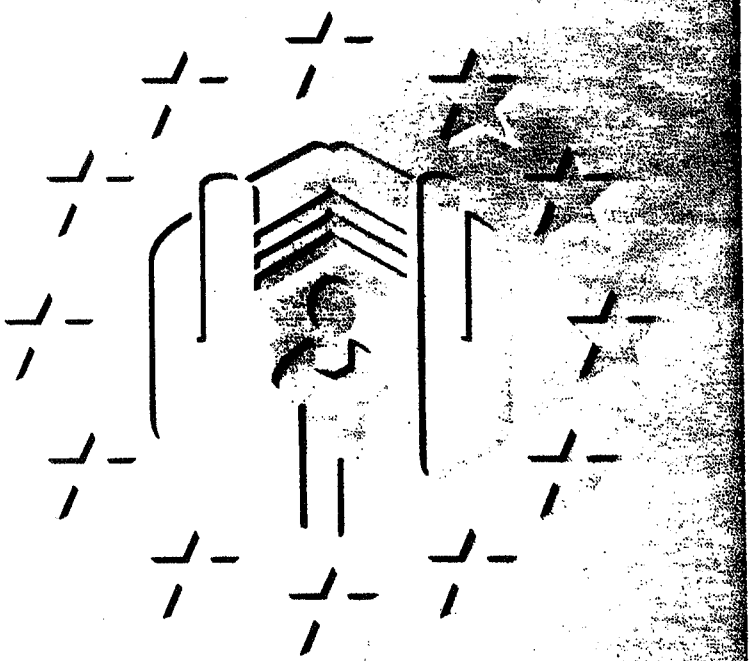
EUROPEAN COMMISSION

Occupational exposure limits

Recommendations of the Scientific Expert Group 1991-92



Health and safety

Report
EUR 15091 EN

Phosgene

8-hour TWA:	0.02 ppm (0.08 mg/m^3)
STEL (15 minutes):	0.1 ppm (0.4 mg/m^3)
Additional classification:	—

Substance identification

Phosgene	$COCl_2$
Synonyms:	Carbonyl chloride, carbon oxychloride
Einecs No:	200-870-3
EEC No:	006-002-00-8; Classification: T+; R26
CAS No:	75-44-5
MWt:	98.92
Conversion factor (20°C, 101 kPa):	4.11 mg/m^3 = 1 ppm

Occurrence/use

Phosgene is a colourless gas with a characteristic odour like wet hay. It has a melting-point of −127°C, a boiling-point of 8.1°C and a vapour pressure of 157.3 kPa at 20°C. Its vapour density is three times that of air. The odour threshold is about 1 ppm (4 mg/m^3), with considerable individual variation.

Phosgene is a high-volume substance used as an intermediate with a production rate in the European Community greater than 10 000 tonnes per annum. It is used in the production of isocyanates as well as in the production of a variety of dyestuffs, polycarbonates and pharmaceuticals.

Phosgene can be generated accidentally when volatile organochlorine compounds come into contact with flames or hot metal. During World War I, phosgene was used as a poison gas.

Health significance

The SEG reviewed and discussed the MAK documents and some recent publications on phosgene.

On the basis of these papers, the SEG considered the experimental data available to be limited. Data on the effects of long-term exposure at low dosage, below levels causing acute effects, are lacking. Epidemiologic data are also scarce.

The target organ/critical effect is acute irritation of the mucous membranes of the respiratory tract and direct damage to the alveolar capillary membrane and sometimes, subsequently, to delayed pulmonary oedema. Therefore, it is also important to control short-term peaks in exposure.

With respect to acute effects, the results of human experience and most animal experiments have led to a limit value of 0.1 ppm (0.4 mg/m^3) being derived in the MAK documents.

However, the additional data from Cameron (1942) — reviewed by Cucinell (1974)— which were not available at the time when the MAK documents were prepared, indicate that some lesions, such as slight pulmonary oedema, can occur in exposing different species to approximately 0.2 ppm (0.8 mg/m^3) phosgene five hours a day for five days. These effect levels are below the threshold of effect considered up to now. It should be noted that these exposure levels were calculated rather than analytically controlled. More recent studies conducted by Franch and Hatch (1986) have confirmed that exposure of rats to 0.25 ppm (1.0 mg/m^3) phosgene for 17 days (four hours a day) resulted in irritation of the lower respiratory tract. A NOAEL of 0.125 ppm (0.5 mg/m^3) was established. Transient changes in arachidonic acid metabolism have been reported following a four-hour exposure of rats to 0.1 ppm (0.4 mg/m^3) phosgene (Madden et al., 1991), but due to the extreme sensitivity of this measurement, this study was not taken as the basis for recommending the exposure limits.

The study reported by Selgrade et al. (1989) indicated that exposure of mice to 0.025 ppm (0.1 mg/m^3) phosgene for four hours increased their susceptibility to bacterial infection and also to lung-tumour formation following the inoculation of melanoma cells. However, this study design is unusual and has not been adequately validated. In addition, there is evidence that mice and rats may be more sensitive than humans to typical deep lung irritants due to their relatively greater minute volume per kilogram body weight (Andersen, 1983; Filser, 1992). The SEG thus considered that the Selgrade study (1989) should not be used as the basis for proposing a limit value. The greater sensitivity of mice and rats to deep lung irritants justifies an uncertainty factor of 5 rather than a higher figure.

The epidemiological studies taken into account to date indicate no adverse effects following long-term exposure levels averaging about 0.1 ppm (0.4 mg/m^3) with peak exposures up to 0.5 ppm (2 mg/m^3). However, they are not considered to be sufficiently reliable and conclusive as to be used as the basis for evaluation.

Recommendation

The Franch and Hatch study (1986), establishing a NOAEL of 0.125 ppm (0.5 mg/m^3) was considered to be an adequate basis for setting exposure limits. An uncertainty factor of 5 was applied to allow for the absence of human data. The SEG recommended an 8-hour TWA of 0.02 ppm (0.08 mg/m^3). To prevent short-term exposure to irritant levels, a STEL (15 minutes) of 0.1 ppm (0.4 mg/m^3) is also recommended.

At the levels recommended no measurement difficulties are foreseen.

Key bibliography

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