permethrin

Review Date: 11/2/2010
CAS #: 52645-53-1

Type	Synthetic pyrethroid that is a general use insecticide in residential and industrial applications and restricted use for crops and wide areas.
Controls	Controls a broad spectrum of insect pests (including mosquitoes and termites).
Mode of Action	The primary target organ is the nervous system of insects resulting in muscle spasms, paralysis and death (Reference 1).

Thurston County Review Summary:

Insecticide products containing permethrin as an active ingredient are rated high in hazard because it is considered a "likely human carcinogen" and fail Thurston County's review criteria. Permethrin is rated as high in hazard for the potential to kill non-target beneficial insects and bees. Risk to aquatic organisms is only rated high in hazard for certain agricultural uses (which are not part of this review).

There are no identified exposures for residential uses of permethrin products that are rated high in hazard (to humans or pets) although, there are several that are rated moderate in hazard (see the summary in the Acute Toxicity Risk Assessment section).

MOBILITY

Property	Value	Reference	Rating
Solubility (mg/L)	0.2	2	Low
Soil Sorption (Kd=mL/g)	1.87	2	High
Organic Sorption (Koc=mL/g)	100,000	2	Low

Mobility Summary:

Permethrin is not soluble in water, adheres very strongly to organic matter, but adheres pooly to soil with very little organic material (sand or gravel). The hazard for permethrin to move off the site of application with rain or irrigation water is rated low.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.00000008	2	High
Biotic or Aerobic Half-life (days)	39.5	3	Moderate
Abiotic Half-life (days)	>56	3	High
Terrestrial Field Test Half-life (days)	42	2	Moderate
Hydrolysis Half-life (days)	31	2	Moderate
Anaerobic Half-life (days)	40	2	Moderate
Aquatic Field Test Half-life (days)	Not found		

Persistence Summary:

Permethrin has a low vapor pressure so, it is not likely to volatilize into the air from the ground or plant surfaces. For outdoor applications, permethrin is likely to degrade to half of the applied concentration between two weeks and two months - which is rated moderate in hazard for persistence. Since microbial degradation appears to be the primary route of permethrin breakdown, indoor applications are rated high in hazard for persistence because breakdown by photolysis is expected to be longer than microbial breakdown.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	300	2	Moderate
Octanol/Water Partition Coefficient	6.1	2	High

Bioaccumulation Summary:

Permethrin has a much stronger attraction to organic matter than it does to water. Lab testing indicates that there is a moderate hazard for permethrin to bioaccumulate in fish tissue. Rat metabolism studies indicate that only about 1% of permethrin is absorbed into the body. The physical and chemical properties of permethrin indicate that it is likely to accumulate in fish or animal tissue, bioconcentration studies indicate that there is a moderate chance for accumulation in tissue, and metabolism studies indicate that permethrin is poorly absorbed by mammals and accumulation is not likely. Thurston County conservatively rates the hazard for bioacumulation as moderate.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	4,000 mg/kg	3	Low
Avian (LD50)	>4640 mg/kg	3	Low
Honey bee or insect (LD50)	0.05 ug/bee	3	High
Annelida -worms (LC50)	1440 mg/kg	2	Low
Fish (LC50)	6.1 ppb	3	Very high
Crustacean (LC50)	0.075 ppb	3	Very high
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Summary:

Permethrin is so toxic to insects that the EPA stated that they received several field studies showing that use of permethrin products can reduce or eliminate populations of non-target beneficial insects. Risk to bees and non-target insects is rated high in hazard. Permethrin is very highly toxic to fish and other aquatic organisms. Risk of toxicity to aquatic organisms is rated as high in hazard for many crop applications (which are not part of Thurston County's review criteria).

Ecological risk assessments calculate the risk to birds and small animals following applications of permethrin products does not exceed the EPA's level of concern for short-term or long-term exposures. Risk of toxicity to birds and mammals from the use of products containing permethrin as the only active ingredient is rated low in hazard.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Residential handler / applicator	Not found	Not found	6.9 (stated - not calculated)	Not found	1	Moderate
Hand-to-mouth action + skin after carpet spray	0.25 mg/kg/day & 5 mg/kg/day	0.2 mg/kg/d & 2.2 mg/kg/day	<1	Toddler ingestion + skin absorption	1	High
Hand-to-mouth action + skin after pet shampoo	0.25 mg/kg/day & 5 mg/kg/day	0.069 mg/kg/d & 0.04 mg/kg/d	3.5	Toddler ingestion + skin absorption	1	Moderate
Hand-to-mouth action + skin after turf spray	0.25 mg/kg/day & 5 mg/kg/day	0.0018 mg/kg/d & 0.04 mg/kg/d	64	Toddler ingestion + skin absorption	1	Low

Acute Toxicity Risk Assessment Summary

The EPA risk assessment considered 25 residential exposure scenarios, based on the types of equipment and techniques that can potentially be used to make permethrin applications; for example low pressure hand wand sprayers, backpack sprayers, hose-end sprayer, paint brush, and dip applications; automatic outdoor mister systems; and aerosol cans, wipes, ear tags and protective flanges (Reference 1). The assessments were not numerically documented but the exposures were stated as ranging from 6.9 to 220,000 times less than the EPA's level of concern.

