Thionyl chloride

(CAS reg no: 7719-09-7)

Health-based Reassessment of Administrative Occupational Exposure Limits

Committee on Updating of Occupational Exposure Limits,
a committee of the Health Council of the Netherlands

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1 Introduction

The present document contains the assessment of the health hazard of thionyl chloride by the Committee on Updating of Occupational Exposure Limits, a committee of the Health Council of the Netherlands. The first draft of this document was prepared by AAE Wibowo, Ph.D. and MM Verberk, Ph.D. (Coronel Institute of the Academic Medical Center, Amsterdam, the Netherlands).

Literature was retrieved from the data bases Medline, Embase and Chemical Abstracts starting from 1966, 1988, and 1970, respectively. CD-rom versions of the data bases HSEline, Cisdoc, Mhidas, and NIOSHtic (covering the period 1985/87 until 1998) as well as Poltox (Toxline, Cambridge Scient. Abstr., and FSTA; covering the period 1990 until 1995) were also consulted. The following key words werd used: thionyl chloride, sulfurous dichloride and 7719-09-7.

Data considered to be critical were evaluated by reviewing the orginal publications. The final literature search has been carried out in May 1998.

In April 2001, the President of the Health Council released a draft of the document for public review. The committee received no comments.

2 Identity

name	:	thionyl chloride
synonyms	:	thionyl dichloride; sulfurous dichloride; sulfur chloride oxide; sulfinyl chloride; sulfurous oxychloride; sulphurous dichloride; sulphur chloride oxide; sulphinyl chloride; sulphurous oxychloride
molecular formula	:	$SOCl_2$
structural formula	:	-
CAS reg no	:	7719-09-7

3 Physical and chemical properties

molecular weight	:	118.98
boiling point	:	76°C
melting point	:	-104.5°C
flash point	:	-
vapour pressure	:	at 21°C: 13.3 kPa
solubility in water	:	rapid and violent reaction
log $P_{octanol/water}$	:	0.92 (estimated)
conversion factors (20°C, 101.3 kPa)	:	1 ppm = 2.5 mg/m^3 1 mg/m^3 = 0.40 ppm

Data from ACG99, http://esc.syres.com.

Thionyl chloride is a colourless to pale yellow or reddish, fuming, refractive liquid with a suffocating odour (ACG99). The odour threshold is not known.

In contact with water or water vapour, the compound reacts rapidly and violently to form sulfur dioxide and hydrogen chloride (fumes when exposed to moist air) (ACG99).

4 Uses

Thionyl chloride is used as a chlorinating agent in the chemical manufacture of herbicides, surfactants, drugs, vitamins, and dyestuffs. It is further used in the preparation of polyarylate-type engineering thermoplastics made from iso- and terephthaloyl chlorides and as an electrolyte in lithium batteries (ACG99).

5 Biotransformation and kinetics

The committee did not find data on the kinetics of thionyl chloride.

In view of its reactivity with water, moisture, *etc*., rapid hydrolysis upon contact with mucous membranes (eyes, respiratory tract) releasing sulfur dioxide and hydrogen chloride can be expected.

6 Effects and mechanism of action

Human data

Human data are limited to three cases of accidental occupational exposure to unknown concentrations of thionyl chloride.

In one case, a worker experienced, amongst others, chemical burns, unconciousness, and severe respiratory distress after an explosion of a lithium thionyl chloride battery. Three hours after the accident, he died from severe pulmonary oedema which was attributed to inhalation of sulfur dioxide, hydrochloric acid mist, and, possibly, alkaline lithium oxide fumes. The exposure duration was estimated to be 6 minutes; the concentration of thionyl chloride was not known, that of sulfur dioxide was estimated to be about 17,000 ppm (Duc88).

In one of the other cases, the patient had chemical burns. In both cases, symptoms were manifest only after 2 to 3 weeks and included shortness of breath, restrictive/obstructive patterns in lung function tests, and metabolic acidosis or hypocapnia (Kon93).

Animal data

Referring to an unpublished study, a 1-hour LC_{50} of 500 ppm (1250 mg/m^3) in rats has been reported. Exposure to a concentration of thionyl chloride of 17.5 ppm (87 mg/m^3) was stated to cause the death of cats in 20 minutes (ACG99).

The committee did not find any other experimental animal data on the effects of thionyl chloride.

