

Carbaryl (Sevin) Research
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From Carbaryl in Drinking Water, Background document for development of WHO Guidelines for Drinking-Water Quality

Major uses

Carbaryl is a broad spectrum carbamate insecticide that is used to control insect pests in crops, trees and ornamental plants. It also has some uses in public health and veterinary practice.

Environmental fate

Carbaryl is not usually persistent in the environment and is hydrolysed in water, the rate depending on temperature and pH, although at low concentrations it may be hydrolysed within hours under favourable conditions. It does not significantly bioconcentrate in fish. It adsorbs to soils with a high organic content but adsorption is much lower in sandy soils. At usual rates of application it rapidly dissipates, with a half-life of 1 month or less. It is degraded by photodecomposition, hydrolysis and microbial activity and the rate of degradation is more rapid under hot climatic conditions, it may be found occasionally in surface water (ILO 1992).

EXPOSURE IN DRINKING WATER

Carbaryl has not been reported in drinking water, however, it could occur following overspraying or spillage into surface water. Exposure through drinking-water is, therefore considered to be low unless in exceptional circumstances. The major route of carbaryl intake for the general population is food but residues are considered to be relatively low. These range from trace amounts to about 0.05 mg/kg of food. It has been reported that the intake in the USA was 0.15 mg/day per person but has declined to 0.003 mg/day per person (ILO 1992).

Treatment and control methods and technical achievability

Available data indicate that granular activated carbon (GAC) adsorption, ozonation and coagulation treatment will remove carbaryl from water. The percentage removal efficiency ranges from 43 to 99% (Kumbhat, 1994). A carbaryl concentration below 50 µg/l should be achievable by drinking water treatment.

Conventional water treatment using aluminium coagulation (Al dosage 8 mg/l plus the addition of 1 mg/l of an anionic polymer), a 30-minute settling period and filtration removed 56% of the carbaryl present (Kumbhat, 1994).

Pilot studies indicate that GAC adsorption is 99% effective for carbaryl removal (Kumbhat, 1994). An adsorption isotherm for carbaryl on Darco carbon gave loadings of 0.06 and 0.34 mg/g with equilibrium carbaryl concentrations of 0.1 and 100 µg/l respectively (El Dib, 1975). Experiments using Waco PAC showed that a dose of approximately 5 mg/l was required to reduce the carbaryl concentration from 500 to 50 µg/l (Hu et al., 1997).

No reaction was found to occur with chlorine: 2 µg/l carbaryl, 10 mg/l chlorine, pH 7, 20 °C, 24 hours (Mason et al., 1990). Carbaryl reacts rapidly with ozone in laboratory tests (Mason et al, 1990). Ozonation of a 21 mg/l solution at an ozone dose of 25 mg/l gave complete removal (Shevchenko et al., 1982).

The ability of different nanofiltration membranes to remove carbaryl from 0.5-1.5 mg/l solutions was examined in laboratory tests (Kiso et al., 2001). The best removal (92%) was obtained with a PVA/polyamide membrane with a nominal NaCl rejection of 92%. Adsorption of the pesticide onto the membrane was found to be an important contributor to overall removal. A removal of 87% from an initial concentration of 0.1 mg/l was obtained using a HNF-1 polyamide/polysulfone hollow fibre NF membrane (Jung et al., 2005). A polyamide RO membrane (XLE) gave 79% removal from a 100 µg/l solution but no removal was obtained with a cellulose acetate SC-3100 membrane (Kimura et al., 2004).

From EPA Health Advisory



HEALTH ADVISORY SUMMARY

Carbaryl

What is a Health Advisory?

Health Advisories are guidance documents issued by the U.S. Environmental Protection Agency to assist federal, state, and local officials in responding to drinking water contamination. The Health Advisories contain information on health risks and treatment technologies, and specify levels of chemical concentrations in water that are acceptable for drinking. In preparing Health Advisories, EPA reviews available human data and experimental animal studies in evaluating potential human health effects. The Health Advisories are updated as new information becomes available. This summary presents key highlights from the Health Advisory for Carbaryl.

What is Carbaryl?

Carbaryl, also known as Sevin[®], is an insecticide used for the control of pests on more than 100 different crops, and on forests, lawns, ornamentals, shade trees and rangeland.

What Health Effects Might Be Caused by Carbaryl in My Water?

Non-Cancer Effects. EPA has set a Lifetime Health Advisory level for Carbaryl in drinking water at **700 micrograms per liter***. This level includes a margin of safety to protect human health and should be regarded as a guideline. EPA believes that water containing Carbaryl at or below this level is acceptable for drinking every day over the course of one's lifetime, and does not pose any health concerns.

However, consuming Carbaryl at high levels well above the Lifetime Health Advisory level over a long period of time has been shown to result in damage to the liver and kidneys and reduced fertility in animal studies, as well as inhibition of an enzyme called cholinesterase, in both humans and animals. Symptoms associated with inhibition of this enzyme in humans include nausea, vomiting, blurred vision, stomach cramps, excessive sweating, muscle weakness, headaches, and rapid heart rate.

Cancer Risk. Data from laboratory studies are inadequate for EPA to determine if Carbaryl can increase the risk of cancer in humans.

What Actions Should I Take?

Your first step should be to get the advice of your state or county health officials. Other experts in your state environmental agency or agriculture department may also be helpful to you.

These people are likely to recommend that you retest your well to get an accurate overall picture of the water quality. Seasonal precipitation changes and changes in pesticide use can cause wide variations in the amount of pesticides found in your well.

Upon retesting, if Carbaryl is detected in your drinking well at or below 700 micrograms per liter, you should continue to retest your well periodically. Your state or county health officials can refer you to approved testing services, advise you on the cost of testing, and recommend how often you should retest.

If Carbaryl is detected in your water and confirmed by retesting at a level above 700 micrograms per liter, once again consult your state or county health officials. They may advise you to continue periodic retesting, or in some cases, to use an alternative drinking water supply (such as bottled water) or treat the water or dig a new or deeper well.

Treatment technologies that can remove Carbaryl from water include activated carbon adsorption, ozonation, and conventional water treatment (coagulation, settling, and filtration). However, these techniques are not necessarily appropriate or available in every situation. Certain treatment methods are more suitable for large community water systems than for individual domestic wells. Your state or county health officials should be able to advise you on the best approach to follow.

Where Can I Get More Information?

In addition to your state and county experts, EPA has two toll-free lines you can call. For further information on drinking water quality, treatment technologies, and EPA's Health Advisories, please contact EPA's toll-free Safe Drinking Water Hotline, Monday thru Friday, 8:30 A.M. to 4:30 P.M. E.S.T. at 1-800-426-4791.

Additional information on the health effects of pesticides is available from the National Pesticide Telecommunications Network, toll-free, 24 hours a day, 1-800-858-7378.

From
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Water: Hydrolysis is the primary degradation pathway for carbaryl at pH 7 or above. The compound degrades rapidly at pH 7 and 9 at 25°C, with half-lives of approximately 10~17 days and 3 hours, respectively (Aly&El-Dib, 1971; Carpenter, 1990). In acidic water, carbaryl is rather stable with a half-life of more than 1500 days at 27°C.

C (Wolfe et al., 1978). The identified degradation products are 1-naphthol, methylamine and CO₂ (Aly and ElDib, 1971; Larkin and Day, 1986). In natural water, carbaryl is expected to degrade faster due to the presence of microorganisms. The half-lives of carbaryl in streams, rivers and brooks as a result of forest spraying are 25, 28 and 23 hours, respectively (Stanley et al., 1980).