Monochlorobenzene (CAS 108-90-7, molecular weight 112.6) is a liquid used as a pesticide carrier (i.e., solvent for insecticides), a reagent in the production of rubber polymers, and as a solvent carrier for textile dyes (CIS 1991). Monochlorobenzene is not produced in Canada.

Monochlorobenzene is not commonly found in quantifiable amounts in groundwater in Canada. In areas of known chemical contamination, however, levels as high as 5310 µg·L⁻¹ have been found. Otherwise, levels exceeding the detection limits are usually 10 µg·L⁻¹ or less and rarely exceed 100 µg·L⁻¹. Monochlorobenzene is also not commonly found at quantifiable levels in surface waters in Canada (detection limits range from 0.5–1 µg·L⁻¹) (Government of Canada 1992).

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 monochlorobenzene tends to partition into air, with small amounts going to water and soil, as it has a relatively high vapour pressure (1580 Pa) and low water solubility (484 mg·L⁻¹). Level II modelling indicates that the primary removal processes for all chlorobenzenes are in air. For monochlorobenzene, removal is by advection (e.g., deposition, sedimentation) and chemical reaction (approximately 30%). Photodegradation is slow, resulting in atmospheric half-lives of 4–12 d. In the aquatic environment, monochlorobenzene 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 2.8), with half-lives of 6–18 weeks in the water and 1.1–3.4 years in the sediment. Although minor, biotransformation does occur at a slow rate, with a half-life of 6–18 weeks.

Water Quality Guideline Derivation

The interim Canadian water quality guidelines for monochlorobenzene for the protection of aquatic life were 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 1992) and the supporting document (Environment Canada 1997).

Freshwater Life

Acute and chronic endpoint data were found for fish and amphibians. Acute bioassay results for 48-h, 96-h, and 96-h LC₅₀s were 4100, 4700, and 7460 µg·L⁻¹ for rainbow trout (Oncorhynchus mykiss), as reported by Calamari et al. (1983), Dalich et al. (1982), and Hodson et al. (1984), respectively.

In chronic exposure bioassays, Black et al. (1982) reported reduced egg hatchabilities of 10% after a 23-d exposure at 13 µg·L⁻¹ for rainbow trout (O. mykiss), of 6% after a 5.5-d exposure at 44 µg·L⁻¹ for the northwestern salamander (Ambystoma gracile), and of 5% after a 5-d exposure at 11 µg·L⁻¹ for the leopard frog (Rana pipiens). The respective corresponding 4-d posthatching mortalities are reported as a 27-d LC₁₀ of 13 µg·L⁻¹ for trout, a 9.5-d LC₁₀ of 44 µg·L⁻¹ for the salamander, and a 9-d LC₅ of 11 µg·L⁻¹ for the frog. Using the same experimental procedure, Birge et al. (1979) reported 4-d posthatching mortalities as 7.5-d LC₅₀s of 880 µg·L⁻¹ for goldfish hatchlings (Carassius auratus) and 50 µg·L⁻¹ for largemouth bass hatchlings (Micropterus salmoides). The corresponding 7.5-d LC₅₀s were 1.0 µg·L⁻¹ and 10 µg·L⁻¹ for embryonic and larval stages of bass and goldfish, respectively. However, these LC₅₀s are not considered to be statistically significant enough to derive a guideline value.

The lowest acute toxicity test result for invertebrates is by Calamari et al. (1983), who reported a 24-h EC₅₀ for immobilization of Daphnia magna of 4300 µg·L⁻¹. A recent

Table 1. Water quality guidelines for monochlorobenzene 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>1.3*</td>
</tr>
<tr>
<td>Marine</td>
<td>25*</td>
</tr>
</tbody>
</table>

* Interim guideline.
The lowest chronic invertebrate data are for *D. magna*, with a 16-d NOEC based on growth of 320 µg·L⁻¹ (de Wolf et al. 1988), 16-d LC₅₀ based on food consumption, 27-d LC₅₀ of 3390 µg·L⁻¹ (Hermens et al. 1984), 16-d EC₅₀ based on growth of 3390 µg·L⁻¹ (Hermens et al. 1984), and a 14-d EC₅₀ and EC₆₀ (reduced fertility) of 2500 µg·L⁻¹ and 2100 µg·L⁻¹, respectively (Calamari et al. 1983).

Calamari et al. (1983) reported a 96-h EC₅₀ of 12 500 µg·L⁻¹ (growth inhibition) and a 3-h EC₅₀ of 33 000 µg·L⁻¹ (photosynthesis inhibition) for the alga *Skeletonema costatum*.

