tetramethrin

Review Date: 12/10/2010
CAS #: 7696-12-0

Type	Contact insecticide - sythetic pyrethroid.
Controls	Flying and crawling insects such as wasps, hornets, cockroaches, ants, fleas, and mosquitos.
Mode of Action	Tetramethrin effects the central and peripheral nervous system by modulation of the sodium channel resulting in hyperactivity of the nervous system and death.

Thurston County Review Summary:

The insecticide active ingredient tetramethrin is rated high in hazard by Thurston County's review criteria for carcinogenicity and due to the risk of toxicity to children following specific indoor aerosol uses. Products containing tetramethrin fail the County's review.

Tetramethrin is considered low in hazard for the potential to move off the site of application, persistence, and bioaccumulation potential. It is also considered low in hazard for the risk of toxicity to non-target organisms (except insects) - even though it is very highly toxic to fish and other aquatic organisms.

MOBILITY

Property	Value	Reference	Rating
Water Solubility (mg/L)	1.83	1	Low
Soil Sorption (Kd=mL/g)	Not found		
Organic Sorption (Koc=mL/g)	1423	1	Moderate

Mobility Summary:

Tetramehtrin is not very soluble in water and adheres moderately to soil containing organic material. Because tetramethrin is not likely to persist more than one day and adheres moderately to soil, the hazard of tetramethrin to move off the site of application is rated low.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.0000071	1	High
Biotic or Aerobic Half-life (days)	3	1	Low
Abiotic Half-life (days)	0.32	1	Low
Terrestrial Field Test Half-life (days)	<1	2	Low
Hydrolysis Half-life (days)	1 (pH = 7)	2	Low
Anaerobic Half-life (days)	Not found		
Aquatic Field Test Half-life (days)	1 or less	2	Low

Persistence Summary:

Tetramethrin is very susceptable to degradation by sunlight and interaction with water. In nearly any environment, tetramethrin can be expected to breakdown to less than half of the applied concentration within one day. The EPA stated that tetramethrin "degrades in hours" following indoor use. The hazard for persistence is rated low.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	20	5	Low
Octanol/Water Partition Coefficient	4.6	1	Moderate

Bioaccumulation Summary:

Tetramethrin has a stronger affinity to bind to organic solvent than it does to water indicating that when consumed, there is a potential for it to bind to fish or animal tissues. Metabolism studies with rats show that when they eat tetramethrin, around 95% of the metabolised tetramethrin is eliminated in the urine and faeces within 5 days (Reference 4). Also, bioconcentration values found for tetramethrin indicate that bioaccumulation is unlikely. The hazard for bioaccumulation is rated low.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	>5,000 mg/kg	1	Low
Avian (LD50)	>2,250 mg/kg	1	Low
Honey bee or insect (LD50)	0.16 ug/bee	1	High
Annelida -worms (LC50)	Not found		
Fish (LC50)	0.0037	2	Very high
Crustacean (LC50)	0.045 mg/L	1	Very high
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single dose toxicity testing indicates that tetramethrin is highly toxic to bees, fish and other aquatic organisms but low in toxicity to mammals and birds (Reference 1).

The EPA evaluated risk from post-appication exposures to tetramethrin to fish and other aquatic organisms, mammals, birds, and associated endangered species (except insects) and determined that there are no direct or indirect effects expected (Reference 2). Thurston County rates the risk, to non-target organisms, from the use of tetramethrin as an insecticide as low in hazard.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Occupational aerosol applicator max rate (0.35%)	0.0035 mg/kg/day	0.00039 mg/kg/day	9	Inhalation	2 and 7	Moderate
Residential applicator with aerosol can	0.0035 mg/kg/day	0.000065 mg/kg/day	54	Inhalation	2	Low
Child - indoor aerosol space spray (at 0.35% rate)	0.061 mg/kg/day (BMDL)	Not documented	<2	Incidental oral	2	High
Combined exposures were not calculated						

Acute Toxicity Risk Assessment Summary:

Risk assessments evaluated by the EPA did not include exposures from skin absorption because skin absorption testing did not produce toxicity. Also, inhalation exposures and oral exposures did not produce a common mode of toxicity so a risk assessment that combines inhalation exposures with oral exposures was not calculated.

Occupational exposure assessments included inhalation during mixing and applying sprays but did not include post-application inhalation or skin absorption exposures. The worst-case potential exposure to occupational applicators was calculated from the indoor spraying of 6 aerosol cans with 0.35% tetramethrin within one day. These potential exposures were calculated to be 9 times less than the EPA's dose of concern and are rated moderate in hazard by Thurston County. All other short-term occupational exposures would be rated low in hazard.

The initial risk assessments evaluated by the EPA had many potential residential use exposures that exceeded the calculated dose of concern. To address these exposures of concern, the registrants provided additional data that the EPA accepted to produce a different dose of concern for incidental ingestion exposures. The EPA accepted the rationale to use a "benchmark dose analysis" to create a benchmark dose (lower confidence) level (BMDL) instead of using the no observeable adverse effect level (NOAEL) to get the dose of concern. With this change the products that created a potential exposure that exceeded the EPA's NOAEL-derived dose of concern no longer exceeded the BMDL-derived dose of concern.