Potential post-application exposure assessment to a toddler playing in treated turf grass includes hand-to-mouth activities, object-to-mouth activities and incidental soil ingestion. This exposure is calculated to be 64 times less than the EPA's level of concern and is rated low in hazard.

Risk assessment also included potential exposures to toddlers from indoor use of permethrin on carpets (broadcast, aerosol and fogger), pets (shampoo, dust, spot on), and impregnated clothing. Post-application exposures that are calculated to be at least ten-times less than the EPA's level of concern are rated as low in hazard by Thurston County's review criteria. These include; aerosol applications to carpet, spot on applications to pets, and impregnated clothing.

Broadcast applications to carpet created a potential exposure that was more than half of the EPA's level of concern. Because these exposures exceeded the level of concern, the EPA discontinued indoor broadcast and spot treatment applications and reduced the amount of active ingredient to 0.5%. The changes result in calculated exposures that are less than half of the level of concern and are rated moderate in hazard by Thurston County. The use of indoor foggers, for carpet applications, can result in exposures that are also rated moderate in hazard.

Exposure to toddlers handling their pet after a shampoo treatment can result in a potential exposure that is 3.5 times less than the EPA's level of concern. This exposure, and potential exposures from handling pets after the use of dust products is rated moderate in hazard.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	"Likely to be carcinogenic to humans"	- -	1	High
Mutagenicity	- -	"no mutagenic activity"	4	Low
Neurotoxicity - (NOAEL)	150 mg/kg/day	"No neuropathological changes"	5	Low
Endocrine Disruption	"no significant evidence"	- -	1	Low
Developmental Toxicity (NOAEL)	50 mg/kg/day	Decreased fetal weights	1	Check risk
Reproductive Toxicity (NOAEL)	250 mg/kg/day	Decreased fertility	4	Check risk
Chronic Toxicity (NOAEL)	25 mg/kg/day	Increased mean body temperatures	1	Check risk

Chronic Toxicity Summary:

Permethrin is categorized as "likely to be carcinogenic to humans" which is rated as high in hazard by Thurton County. The EPA made the following statement concerning the potential for endocrine disruption; "In the available toxicity studies on permethrin, there was no toxicologically significant evidence of endocrine disruptor effects." (Reference 1). Developmental and reproductive toxicity was observed after maternal toxicity (no known increased susceptibitlity to the developing fetus). The hazards from long-term exposures to permethrin are rated high in hazard.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Occupational handler applicator	Not found	Not found	1.6 (stated)	Presumed dermal	1	High
Combined long-term exposures not evaluated						
Long-term post-application exposures not evaluated						
Long-term residential handler risk not evaluated						

Chronic Toxicity Risk Assessment Summary:

The EPA calculated the risk for cancer from residential uses and the level of concern was exceeded for the scenario of mixing and applying an emulsifiable concentrate product with a hose-end sprayer (at least four applications with 5-gallons at a rate of either 0.46 or 0.04 pounds of active ingredient per gallon). The potential exposures from these applications are rated high in hazard.

Potential exposures to workers (applicable to agricultural uses), who mix and apply liquid emulsifiable concentrated products using handheld applicators, and wearing chemically resistant gloves can be enough to be rated high in hazard.

Cancer risk was also calculated for impregnated clothing. The assessment reached the level of concern when 50 years of use included either 150 days per year (from treated long sleeve shirt) or 92 days to include treated pants and long sleeve shirts. The entire exposure would be rated as high in hazard (7,500 days with treated long sleeve shirts or 4,600 days with treated shirt and pants). Lowering the number of days treated clothing is worn and other considerations like manufacturing changes, percent of active ingredient impregnated, etc., are likely to lessen the risk considerably.

Degradation Products:

The parent chemicals, cis-and trans-permethrin, are the only residue of concern for plants, livestock, and drinking water exposures (Reference 1). California Department of Pesticide Registration identified phenoxybenzyl alcohol and phenoxybenzoic acid as degradation products of permethrin (Reference 3). The World Health Organization also identified the metabolites 4'-hydroxypermethrin and dichlorovinyl acid as animal metabolites (Reference 5).

Comments:

Permethrin is considered an eye irritant (EPA toxicity category III) and is also considered a mild skin irritant (EPA toxicity category IV), but is not considered a skin sensitizer (Reference 1). It should also be noted that permethrin may share a common mode of toxic action (affects to nerve function due to specific alterations in the nerve membrane sodium channels) as other pyrethroids which the EPA hopes to further evaluate.

References

1. USEPA. Prevention, Pesticides and Toxic Substances. Reregistration Eligibility Decision (RED) for Permethrin. EPA 738-R-09-306. May 2009.
2. International Union of Pure & Applied Chemistry. Pesticide Properties Database, Permethrin (Ref: OMS 1821). Accessed 11/3/2010. http://sitem.herts.ac.uk/aeru/iupac/
3 Imgrund, Heather. California Department of Pesticide Regulation, Environmental Monitoring Branch. Environmental Fate of Permethrin. January 28, 2003.
4. Extension Toxicology Network - Pesticide Information Profiles [EXTOXNET]. Permethrin. Revised June 1996.
5. World Health Organization. 2004. Permethrin in Drinking-water. WHO/SDE/WSH/03.04/111