFG 2016).

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.

References

Bader M, Lämmlein P, Klotz K (2016) 1,2-Epoxypropane. BAT Value Documentation, 2012. MAK Collect Occup Health Saf. DOI: 10.1002/3527600418.bb7556e1916

Bader M (2021) 1,2-Epoxypropane – Addendum for evaluation of a BAT value. Assessment Values in Biological Material – Translation of the German version from 2015. MAK Collect Occup Health Saf: Doc913. DOI: 10.34865/bb7556pobeoj21_1ad

Boogaard PJ (2002) Use of haemoglobin adducts in exposure monitoring and risk assessment. J Chromatogr B Analyt Technol Biomed Life Sci 778(1-2): 309–322. DOI: 10.1016/S0378-4347(01)00445-5

Boogaard PJ, Rocchi PS, van Sittert NJ (1999) Biomonitoring of exposure to ethylene oxide and propylene oxide by determination of hemoglobin adducts: correlations between airborne exposure and adduct levels. Int Arch Occup Environ Health 72(3): 142–150. DOI: 10.1007/s004200050353

DFG (Deutsche Forschungsgemeinschaft) (2016) List of MAK and BAT Values 2016. Maximum Concentrations and Biological Tolerance Values at the Workplace. Permanent Senate Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area, report 52. Wiley-VCH, Weinheim. DOI: 10.1002/9783527805983