With the BMDL used to create the EPA's dose of concern, a child's potential incidental oral exposure following an indoor application of a 16 ounce aerosol can (0.35% tetramethrin) is calculated to be more than half of the EPA's dose of concern. These potential exposures are rated high in hazard by Thurston County.

The worst-case potential exposure to a residential applicator of a tetramethrin insecticide is from spraying one 16 ounce can (0.35% active ingredient) indoors. This potential exposure is calculated to be 54 time less than the EPA's dose of concern and is rated low in hazard by Thurston County.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Group C (likely to become Group B)	EPA likely to upgrade to "suggestive evidence"	2	High
Mutagenicity	up to 1,000 mg/kg-bw	Negative	6	Low
Neurotoxicity - (NOAEL)	Data gap			
Endocrine Disruption	Not on the EPA's review list	- -	2 and 3	Low
Developmental Toxicity (NOAEL)	90 mg/kg/day	"No significant adverse effects"	6	Low
Reproductive Toxicity (NOAEL)	50 mg/kg/day	Maternal and pup toxicity	2	Low
Chronic Toxicity (NOAEL)	25 mg/kg/day	Decrease weight and eating	7	Check risk

Chronic Toxicity Hazard Summary:

In the 2008 review of carcinogenicity studies, the EPA stated that the Group C (possible carcinogen) classification is likely to be reclassified in Group B (suggestive evidence if carcinogenic potential). Both Group B and Group C chemicals are rated high in hazard by Thurston County's review criteria. Tetramethrin is not listed on the Illinois EPA's list of potential endocrine disruptors and the EPA has not included tetramethrin in the initial list of 68 chemicals to be reviewed for potential endocrine disrupting effects. Mutagenicity testing produced all negative results (non-mutagenic) except one study that used an "industrial grade" product containing 28% unknown ingredients. The World Health Organization stated that the mutagenicity study results were unclear if the positive result was from tetramethrin or from the unknown chemicals. Based on the results from all other studies that were documented completely, the potential for mutagenicity is rated low in hazard by Thurston County. In reproductive and developmental toxicity testing, there were no adverse effects observed in the fetuses without maternal toxicity. Acute neurotoxicity testing was a data gap in the toxicity profile and so the EPA added a 10 times safety in the risk assessments to compensate for the lack of data. The toxicity hazards associated with long-term exposures to tetramethrin are rated high in hazard due to its cancer classification.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Long-term exposures were not assessed by EPA						
Long-term exposures were not assessed by EPA						
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Chronic Toxicity Risk Assessment Summary:

There were no long-term exposures assessed by the EPA - so the risk from long-term exposures cannot be evaluated. Even though tetramethrin products are not expected to persist long enough to create a long-term exposure, occupational handers could apply insecticide products throughout the year to produce a long-term exposure (although tetramethrin is predominantly used by residential users and not commercial applicators). The lack of a long-term occupational exposure assessment is considered a data gap by Thurston County (at least until the EPA documents why they did not assess this potential route of exposure).

Metabolites and Degradation Products:

The EPA reviewed the metabolism of tetramethrin and determined that tetramethrin itself is the only compound of toxicological concern for risk assessment (Reference 2). The principal metabolite of tetramethrin is 3-hydroxycyclohexan-1,2-dicarboximide.

Soil and environmental degradation involves cleavage of the ester bond, leading to chrysanthemic acid derivatives and phenoxybenzoic acid (Reference 4).

Comments:

Tetramethrin is considered a moderate eye irritant (EPA Toxicity Category III), but tetramethrin is not considered a skin irritant (EPA Toxicity Category IV) or skin sensitizer (Reference 6 and 7).

References

1. International Union of Pure & Applied Chemistry. Pesticide Properties Database, tetramethrin (Ref: ENT 27339). Accessed 12/10/2010. http://sitem.herts.ac.uk/aeru/iupac/
2. USEPA. Prevention, Pesticides and Toxic Substances (7508P). EPA 738-R-08-012. Reregistration Eligibility Decision (RED) Document for Tetramethrin. Revised April 2010.
3. Illinois EPA. "Endocrine Disruptors Strategy" February 1997.
4. SHANGHAI SKYBLUE CHEMICAL CO.,LTD. 2010. "Tetramethrin" www.skybluechem.com (Accessed 12/16/2010).
5. www.bvsde.paho.org (Accessed 12/16/2010).
6. World Health Organization. International Programme on Chemical Safety. Environmental Health Criteria 98: Tetramethrin (1990).
7. USEPA. Office of Prevention, Pesticides and Toxic Substances. February 5, 2008. MEMORANDUM Tetramethrin: Phase I Revised Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision.