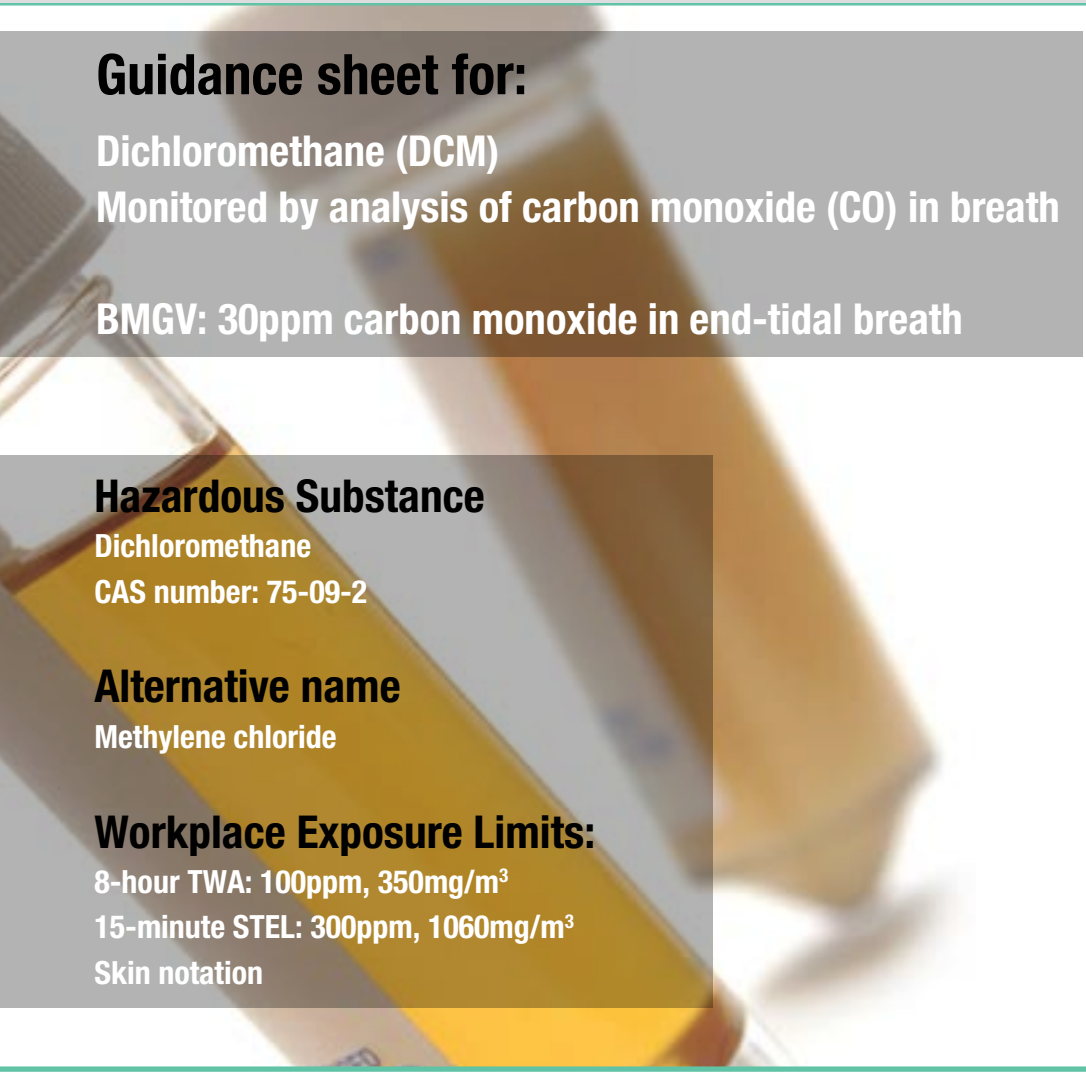
Biological Monitoring Guidance Values



Guidance sheet for:

Dichloromethane (DCM)
Monitored by analysis of carbon monoxide (CO) in breath

BMGV: 30ppm carbon monoxide in end-tidal breath

Hazardous Substance

Dichloromethane
CAS number: 75-09-2

Alternative name

Methylene chloride

Workplace Exposure Limits:

8-hour TWA: 100ppm, 350mg/m^3
15-minute STEL: 300ppm, 1060mg/m^3
Skin notation

HSL: HSE's Health & Safety Laboratory

HEALTH & SAFETY LABORATORY

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Biological Monitoring Guidance Value (BMGV)

Guidance value: 30ppm end-tidal breath CO

Other Guidance Values

The ACGIH BEI value is based on the measurement of DCM in urine: 0.3mg/L urine (3.5µmol/L). The DFG BAT is based on the measurement of DCM in whole blood: 1mg/L whole blood (11.8µmol/L).

