Canadian Water Quality Guidelines for the Protection of Aquatic Life

CAPTAN

Captan ($C_9H_8Cl_3NO_2S$) has a CAS name and registry number of 3a,4,7,7a-tetrahydro-2-[(trichloro-methyl)thio]-1*H*-isoindole-1,3(2*H*)-dione and 133-06-2, respectively (Tomlin 1994). The most common trade name for captan is Orthocide, but other trade names and formulations registered in Canada can be found in Agriculture and Agri-Food Canada (1997).

Captan is a broad-spectrum, nonsystemic fungicide that was first registered in Canada in 1953 and is used to control disease in vegetables, fruit, tobacco, turf, and ornamentals. It may be used as a seed treatment on corn, beans, peas, and other crops and also to control mildew in vinyl, lacquer, wallpaper flour paste, rubber, and polyethylene articles (Agriculture and Agri-Food Canada 1997).

The principal mode of action in fungal cells results from the reaction of captan with sulphydryl groups (Lukens 1969). Ultimately, captan reduces fungal spore germination, growth, and oxygen uptake (Owens and Novotny 1959; Richmond and Somers 1963).

In 1990, the United States Environmental Protection Agency (USEPA) revoked some registrations and since then, is denying registrations for pesticide products containing captan as an active ingredient. All uses of captan on crabapples, cranberries, grapefruit, lemons, limes, oranges, pineapples, quinces, rhubarb, and tangerines have been cancelled (USEPA 1990).

In 1984, 71 410 kg of captan were used in Ontario (Moxley 1989). In New Brunswick, 4915 kg of the active ingredient were sold in 1988 (Carr 1988). In Quebec, 64 403 kg of phthalimides (which includes captan) were used in 1982 (Gordon et al. 1983).

After application to soil and crop plants, captan has little potential for long-range transport. Captan is nonvolatile, is unlikely to exhibit substantial leaching in soil, and rapidly hydrolyzes in water. Potential routes of contamination include accidental spills, misuse and mishandling, back-siphoning near wells, and washing or loading spray equipment near streams or ponds.

Contamination resulting from washing or loading of spray equipment was reported on a waterway in 1982. Although concentrations of captan in the water were not reported, a fish kill apparently resulted from this spill (Eaton et al. 1986).

In water, hydrolysis is a rapid and important mechanism in captan dissipation and is probably the fate-determining step in natural waters (Wolfe et al. 1976a, 1976b). The rate of hydrolysis increases with temperature and with alkaline pH. In acidic pH the hydrolytic half-life is approximately 12 h; at pH 7 the half-life is about 155 min, while at pH 10, this half-life is about 10 s (USEPA 1984). Photolysis, biodegradation, and volatilization are not significant processes, although captan may be removed to a certain extent from water through sorption to particulate matter (USEPA 1984).

Captan has been shown to have little bioaccumulative potential. Bioconcentration factors (BCFs) for golden ide *(Leuciscus idus melanotus)* and a green alga *(Chlorella fusca var. vacuolata)* were 10 and 20, respectively (Freitag et al. 1985).

Water Quality Guideline Derivation

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

Freshwater Life

The acute toxicity values of captan to fish ranged from a 96-h LC_{50} of 26.2 $\mu g \cdot L^{-1}$ for brown trout *(Salmo trutta)* (Mayer and Ellersieck 1986) to a 48-h LC_{50} of 1000 $\mu g \cdot L^{-1}$ for medaka *(Oryzias latipes)* (Hashimoto and Nishiuchi 1981). In studies with amphibians, a 48-h LC_{50} of 3000 $\mu g \cdot L^{-1}$ was determined for the tadpole *(Bufo bufo japonicus)* (Hashimoto and Nishiuchi 1981).

A single chronic study on fathead minnows (*Pimephales promelas)* reported a MATC of between 16.8 and

Table 1. Water quality guidelines for captan for the protection of aquatic life (CCME 1991a).

Aquatic life	Guideline value ($\mu g \cdot L^{-1}$)
Freshwater	1.3*
Marine	NRG†

*Interim guideline.
†No recommended guideline.

39.5 μg·L^{-1}, based on no significant effect at 16.8 μg·L^{-1} and growth reduction at 39.5 μg·L^{-1} (Hermanutz et al. 1973). The LOEL, therefore, was 39.5 μg·L^{-1}. However, no positive controls were studied during these experiments.

Invertebrate acute toxicity test data indicate that these animals are less susceptible to captan toxicity. The lowest LC_{50} (48-h) of 1 mg·L^{-1} was for the snail *Physa acuta* (Hashimoto and Nishiuchi 1981).

For plants, exposure to 500 mg·L^{-1} for 30 d caused growth reductions up to 14% for the blue-green algae *Nostoc* sp., *Calothrix* sp., *Westiellopsis prolifica*, *Aulosira fertilissima*, and *Tolpothrix tenuis* (Babu and Bhalla 1979). An EC_{90} (reduced photosynthesis) of 1 mg·L^{-1} was reported for the green alga *Chlorella vulgaris* (Malewicz and Borowski 1979).

The interim water quality guideline for captan for the protection of freshwater life is 1.3 μg·L^{-1}. It was derived by multiplying the 96-h LC_{50} of 26.2 μg·L^{-1}, the lowest acute toxicity value from standardized testing methods (Mayer and Ellersieck 1986) for the most sensitive organism to captan, the brown trout, by a safety factor of 0.05 (for nonpersistent substances) (CCME 1991a). The guideline was derived from an acute study, as no acceptable lower chronic toxicity study was available.

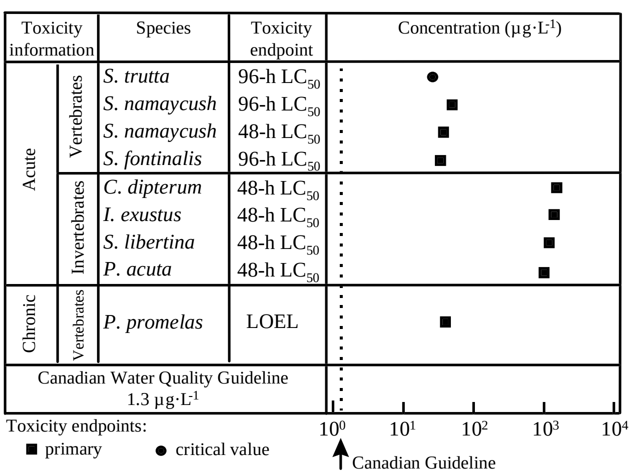

Figure 1. Select freshwater toxicity data for captan.

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