The interim water quality guideline for monochlorobenzene for the protection of aquatic life is 1.3 µg·L⁻¹. It was derived by multiplying the growth rate reductions of 10% after 40-d exposures of 253.4 µg·L⁻¹ for the sand crab *Portunus pelagicus* (Mortimer and Connell, 1995) by a safety factor of 0.1 (CCME 1991). For acute fish toxicity data, Furay and Smith (1995) reported 96-h LC₅₀ of 5820 µg·L⁻¹ for sole (*Solea solea*) and 6610 µg·L⁻¹ for flounder (*Platichthys flesus*), while Heitmuller et al. (1981) reported a 48-h LC₅₀ at 8900 µg·L⁻¹ for sheepshead minnows (*Cyprinodon aggregata*). Available acute marine invertebrate data consist of a 96-h LC₅₀ at 16 300 µg·L⁻¹ for opossum shrimp (*Mysidopsis bahia*) (Class Malacostraca) (USEPA 1980) and a 24-h LC₅₀ at 40 900 µg·L⁻¹ for the brine shrimp (*Artemia nauplii*) (Class Branchiopoda) (Abernethy et al. 1988). Mortimer and Connell (1995) also reported growth rate reductions of 50% after 40-d exposures of 573.0 µg·L⁻¹, for the sand crab *P. pelagicus*.

Data for marine algae were 96-h EC₅₀ for chlorophyll *a* inhibition and reduction in cell numbers of 343 000 and 341 000 µg·L⁻¹, respectively, for the diatom *Skeletonema costatum* (USEPA 1978). Cowgill et al. (1989) reported 96-h EC₅₀ for reductions in cell count and cell volume of 203 000 and 201 000 µg·L⁻¹, respectively, for the same species of diatom.

The interim water quality guideline for monochlorobenzene for the protection of marine life is 25 µg·L⁻¹. It was derived by multiplying the growth rate reductions of 10% after 40-d exposures of 253.4 µg·L⁻¹ for the sand crab *Portunus pelagicus* (Mortimer and Connell, 1995) by a safety factor of 0.1 (CCME 1991). For acute fish toxicity data, Furay and Smith (1995) reported 96-h LC₅₀ of 5820 µg·L⁻¹ for sole (*Solea solea*) and 6610 µg·L⁻¹ for flounder (*Platichthys flesus*), while Heitmuller et al. (1981) reported a 48-h LC₅₀ at 8900 µg·L⁻¹ for sheepshead minnows (*Cyprinodon aggregata*). Available acute marine invertebrate data consist of a 96-h LC₅₀ at 16 300 µg·L⁻¹ for opossum shrimp (*Mysidopsis bahia*) (Class Malacostraca) (USEPA 1980) and a 24-h LC₅₀ at 40 900 µg·L⁻¹ for the brine shrimp (*Artemia nauplii*) (Class Branchiopoda) (Abernethy et al. 1988). Mortimer and Connell (1995) also reported growth rate reductions of 50% after 40-d exposures of 573.0 µg·L⁻¹, for the sand crab *P. pelagicus*.

Data for marine algae were 96-h EC₅₀ for chlorophyll *a* inhibition and reduction in cell numbers of 343 000 and 341 000 µg·L⁻¹, respectively, for the diatom *Skeletonema costatum* (USEPA 1978). Cowgill et al. (1989) reported 96-h EC₅₀ for reductions in cell count and cell volume of 203 000 and 201 000 µg·L⁻¹, respectively, for the same species of diatom.
References
USEPA (U.S. Environmental Protection Agency). 1978. In-depth studies on health and environmental impacts of selected water pollutants. (Table of data available from Charles E. Stephan.) USEPA, Duluth, MN.

Reference listing:

For further scientific information, contact:
Environment Canada
Guidelines and Standards Division
351 St. Joseph Blvd.
Hull, QC K1A 0H3
Phone: (819) 953-1550
Facsimile: (819) 953-0461
E-mail: cceq-rqce@ec.gc.ca
Internet: http://www.ec.gc.ca

© Canadian Council of Ministers of the Environment 1999
Excerpt from Publication No. 1299; ISBN 1-896997-34-1

For additional copies, contact:
CCME Documents
c/o Manitoba Statutory Publications
200 Vaughan St.
Winnipeg, MB R3C 1T5
Phone: (204) 945-4664
Facsimile: (204) 945-7172
E-mail: spccme@chc.gov.mb.ca

Aussi disponible en français.