Canadian Water Quality Guidelines for the Protection of Aquatic Life

HALOGENATED METHANES

trichloromethane (chloroform)

Trichloromethane (CAS 67-66-3) is a clear, colourless liquid with a molecular formula of $CHCl_3$. It is also known as chloroform and methyl trichloride. Trichloromethane is used in the production of refrigerants, plastics, pharmaceuticals, and aerosol propellants. It is also an important solvent and degreasing agent. Canada has not produced trichloromethane since 1976, but continues to import it (CCME 1992).

The primary source of trichloromethane in natural aquatic environments is from the reaction of chlorine with organic chemicals in effluents and raw water wherein the amount of trichloromethane produced is proportional to the organic content of the water (USEPA 1980). High-level point sources include industrial effluents and accidental spills (NAS 1978; Thomas et al. 1979). Trichloromethane levels up to 1200 $\mu g \cdot L^{-1}$ have been detected in final effluent samples collected from industrial and municipal plants in Cornwall, Ontario. In turn, water samples from the St. Lawrence River at Cornwall, and Montreal, had 200 and 500 $ng \cdot L^{-1}$ (Environment Canada 1984). In 1979, samples from final effluents discharged to the St. Clair River had a trichloromethane detection frequency of 39% and a median concentration range of 1–10 $\mu g \cdot L^{-1}$ (Munro et al. 1985). Meanwhile, Lake St. Clair and the St. Clair River had trichloromethane concentrations up to 300 $ng \cdot L^{-1}$ (Kaiser and Comba 1986). Pulp mills in Ontario and British Columbia have produced effluent containing up 200 $\mu g \cdot L^{-1}$ (N. Bazinet 1990, Ontario Ministry of the Environment, Toronto, pers. com.; M.J. Clarke 1989, Ministry of the Environment, Vancouver, pers. com.). Groundwater contamination may occur through landfill leachates. Leachates from a chemical company landfill near Sarnia, Ontario, for example, contained trichloromethane concentrations up to 950 $\mu g \cdot L^{-1}$ (King and Sherbin 1986).

Volatilization (vapour pressure = 21 kPa at 20°C) is the major removal process of trichloromethane from natural waters. Half-life estimates range from 1.2 to 31 d for the Rhine River and a nearby lake (Zoeteman et al. 1980). Photolysis, hydrolysis, and microbial degradation are not significant processes in water (Lillian et al. 1975; Pearson and McConnell 1975; Mabey and Mill 1978). Although trichloromethane has a low K_{ow} (1.97), its BCF in green algae *(Selenastrum capricornutum)* is 690 (Neely et al. 1974; Mailhot 1987). The BCFs are low in fish (<10), and depuration from tissues is rapid (half-life <1 d) (USEPA 1978; Anderson and Lusty 1980).

Water Quality Guideline Derivation

The interim Canadian water quality guideline for trichloromethane for the protection of freshwater life was developed based on the CCME protocol (CCME 1991).

Freshwater Life

The toxicity of trichloromethane varies widely across taxonomic groups. Rainbow trout *(Oncorhynchus mykiss)* and bluegill sunfish *(Lepomis macrochirus)* are the species of freshwater fish most sensitive to trichloromethane, both having a 96-h LC_{50} of 18.2 $mg \cdot L^{-1}$ (Anderson and Lusty 1980). Trichloromethane levels as low as 2 $mg \cdot L^{-1}$ are toxic to rainbow trout eggs and alevins over a 27-d exposure period (Black et al. 1982; Birge et al. 1979).

Embryonic spring peepers *(Hyla crucifer)* have a 7-d LC_{50} of 270 $\mu g \cdot L^{-1}$ and a 7-d EC_{10} for teratogenesis of 18 $\mu g \cdot L^{-1}$ (Birge et al. 1980). Trichloromethane toxicity to *Daphnia magna* varied from 29 to 78.9 $mg \cdot L^{-1}$ for 48-h LC_{50}s (LeBlanc 1980; Abernethy et al. 1986). Bringmann and Kühn (1978) found the blue-green alga *Anacystis aeruginosa* to be the most susceptible algal species, with reduced cell multiplication at 185 $mg \cdot L^{-1}$.

The interim water quality guideline for trichloromethane for the protection of freshwater life is 1.8 $\mu g \cdot L^{-1}$. It was derived by multiplying the LOEC of 18 $\mu g \cdot L^{-1}$ for teratogenesis in spring peepers by a safety factor of 0.1 (CCME 1991, 1992).

Table 1. Water quality guidelines for trichloromethane for the protection of aquatic life (CCME 1992).

Aquatic life	Guideline value ($\mu g \cdot L^{-1}$)
Freshwater	1.8*
Marine	NGR†

*Interim guideline.
†No recommended guideline.

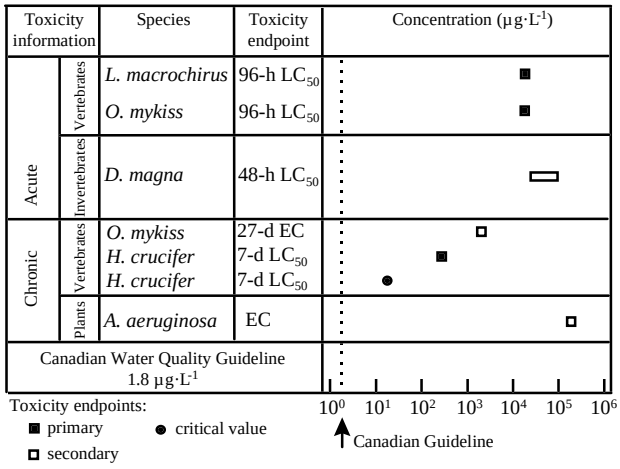

Figure 1. Select freshwater toxicity data for trichloromethane.

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