

Carbon disulphide

Occupational exposure in the data period 2000 to 2022 for the generation of REACH exposure scenarios

1 Introduction

The measurement data of workplace exposures evaluated in the following were determined and documented according to the criteria of the accident insurance institutions' measurement system for risk assessment (MGU).¹ A quality management system, which essentially implements the requirements of DIN EN ISO 9001, ensures the standard of the MGU. The testing laboratories are operated in accordance with DIN EN ISO 17025 "General requirements for the competence of testing and calibration laboratories".

To determine carbon disulphide contained in the air at the workplace, a defined volume of air is sucked through an activated carbon tube by means of a sampling pump. After extraction with a toluene/dichloromethane mixture in a ratio of 9:1, the carbon disulphide is quantitatively determined using gas chromatography and a mass selective detector. The limit of quantification (LOQ) for carbon disulphide is 0.1 mg/m³ for a two-hour sampling with a flow rate of 20 l/h (\cong 40 litre sample volume).

For measurements done before 2004 the extraction of the carbon disulfide was performed with pure toluene and the detection with an "electron capture" detector. For this procedure the LOQ for carbon disulphide is 1 mg/m³ for a two-hour sampling with a flow rate of 20 l/h (\cong 40 litre sample volume).

All data collected in the MGU are compiled in the IFA exposure database measurement data relating to workplace exposure to hazardous substances (MEGA). The MEGA^{Pro} software developed by the IFA allows statistical evaluation of the database according to different selection criteria and evaluation strategies.

2 Data situation and evaluation strategy

For carbon disulphide there is an occupational exposure limit (OEL) of 30.0 mg/m³ in Germany according to the Technical Rules for Hazardous Substances (TRGS) 900. This is used as an assessment standard for carbon disulphide.

2.1 Selection criteria for the statistical evaluations

- Hazardous substance: carbon disulphide
- Limit value: 30.0 mg/m³ (OEL)
- Data period: January 2000 to December 2022
- Air samples relevant to exposure
- Workplace measurements
- Sampling representative of exposure duration
- Usual operational situations (normal conditions, assembly, disassembly, start-up procedures, preparations, set-up work) and unfavourable but realistic conditions
- Standard procedures in the MGU, measurement procedures under trial

2.2 Data situation

In the data period from January 2000 to December 2022, the selection criteria presented in Section 2.1 resulted in the data situation for carbon disulphide summarised in **table 1**.

¹ Gabriel, S.; Koppisch, D.; Range, D.: The MGU – a monitoring system for the collection and documentation of valid workplace exposure data. Gefahrstoffe – Reinhalt. Luft 70 (2010) Nr. 1/2, S. 43-49.

Table 1:
Data situation on the carbon disulphide measurements evaluated for this report

General description	Number of measurement values
Total	174
Number of measurements < LOQ	77
Sampling method	
Personal	110
Stationary:	
– Unspecified	55
– Person specific for exposure assessment	7
– Background exposure for exposure assessment	2
Limit value reference	
Number of measurements > limit value	12
Sampling duration	
≥ 2 hours	143
< 2 hours	28
Local exhaust ventilation	
With LEV	102
Without LEV	46
No information on LEV	26

2.3 Evaluation strategy

Due to the limited data available, the measured values for carbon disulphide are only differentiated according to different industrial sector groups or groups of working areas. A further differentiation of the measured values according to sampling type and sampling duration was carried out only for the production of chemical fibres. In addition to the statistical evaluations, the working areas in the sectors are listed, in which measurement values above the limit value were determined. The probability of exceeding the limit value as well as the 90th and 95th percentile for the total population were estimated from the measured values with the maximum likelihood method using the statistical programming language R in the software RStudio.²

² Henningsen, A.; Toomet, O.: maxLik: A package for maximum likelihood estimation in R. Computational Statistics 26 (2011) Nr. 3, S. 443-58

3 Exposure data

3.1 Production of chemical fibres

Industrial sector
Chemical industry
Chemical fibres, production
Spinning and weaving

Working areas
Filtering
Winding
Spinning
Dipping plant
High pressure cleaning (wet/steam)
Cleaning of installations
Worsted spinning, miscellaneous spinning machine
Yarn processing, roping, winding, room
Wet spinning
Spinnerets

In addition to the 60 measured values statistically evaluated here (table 2), there are also 3 personal measurements with a two-hour sampling duration from one measurement series in 2004 during wet spinning. These measurement values lie between 0.2 mg/m³ and 0.67 mg/m³. The values were not included in the collective of personal measurements with a sampling time ≥ 2 hours because they are at least a factor of 10 lower than all other measured values in the production of chemical fibres. Therefore, they do not fit into the lognormal distribution of the measured values required for the maximum likelihood method.

Table 2:
Exposure data on carbon disulphide determined in the MGU during the production of chemical fibres (personal sampling)

Sampling duration	Number of measurement values	Number of companies	Number values < LOQ	Probability exceedance OEL in %	90 th percentile in mg/m ³	95 th percentile in mg/m ³
≥ 2 hours	60	5	0	12.3	32.00	38.39
< 2 hours	14	3	0	n. a.	=-values: 5 to 144 mg/m ³	

Table 3:
Working areas in which measurement values above the OEL were determined

Working areas	Number of measurement values
Yarn processing, roping, winding, room	1 of 4
Worsted spinning, miscellaneous spinning machine	4 of 10
Spinning	3 of 39
Cleaning of plants	3 of 5

3.2 Vulcanisation

Industrial sector	Working areas
Rubber products, production and processing	Vulcanisation
Rubber articles (technical), production	Injection moulding and reaction foaming, vulcanisation, vulcanisation of soles, vulcanisation press
Metalworking and metal processing, general	Vulcanisation, general
Shoemaking	Vulcanisation, compression press
Textiles, other	Vulcanisation, Injection moulding press
	Vulcanisation, hot air vulcanisation

Table 4:
Exposure data on carbon disulphide determined in the MGU during vulcanisation processes

Number of measurement values	Number of companies	Number values < LOQ	Values < LOQ in %	Highest LOQ in mg/m ³	Min =-value in mg/m ³	Max =-value in mg/m ³
14	8	10	71.4	1	0.4	0.9

3.3 Further sectors

Table 5:
Exposure data on carbon disulphide determined in the MGU in further sectors

Number of measurement values	Number of companies	Number values < LOQ	Values < LOQ in %	Highest LOQ in mg/m ³	Number values > OEL	Min =-value in mg/m ³	Max =-value in mg/m ³
76	44	35	74.5	3.6	1	0.1	89

Working areas in which measurement values above the OEL were determined

Filters, general in the chemical industry

Sectors and working areas in which measurement values above the LOQ were determined

Chemical industry

Decanting, general

Laboratory, room

Laboratory, at facilities

Reaction apparatus and plants, reaction vessels for various phases

Filters, general

Transport, haulage, transport companies and the like

Submerged arc welding

Research and testing institutes, laboratories

Extraction

Laboratory, room

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