7 Existing guidelines

The current administrative occupational exposure limit (MAC) for thionyl chloride in the Netherlands is 5 mg/m^3 (1 ppm), as a ceiling value.

Existing occupational exposure limits for ethyl formate in some European countries and in the USA are summarised in the annex.

8 Assessment of health hazard

The committee notices that thionyl chloride is a very reactive compound releasing sulfur dioxide and hydrogen chloride upon contact with water, moisture, or moist air.

Although no human or experimental animal data on thionyl chloride were found which could be used for a proper health hazard evaluation, the committee expects from the hydrolysis into sulfur dioxide and hydrogen chloride that the mucous membranes and respiratory tract are the target tissues.

The committee considers the toxicological data base on thionyl chloride too poor to justify recommendation of a health-based occupational exposure limit.

The committee concludes that there is insufficient information to comment on the level of the present MAC-value.

References

ACG99 American Conference of Governmental Industrial Hygienists (ACGIH). Thionyl chloride. In: TLVs® and other occupational exposure values -1999. [CD-ROM]. Cincinnati OH, USA; ACGIH®, 1999.

ACG00 American Conference of Governmental Industrial Hygienists (ACGIH). Guide to occupational exposure values - 2000. Cincinnati OH, USA: ACGIH®, Inc, 2000: 119.

ACG01 American Conference of Governmental Industrial Hygienists (ACGIH). 2001 TLVs® and BEIs®. Threshold Limit Values for chemical substances and fysical agents. Biological Exposure Indices. Cincinnati OH, USA: ACGIH®, Inc, 2001: 56.

Arb00a Arbejdstilsynet. Grænseværdier for stoffer og materialer. Copenhagen, Denmark: Arbejdstilsynet, 2000; At-vejledning C.0.1.

Arb00b Arbetarskyddstyrelsen. Hygieniska gränsvärden och åtgärder mot luftföroreningar. Solna, Sweden: National Board of Occupational Safety and Health, 2000; Ordinance AFS 2000/3.

CEC00 Commission of the European Communities (CEC). Commission Directive 2000/39/EC of 8 June 2000 establishing a first list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. Official Journal of the European Communities 2000; L142 (16/06/2000): 47-50.

DFG01 Deutsche Forschungsgemeinschaft (DFG): Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area. List of MAK and BAT values 2001. Maximum concentrations and biological tolerance values at the workplace. Weinheim, FRG: Wiley-VCH, 2001; rep no 37.

Duc88 Ducatman AM, Ducatman BS, Bames JA. Lithium battery hazard: old-fashioned planning implications of new technology. J Occup Med 1988; 30: 309-11.

HSE01 Health and Safety Executive (HSE). EH40/2001. Occupational Exposure Limits 2001. Sudbury (Suffolk), England: HSE Books, 2001: 27.

Kon93 Konichezky S, Schattner A, Ezri T, *et al.* Thionyl-chloride-induced lung injury and bronchiolitis obliterans. Chest 1993; 104: 971-3

SZW01 Ministerie van Sociale Zaken en Werkgelegenheid (SZW). Nationale MAC-lijst 2001. The Hague, The Netherlands: Sdu, Servicecentrum Uitgevers, 2001: 41.

TRG00 TRGS 900: Grenzwerte in der Luft am Arbeitsplatz; Technische Regeln für Gefahrstoffe. BArbBl 2000; 2.

Annex

Occupational exposure limits for thionyl chloride in various countries.

country -organisation	occupational exposure limit		time-weighted average	type of exposure limit	note[a]	lit ref[b]
	ppm	mg/m^3				
the Netherlands						
- Ministry	1	5	ceiling	administrative		SZW01
Germany						
- AGS	-	-				TRG00
- DFG MAK-Kom.	-	-				DFG01
Great Britain						
- HSE	1	4.9	15 min	OES		HSE01
Sweden	-	-				Arb00b
Denmark	1	5	15 min			Arb00a
USA						
- ACGIH	1	-	ceiling	TLV		ACG01
- OSHA	-	-				ACG00
- NIOSH	1	5	ceiling	REL		ACG00
European Union						
- SCOEL	-	-				CEC00

[a] S = skin notation, which means that skin absorption may contribute considerably to body burden; sens = substance can cause sensitisation

[b] Reference to the most recent official publication of occupational exposure limits