malathion

Review Date: 06/29/2012

CAS #: 121-75-5

Type	Organophosphate insecticide, non-systemic with contact, stomach, and respiratory action.
Controls	Broad spectrum insecticide.
Mode of Action	Malathion converts to malaoxon which affects the nervous system by inhibiting cholinesterase (ChEI).

Thurston County Review Summary:

Malathion is rated high in hazard and products containing it fail Thurston County's pesticide review criteria. Malathion is rated high in hazard because it is known to cause reproductive and developmental toxicity without maternal toxicity and young animals are more vulnerable to the developmental neurotoxicity effects of malathion than adult animals.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	130	4	Moderate
Soil Sorption (Kd=mL/g)	Value not found		
Organic Sorption (Koc=mL/g)	1,800	4	Moderate

Mobility Summary:

Malathion is soluble in water and adheres moderately to soil with organic matter. Groundwater testing has found malathion in a few samples across the nation and there has been reported instances in which surface water bodies have been affected by malathion moving off the site of application with rainwater (Reference 5). The hazard for malathion to move off the site of application is rated moderate because malathion is not very persistent but is known to move off the application area and reach surface water.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.00004	9	Moderate
Biotic or Aerobic Half-life (days)	3 to 7	4	Low
Abiotic Half-life (days)	173 (photodegradation)	6	High
Terrestrial Field Test Half-life (days)	3	7	Low
Hydrolysis Half-life (days)	1 (pH=8) to 147 (pH=6)	4	Low to high
Anaerobic Half-life (days)	0.4	5	Low
Aquatic Field Test Half-life (days)	About 7	4	Low

Persistence Summary:

Malathion is expected to degrade to half of the applied concentration beween 1 and 10 days on vegetation and about 1 week on soil. In most application areas malathion is expected to degrade to half of the applied concentration in about 7 days and is rated low in hazard for persistence.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	103	5	Moderate
Octanol/Water Partition Coefficient	log Kow = 2.75	5	Moderate

Bioaccumulation Summary:

The octanol/water partition coefficient indicates that malathion has a moderate potential to bind to fish or animal fat and tissue. Studies using freshwater fish calculated a range of bioconcentration factors from 87 - 119, which is indicative of moderate accumulation. The fish accumulation study noted that malathion was quickly eliminated from the fish when they were moved to clean water (depuration) but no rate of elimination was reported. In a rat metabolism study, it was noted that 80 to 90% of the malathion was eliminated from their bodies within one day and that there was no bioaccumulation in any of the organs or tissues (Reference 9). The potential for malathion to bioaccumulate is rated low in hazard.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	5,400 mg/kg	1	Low
Avian (LD50)	167 mg/kg	4	Moderate
Honey bee or insect (LD50)	0.16 ug/bee	5	High
Annelida -worms (LC50)	306 mg/kg	5	Moderate
Fish (LC50)	0.004 mg/L	4	Very high
Crustacean (LC50)	0.001 ppm	1	Very high
Mollusk (LC50)	2.9 mg/L	4	Moderate
Amphibian (LD50 or LC50)	Value not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that malathion is low in toxicity to animals, moderately toxic to birds and worms, but highly toxic to insects (honeybees and other beneficial insects), fish and other aquatic organisms. Malathion residues on plants have been found to be very toxic to honeybees for up to 48-hours (Reference 4).

The EPA evaluated risk to fish and other aquatic organisms for several agricultural applications and nearly all scenarios exceeded the level of concern. Modeled risk to aquatic organisms in a shallow pond adjacent to a Public Health mosquito abatement application was above the EPA's level of concern.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Home applicator with post-application exposure	Dermal	1.27 mg/kg/day	0.19 to 0.47 mg/kg/day	2.7 to 6.7	1	Moderate
Adult mixing and using handheld fogger	Dermal	1.27 mg/kg/day	0.16 mg/kg/day	7.9	9	Moderate
Adult harvesting "pick your own" strawberries	Dermal	1.27 mg/kg/day	0.47 mg/kg/day	2.7	9	Moderate
Toddler in area of outdoor fogger (3 hrs)	Inhalation	0.0258 mg/kg/day	0.0064 mg/kg/day	4	1	Moderate

Acute Toxicity Risk Assessment Summary:

All residential applicator and post-application exposures are expected to be short-term (less than 30 days) in duration. Residential applicator and other adult exposure risk assessments utilized a Benchmark Dose Limit [BMDL20 (estimated for 20% ChEI)] of 127 mg/kg/day to set the dose of concern. Using the BMDL20 set by the EPA, the risk to residential applicators (for all worst-case application exposures) ranges from low to moderate in hazard. Potential risk to the applicator was highest when using a wettable powder product and applying it with a low pressure hand-wand (which is rated moderate in hazard). Other moderate hazard applications included building perimeter applications using a low pressure hand-wand and mixing and applying liquid product with a handheld fogger. Potential residential applicator exposures using either a backpack sprayer or a hose-end sprayer are rated low in hazard.

