SOLID 1,2,3,4-tetrachlorobenzene (CAS 634-66-2, molecular weight 215.9) is used industrially mainly as an intermediate in the production of fungicides, herbicides, and defoliants (2,4,5-T), and insecticides (USEPA, 1980). It has also been used in the formulation of dielectric fluids for transformers. 1,2,3,4-Tetrachlorobenzene is not produced in Canada and imports are negligible (CIS 1991), however, approximately 1,300,000 kg of tetrachlorobenzenes are present in transformer dielectric fluids either in use or stored before disposal. Small amounts (about 660 kg of tetrachlorobenzene congeners) were imported into Canada in 1992 for the maintenance of existing transformer dielectric fluid (E.D. Brien 1993, Environment Canada, Ottawa, pers. com.). The principle sources of environmental contamination are likely spillage of these dielectric fluids, and long-range transborder transport and deposition. Losses associated with the use as an industrial reagent, residue in the final product, and via industrial effluents and landfill leachates are also expected. The releases of tetrachlorobenzenes to the Canadian environment are likely more than 2000 kg·a⁻¹ (Government of Canada 1993).

Although chlorobenzenes have previously been considered to be entirely anthropogenic, there is now some evidence that some congeners can be produced naturally by both biotic and abiotic processes (e.g., 1,2,3,4-tetrachlorobenzene is found naturally in the Mississippi salt marsh needle rush (Juncus roemerianus) (Gribble 1994)).

There are few data on the levels of tetrachlorobenzenes found in groundwater in Canada. The only reported values are 0.004 and 0.005 μg·L⁻¹ for 1,2,3,4- and 1,2,3,5-tetrachlorobenzene, respectively, in a landfill leachate from Sarnia, Ontario (Government of Canada 1993).

1,2,3,4-Tetrachlorobenzene has been found in various watercourses in Canada, primarily in the Great Lakes basin. When present above detection limits, concentrations have been reported to range from <0.000 01 to 0.126 μg·L⁻¹. Levels near the upper part of the range are usually near known sites of contamination on the St. Clair and Niagara Rivers. Elevated levels, some above the ranges previously noted, have been reported in industrial effluents in Ontario and Nova Scotia (Government of Canada 1993).

Levels of 1,2,3,4-tetrachlorobenzene in invertebrates and fish ranged from <0.01 to 26.8 μg·kg⁻¹ (ww). The values in the upper part of the range are for organisms collected near sites in the Great Lakes basin known to be contaminated (Government of Canada 1993).

Mackay et al. (1992) have modelled the environmental fate of each of the chlorobenzenes using several versions of a fugacity-based model and available information. These modelling results indicate that chlorobenzene behaviour varies as a function of the degree of chlorination. The simplest model, Fugacity Level I, demonstrates that 1,2,3,4-tetrachlorobenzene tends to partition mainly into soil, some into the sediment, and a small amount into air, because of its low vapour pressure (5.2 Pa) and very low water solubility (7.8 mg·L⁻¹). Level II modelling indicates that the primary removal processes for all chlorobenzenes are in air. For 1,2,3,4-tetrachlorobenzene, removal is mainly by advection (e.g., deposition, sedimentation) and, to a much lesser degree, by chemical reaction. Photodegradation is very slow, resulting in atmospheric half-lives of 6-18 weeks. Fugacity Level III modelling indicates that the more highly chlorinated chlorobenzenes tend to accumulate and persist primarily in soils and sediments, with transfer between media being slow, and move in the environment largely by long-range airborne transport and atmospheric deposition. As the primary removal process is advection, soils and sediments end up being long-term sinks/storage sites. In the aquatic environment, 1,2,3,4-tetrachlorobenzene is found mostly in organic phases (organisms, sediments) or associated with suspended/dissolved organic material rather than dissolved in the water phase (log octanol–water partition coefficient 4.5), with half-lives of 4.2–14 months in the water and 1.1–3.4 years in the sediment.

Table 1. Water quality guidelines for 1,2,3,4-tetrachlorobenzene for the protection of aquatic life (Environment Canada 1997).

<table>
<thead>
<tr>
<th>Aquatic life</th>
<th>Guideline value (μg·L⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater</td>
<td>1.8₇</td>
</tr>
<tr>
<td>Marine</td>
<td>NRG⁶</td>
</tr>
</tbody>
</table>

₇Interim guideline.
⁶No recommended guideline.

Canadian Environmental Quality Guidelines
Canadian Council of Ministers of the Environment, 1999
Water Quality Guideline Derivation

The interim Canadian water quality guideline for 1,2,3,4-tetrachlorobenzene for the protection of freshwater life was developed based on the CCME protocol (CCME 1991). For more information, see the Canadian Environmental Protection Act (CEPA) assessment report and supporting document (Government of Canada 1993) and the supporting document (Environment Canada 1997).

Freshwater Life

The interim water quality guideline for 1,2,3,4-tetrachlorobenzene for the protection of freshwater life is 1.8 µg·L⁻¹.

The lowest acute information for fish is a 96-h LC₅₀ of 497 µg·L⁻¹ for rainbow trout (Oncorhyncus mykiss) (Hodson et al. 1988) and a 96-h LC₅₀ of 1070 µg·L⁻¹ for fathead minnows (Pimephales promelas) (Ahmad et al. 1984). In an acute study, Roghair et al. (1994) reported a 96-h LC₅₀ of 184 µg·L⁻¹ for the midge Chironomus riparius. Two acute invertebrate studies report a 96-h LC₅₀ of 184 µg·L⁻¹ for D. pulex (Ikemoto et al. 1992) and a 48-h LC₅₀ of 1080 µg·L⁻¹ for the alga A. falcatus, based on reduction in primary production (photosynthesis).

Chronic fish data consist of a 28-d NOEC and a 28-d endpoint for invertebrates (184 µg·L⁻¹) by a safety factor of 0.01 (acute study), the basis for the interim freshwater guideline of 1.8 µg·L⁻¹, and a 48-h LC₅₀ of 1 080 µg·L⁻¹ for D. magna. (Abernethy et al. 1988).

Marine Life

Insufficient information exists to derive an interim marine guideline for 1,2,3,4-tetrachlorobenzene.

There are no toxicity data for marine fish with 1,2,3,4-tetrachlorobenzene. Mortimer and Connell (1994) reported a 96-h LC₃₀ of 399 µg·L⁻¹ for the sand crab P. pelagicus. Mortimer and Connell (1995) reported growth rate reductions of 10 and 50% for the sand crab after 40-d exposures of 36.1 µg·L⁻¹ (the lowest effect level) and 125.0 µg·L⁻¹, respectively.

References


Reference listing:


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