

# Azinphos-methyl

## Guideline

The maximum acceptable concentration (MAC) for azinphos-methyl in drinking water is 0.02 mg/L (20 µg/L).

## Identity, Use and Sources in the Environment

Azinphos-methyl (C<sub>10</sub>H<sub>12</sub>N<sub>3</sub>O<sub>3</sub>PS<sub>2</sub>) is an organophosphorus insecticide and acaricide used for the control of a variety of pests for many fruit, vegetable, grain and forage crops. More than 100 000 kg are used annually in Canada.<sup>1</sup>

The vapour pressure of azinphos-methyl is higher than  $5.1 \times 10^{-2}$  Pa at 20°C, and its solubility in water is 33 mg/L at room temperature.<sup>2</sup> Azinphos-methyl has a log octanol-water partition coefficient of 2.69.<sup>3</sup> Because it is easily hydrolysed, azinphos-methyl is not considered to be a significant leacher.<sup>4</sup> The half-life of azinphos-methyl in laboratory and natural water systems was found to be 30 to 70 days at pH 5.1 to 8.4.<sup>5</sup>

## Exposure

Azinphos-methyl was not found in a survey of drinking water samples from four Canadian provinces (detection limits ranged from 0.002 to 1 µg/L).<sup>6</sup> Trace levels have been detected in the LaSalle River in Manitoba.<sup>6</sup> It was not detected in surface waters of the Grand River Basin, although over 14 000 kg/year had been used in this area (detection limit 1.0 µg/L).<sup>7</sup>

The theoretical maximum daily intake of azinphos-methyl is 0.62 mg/d, based on the residue tolerance levels set by the Food Directorate of the Department of National Health and Welfare.<sup>8</sup> Because azinphos-methyl was detected in only five of 6391 U.S. domestic food samples, at concentrations below 2.0 ppm,<sup>9</sup> actual daily intake is expected to be low.

## Analytical Methods and Treatment Technology

Analysis of organophosphorus insecticides may be conducted by extraction separately into hexane and dichloromethane, separation by gas chromatography and flame thermionic or flame photometric detection (detection limit 1 µg/L).<sup>10</sup>

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

## Health Effects

Orally administered azinphos-methyl has a biological half-life of eight to nine hours,<sup>11</sup> with 90% of the dose being eliminated within 48 hours in the urine or faeces.<sup>12</sup> The benzotriazin moiety is rapidly excreted without degradation.<sup>11</sup> The principal metabolites identified in *in vitro* mouse tissue studies include dimethyl phosphorothioic and dimethyl phosphoric acids, desmethyl azinphos-methyl and azinphos-methyloxon.<sup>11</sup>

Azinphos-methyl is highly toxic to humans; the acute lethal dose is estimated to be between 5 and 50 mg/kg bw.<sup>2</sup> In human volunteers exposed to azinphos-methyl in doses up to 20 mg per man per day for 30 days, no clinical effects or changes in cholinesterase levels were observed.<sup>13</sup>

Wistar rats were exposed to azinphos-methyl in food for two years at concentrations of 0, 2.5, 5 or 20 mg/kg (diet), or in food containing 50 mg/kg for 47 weeks followed by 100 mg/kg for the remainder of the study duration.<sup>14</sup> Decreases in plasma cholinesterase were observed in rats fed diets containing 5 mg/kg azinphos-methyl or more. The no-observed-adverse-effect level (NOAEL) was considered to be 2.5 mg/kg (diet), or 0.125 mg/kg bw per day.<sup>2</sup>

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In a two-year study in which dogs were fed diets containing constant or progressively increasing amounts of azinphos-methyl,<sup>14</sup> slight effects on erythrocyte cholinesterase activity were observed in animals exposed to 20 mg/kg (diet) for 36 weeks.<sup>14</sup> The NOAEL was considered to be 5 mg/kg (diet), or 0.125 mg/kg bw per day.<sup>2</sup>

The U.S. National Cancer Institute (NCI) evaluated the carcinogenic potential of azinphos-methyl in two-year studies on rats and mice.<sup>15</sup> Although there was some evidence of benign and malignant tumours of the pancreas and thyroid follicle cells in male rats, these were not statistically significant when compared with the matched controls. The NCI evaluators judged the study design to be sufficiently flawed, because of the small number (nine) of control animals employed, that no definite conclusions could be drawn.

In a three-generation study on rats, azinphos-methyl did not induce adverse reproductive effects except at the highest dose level of 50 mg/kg (diet); it has not been found to be teratogenic in several mammalian species.<sup>2</sup> It is immediately neurotoxic but induces no known delayed neurotoxic effects.<sup>2</sup>

Although it has been stated that azinphos-methyl has not been found to be mutagenic to prokaryotes,<sup>16</sup> positive results on tests with mouse lymphoma cells have been reported.<sup>17</sup>

### Rationale

The acceptable daily intake (ADI) for azinphos-methyl for humans has been derived by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO)<sup>11</sup> as follows:

$$\text{ADI} = \frac{0.125 \text{ mg/kg bw per day}}{50} = 0.0025 \text{ mg/kg bw per day}$$

where:

- 0.125 mg/kg bw per day is the NOAEL obtained from two-year studies in the rat and dog.<sup>2,14</sup>
- 50 is the uncertainty factor.

The maximum acceptable concentration (MAC) for azinphos-methyl in drinking water has been derived from the ADI as follows:

$$\text{MAC} = \frac{0.0025 \text{ mg/kg bw per day} \times 70 \text{ kg} \times 0.20}{1.5 \text{ L/d}} \approx 0.02 \text{ mg/L}$$

where:

- 0.0025 mg/kg bw per day is the ADI established by the FAO/WHO
- 70 kg is the average body weight of an adult
- 0.20 is the proportion of daily intake of azinphos-methyl allocated to drinking water
- 1.5 L/d is the average daily consumption of drinking water for an adult.

### References

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