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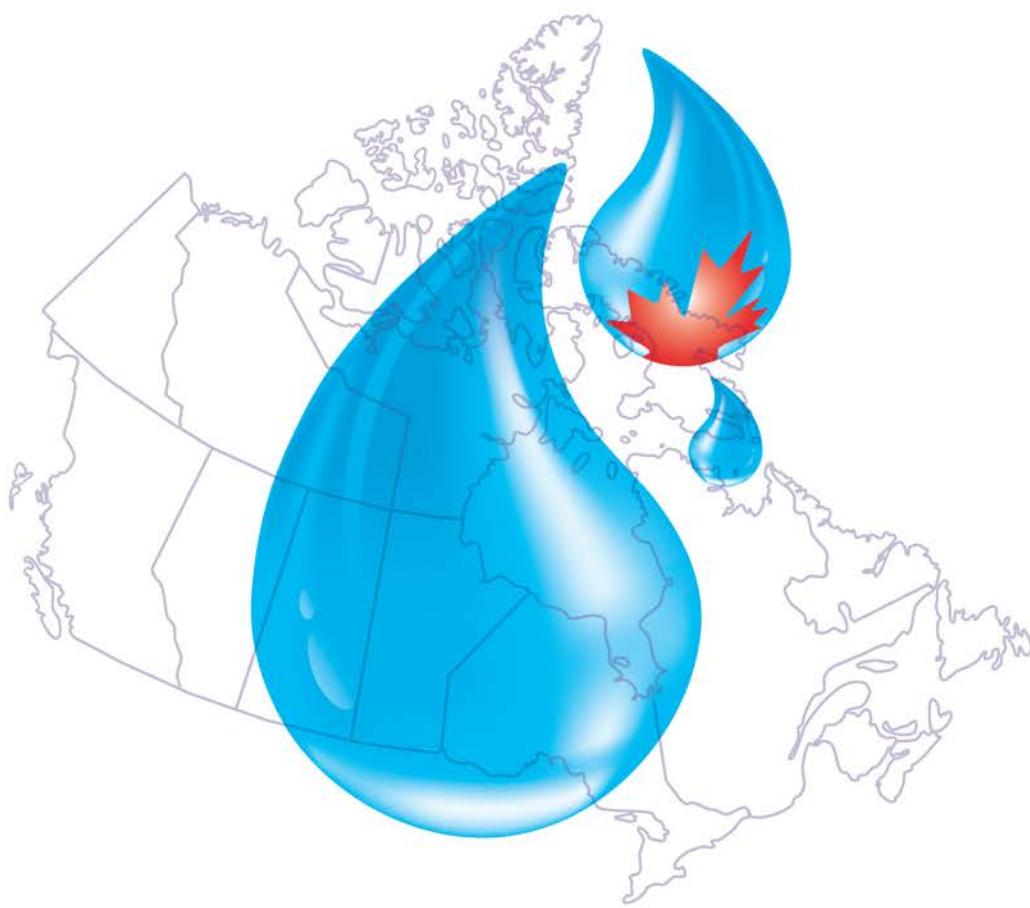
*Your health and
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sécurité... notre priorité.*

Guidelines for Canadian Drinking Water Quality

Guideline Technical Document

Terbufos



Canada

Terbufos

Guideline

The maximum acceptable concentration (MAC) for terbufos in drinking water is 0.001 mg/L (1 µg/L).

Identity, Use and Sources in the Environment

Terbufos ($C_9H_{21}O_2PS_3$) is an organophosphorus insecticide used to control soil-borne insects, primarily on corn, sugar beets and rutabagas. More than 100 000 kg of terbufos were used in Canada in 1990.¹

The vapour pressure of terbufos is 34.6 mPa at 25°C, and its water solubility is 10–15 mg/L at 25°C. Terbufos is hydrolysed under alkaline conditions in soil or water.² Terbufos has some residual action in soil. It was not considered in either the Canadian or U.S. ranking schemes for pesticides deemed to have the potential to leach from soil to water.^{3,4}

Exposure

In a 1986 study of municipal water in Manitoba, terbufos was not detected in 49 samples (detection limit 0.2 µg/L).⁵ Terbufos was not detected in surface water samples from either the Grand or the Thames river basins, which are located in areas heavily used for agriculture (detection limit <0.1 µg/L).⁶

If it is assumed that all crops with registered uses were treated with terbufos at the maximum tolerated level, the theoretical maximum dietary intake of terbufos for an adult Canadian would be 0.00008 mg/kg bw per day. No actual residue levels in foods are available, however, as terbufos was not included in total diet residue surveys in either Canada or the United States.

Analytical Methods and Treatment Technology

Terbufos may be monitored in water samples by solvent extraction followed by gas chromatography and flame thermionic or flame photometric detection.⁷ Thermionic detectors may offer lower detection limits than flame photometric methods.⁸ The practical quantitation limit (PQL) (based on the abilities of laboratories

to measure terbufos within reasonable limits of precision and accuracy) is 1 µg/L; detection limits range from 0.1 to 0.5 µg/L.

No information has been found on the effectiveness of current treatment technologies in removing terbufos from drinking water.