Sample Collection

Breath CO is measured on-site using a portable CO breath analyser, which gives a direct readout of CO in ppm, or the equivalent percentage of carboxyhaemoglobin. Breath should be analysed at the end of the shift.

Description of Suggested Method

Dichloromethane is metabolised to carbon monoxide and so biological monitoring is possible using blood carboxyhaemoglobin or breath CO as a measure of uptake. The good relationship between breath CO and carboxyhaemoglobin levels in blood means that measurement of CO in end-tidal breath is a reliable, non-invasive approach to biological monitoring. This is measured using a portable, direct-reading CO monitor. These are based on electro-chemical sensors and can display CO concentration in the breath, or its blood carboxyhaemoglobin equivalent.

Analytical Evaluation

Detection limit:

2-3ppm

Calibration range:

Typically 0-500ppm

Drift:

Less than 2% a month

Analytical Interferences:

None likely to be encountered in breath.
Negligable effect from organic solvents.
Environmental CO exposure can influence the measurement; it is recommended to carry out breath analysis in an environment removed from external CO sources.
Evaluation of an evaluated representative electrochemical CO monitor has shown no measurable influence from 400ppm DCM.

Other Information

Elimination half-time:

Following DCM exposure, the elimination half-time of carboxyhaemoglobin in the blood has been reported to be as high as 13 hours. This compares with an elimination half-time of 4-5 hours for carboxyhaemoglobin produced following CO exposure. The increased carboxyhaemoglobin half-time following DCM exposure may be explained by ongoing metabolism of DCM stored in body tissues, especially fat. Levels of COHb are reported to return to normal by 24-48 hours after cessation of DCM exposure.

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Confounding factors:

CO exposure from confined vehicle exhaust emissions and tobacco smoke.

Other dihalomethanes (such as bromochloromethane) are also metabolised to CO.

Passive smoking will not significantly influence breath CO levels.

Unexposed levels[1]:

- in non-smokers: <6ppm
- in light smokers: <20ppm
- in heavy smokers: >20ppm

Alternative Methods

The half-life of DCM in the blood is short, and so although blood or breath DCM testing can be offered, it is not recommended. Whilst DCM is present in the blood, some will partition into the urine and be stored in the bladder; therefore the concentration of DCM in urine is proportional to the average concentration in the blood over the period between urine voids. Urinary DCM may therefore be determined by headspace gas chromatography – mass spectrometry as a measure of exposure. Urine samples (25mL) must be collected immediately post-shift.

Quality Assurance

Quality assurance for breath sampling is not practical. However, regular calibration of these instruments is recommended using standard gas mixtures containing CO concentrations at appropriate levels (50ppm). Technical data with specific instruments will suggest calibration intervals, but these are usually between 3-6 months. If the CO monitor needs zeroing between individual readings, it is important that this is performed in a low CO contaminated atmosphere. Outdoor atmospheres without excessive vehicle emissions are generally suitable for this purpose, with CO levels of 2ppm or less. Before zeroing indoors, sources of CO from the work process, heating appliances or tobacco smoke need to be considered.

Interpretation

Unexposed levels are much higher in smokers than non-smokers, and can be above 20ppm in heavy smokers. Therefore smoking during the workshift will reduce the value of the end-of-shift breath CO measurement as a measure of DCM exposure. If the worker has not smoked during the shift its confounding influence is reduced. Although smoking during the shift can complicate the interpretation of the BMGV for DCM for that individual, assessment of biological monitoring on a group basis may still be useful in determining the effectiveness of control.

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Links

EH40 List of Approved Workplace Exposure Limits
http://www.hse.gov.uk/pubns/books/eh40.htm

Biological Monitoring at HSL
http://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring

References

[1]Cunnington, A.J. and Hormbrey, P., 2002. Breath analysis to detect recent exposure to carbon monoxide. Postgraduate Medical Journal, 78(918), pp.233-237.

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Kuster, M. and Sherwood, R.J., 1996. Determination of carbon monoxide in breath: A study of portable techniques. Occupational Hygiene, 3(4), pp.243-254.

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