The worst-case adult post-application exposures are calculated for "pick-your-own" strawberry fields and harvesting/pruning fruit trees after an application. Both of these potential exposures are calculated to be moderate in hazard. All other residential post-application exposures are rated low in hazard.

Potential post-application exposures to children or adults following an outdoor fogger application is rated moderate in hazard (assumes a 3 hour exposure for children and 5 hours for adults).

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	IARC Group 3	Not classifiable to its carcinogenicity in humans	3	Low
Mutagenicity	Not a concern	Negative	1 and 6	Low
Neurotoxicity - (NOAEL)	LOAEL = 5 mg/kg/day (offspring)	Red blood cell ChEI	9	High
Endocrine Disruption	Not a known endocrine disruptor	- -	1	Low
Developmental Toxicity (NOAEL)	50 mg/kg/day	Increased resorptions w/ no maternal toxicity	9	High
Reproductive Toxicity (NOAEL)	131 mg/kg/day	Depressed pup weight without maternal toxicity	9	High
Chronic Toxicity (NOAEL)	3 mg/kg/day	Cholinesterase effects	8	Check risk

Chronic Toxicity Hazard Summary:

Toxicity testing indicates that young animals are more susceptible to cholinesterase inhibition (developmental neurotoxicity) than adult animals; there was also evidence of increased susceptibility to the young or developing animals (when compared to adult animals) for other developmental and reproductive toxicities (Reference 9). The EPA evaluated the mutagenicity potential of malathion and determined that the weight of evidence does not support a mutagenic concern although there was "weak evidence of a mutagenic effect in mammalian cells" at doses toxic to the test cells (References 1and 9). Malathion was negative in in-vitro reverse gene mutation assay testing and did not induce chromosome aberation in male or female rats (Reference 6). In an endocrine disruptor evaluation, the EPA concluded that malathion did not produce androgen or estrogen toxicity and observed thyroid effects were not necessarily related to malathion exposure and were not of concern (Reference 1). The International Agency for Research on Cancer placed malathion in its group 3 chemicals as: "not classifiable as to its carcinogenicity to humans" (Reference 3). The EPA classified malathion as; "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential" (Reference 2) and the metabolite malaoxon is not carcinogenic in rats (Reference 9).

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Adult occupational applicator	Dermal + inhalation	Value not provided	Value not provided	Varies based on clothing	9	Moderate to high
Toddler exposure from Public Health mosquito app.	Dermal + oral + inhalation	Value not provided	Value not provided	9 to 20 (calculated	1	Low
Toddler hand-to-mouth activities after aerial app.	Oral (1% malathion to	0.071 mg/kg/day	0.0011 mg/kg/day	65	9	Low
Toddler hand-to-mouth activities after aerial app.	Oral (10% malathion to	0.071 mg/kg/day	0.0037 mg/kg/day	19	9	Low

Chronic Toxicity Risk Assessment Summary:

There are no long-term exposures expected from residential or Thurston County uses of malathion insecticides however, there could be several short-term exposures that occur repeatedly. This section will further characterize risk from potential exposures following public health use of malathion insecticides for mosquito control.

Concerning potential exposures from public mosquito control programs, the EPA stated that; "…estimated combined short-term risks to adults and toddlers, from all routes of exposure to malathion following both ground and aerial malathion public health mosquito control treatments, do not exceed the Agency's LOC" (Reference 1). The calculated combined post-application exposures from an "ultra low volume" ground or aerial application of malathion for public health mosquito control are rated low in hazard.

Risk assessments were calculated for the potential exposures to children from malathion and the degradation chemical malaoxon following either a ground or aerial ultra low volume application for public health mosquito control. It was determined that the risk to children (and adults) was low in hazard using either a 1%, 5%, or 10% transformation rate of malathion to malaoxon.

There are numerous potential combinations for occupational handling and applicator exposures and most of them exceed the EPA's level of concern (without the use of protective clothing). Because of these exceedences, the EPA requires the use of personal protective equipment (gloves, goggles, respirators, etc.) for specific handling/mixing and application methods. Since the level of concern is exceeded and protective clothing is required, the hazard for occupational handlers and applicators of malathion products is rated moderate to high in hazard (because the margin of safety cannot be calculated).

Metabolites and Degradation Products:

Isomalathion (CAS #3344-12-5) is a known impurity of malathion, the major metabolite of malathion in animals is malaoxon (CAS#1634-78-2), and the major metabolite in soil is malathion beta monoacid (References 1 and 4).

In single dose and short-term exposure assessments for the metabolite malaoxon, the EPA used a Toxicity Adjustment Factor of 61 to account for its greater toxicity (although data submitted later showed that malaoxon toxicity was about 22 to 33 greater).

Comments:

Malathion is an eye irritant (EPA Toxicity Category III) a slight skin irritant (EPA Toxicity Category IV) but not a skin sensitizer (Reference 1).

References

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