Health Effects

Terbufos is readily absorbed by the oral, inhalation and dermal routes. Eighty-three percent of a single oral dose of technical ^{14}C -labelled terbufos (0.8 mg/kg bw) was eliminated in the urine of rats 168 hours after dosing; 3.5% of the dose was recovered in the faeces. Terbufos does not accumulate in body tissues.⁹

Terbufos is highly toxic by both the oral and dermal routes; oral LD₅₀ values are 9.0 mg/kg bw for female rats and between 1.5 and 4.5 mg/kg bw for male rats.¹⁰ The principal toxic effect of terbufos is acetyl-cholinesterase inhibition. High doses also cause congestion of the liver, kidneys and lungs. Symptoms of acute toxicity include muscle tremors, salivation, diuresis, hyperpnoea and tachycardia.¹⁰

A no-observed-adverse-effect level (NOAEL) of 0.0025 mg/kg bw for cholinesterase inhibition was observed in a 28-day dog study.¹¹ Chronic oral administration of doses up to 0.3 mg/kg bw in rats in a two-year feeding study reduced body weights, increased mortality, increased several organ weights and increased the incidence of eye diseases. The NOAELs were 0.04 mg/kg bw for cholinesterase depression and 0.2 mg/kg bw for changes in organ/body weight ratio.¹¹

There were no dose-related tumorigenic effects in an 18-month mouse study¹² or in the two-year rat study.¹¹ Terbufos was not mutagenic in the Ames test in four strains of bacteria or in a similar test on *Escherichia coli* with or without metabolic activation. No results of other short-term tests for mutagenic or genotoxic effects are available. No reproductive, foetotoxic or teratogenic effects other than reduced body weights in both adults and weanlings were observed in a two-generation rat

study. Data base deficiencies include lack of mutagenicity and subchronic/chronic data on a non-rodent species.¹¹

Rationale

A negligible daily intake (NDI) for terbufos was established by the Food Directorate of Health Canada as follows:

$$\text{NDI} = \frac{0.0025 \text{ mg/kg bw per day}}{50} = 0.00005 \text{ mg/kg bw per day}$$

where:

- 0.0025 mg/kg bw per day is the NOAEL for cholinesterase inhibition in a 28-day dog study¹¹
- 50 is the uncertainty factor to compensate for the short duration of the study and other deficiencies of the toxicology data base.

A maximum acceptable concentration (MAC) for terbufos is derived from the NDI as follows:

$$\text{MAC} = \frac{0.00005 \text{ mg/kg bw per day} \times 70 \text{ kg} \times 0.20}{1.5 \text{ L/d}} \approx 0.0005 \text{ mg/L}$$

where:

- 0.00005 mg/kg bw per day is the NDI established by the Food Directorate
- 70 kg is the average body weight of an adult
- 0.20 is the proportion of daily intake of terbufos allocated to drinking water
- 1.5 L/d is the average daily consumption of drinking water for an adult.

Because the MAC must be measurable by available analytical methods, the PQL is also taken into consideration in its derivation. A MAC of 0.001 mg/L, the quantitation limit, is therefore established for terbufos in drinking water.

The theoretical maximum dietary intake of terbufos for an adult Canadian is 0.0008 mg/kg bw per day (see "Exposure"), which exceeds the NDI established by Health Canada, and intake of drinking water at the IMAC will further exceed the NDI. It should be noted, however, that terbufos residues have not been detected in food. Every effort should be made to keep terbufos concentrations in drinking water as low as possible.

References

1. Environment Canada/Agriculture Canada. Pesticide Registrant Survey, 1990 report. Commercial Chemicals Branch, Conservation and Protection, Environment Canada, Ottawa (1993).
2. Spencer, E.Y. Guide to the chemicals used in crop protection. 7th edition. Research Branch, Agriculture Canada, Ottawa (1982).
3. Agriculture Canada. Pesticide priority scheme for Water Monitoring Program. Unpublished report, Pesticide Directorate (1986).
4. U.S. Environmental Protection Agency. EPA draft final list of recommendations for chemicals in the National Survey for Pesticides in Groundwater (August 1985). *Chem. Regul. Rep.*, 9(34): 988 (1985).
5. Hiebsch, S.C. The occurrence of thirty-five pesticides in Canadian drinking water and surface water. Unpublished report prepared for the Environmental Health Directorate, Department of National Health and Welfare, Ottawa (1988).
6. Frank, R. and Logan, L. Pesticide and industrial chemical residues at the mouth of the Grand, Saugeen and Thames rivers, Ontario, Canada, 1981–85. *Arch. Environ. Contam. Toxicol.*, 17: 741 (1988).
7. U.K. Department of Environment. Organophosphorus pesticides in river and drinking water, 1980 tentative method. Her Majesty's Stationery Office, London (1981).
8. U.S. Environmental Protection Agency. National primary drinking water regulations; synthetic organic chemicals, proposed rule. *Fed. Regist.*, 50(219): 47021 (1985).
9. North, N.H. Counter® insecticide: rat metabolism of CL 92,100 – PD-M10: 1008-1080. Progress report, March 1, 1973 – September 28, 1973. Unpublished study, MRID 87695, submitted by American Cyanamid Company, Princeton, NJ (1973). Cited in U.S. Environmental Protection Agency. Drinking water health advisory: pesticides. Office of Drinking Water Health Advisories. Lewis Publishers, Chelsea, MI (1989).
10. Merck Index. 10th edition. Merck Co., Rahway, NJ (1983).
11. Health Canada. Unpublished study; evaluation by Food Directorate (1994).
12. Rapp, R., Tebaldi, A., Wilson, N. et al. An 18-month carcinogenicity study of AC 92,100 in mice. Project No. 71R-728. Unpublished study, MRID 85170, Biodynamics, Inc. (1974).