zinc phosphide

Review Date: 02/07/2011
CAS #: 1314-84-7

Type	Rodenticide - formulated as a bait/solid, dust, granular, pellet/tablet or wettable powder for indoor and outdoor use.
Controls	Used to control rodents - mice, ground squirrels, prairie dogs, voles, moles, rats, muskrats, chipmunks and gophers.
Mode of Action	Reacts with stomach acid and forms phosphine gas which interferes with cell respiration (Reference 1).

Thurston County Review Summary:

Rodenticide products containing zinc phosphide as an active ingredient are rated high in hazard and fail Thurston County's pesticide review criteria.

The EPA believes that a single swallow of zinc phosphide products may be fatal to a young child. Zinc phosphide testing indicates that it is a chemical mutagen, which is also rated high in hazard. The single-dose concentration that causes mortality to half of the test animals is so low that it is rated high in hazard. The risk to small non-target animals and birds is rated high in hazard (if they can access the bait).

MOBILITY

Property	Value	Reference	Rating
Water Solubility (mg/L)	0.0014 mg/L	5	Low
Soil Sorption (Kd=mL/g)	Not found		
Organic Sorption (Koc=mL/g)	Not found		

Mobility Summary:

Zinc phosphide can be expected to degrade rapidly to phosphine and zinc ions, both of which bind strongly to soil and are common nutrients in soil (Reference 1). The risk of zinc phosphide to move off the site of application is rated low.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.0000000000000065	5	High
Biotic or Aerobic Half-life (days)	8 to 14	5	Moderate
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	7-30+	1	Moderate
Hydrolysis Half-life (days)	Stable at pH 5-9	5	High
Anaerobic Half-life (days)	Not found		
Aquatic Field Test Half-life (days)	30+	1	Moderate to high

Persistence Summary:

Hydrolysis is a major route of dissipation, resulting in the formation of volatile phosphine and zinc ions (Reference 1). Zinc phosphide in baits decompose slowly when placed on soil, although increasing soil moisture will quicken the rate of degradation. Bait products exhibited 12 to 39% reduction of zinc phosphide when left in outdoor conditions for 21 to 27 days. The EPA believes that it is likely that hydrolysis is the principal decomposition mechanism for zinc phosphide baits and that the product's additives and packaging slow the rate of chemical degradation. The hazard of persistence is rated moderate because it is likely to take between 7 and 60 days to degrade to half of the applied concentration.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	Not found		
Octanol/Water Partition Coefficient	not found		

Bioaccumulation Summary:

Bioaccumulation data could not be found and is considered a data gap.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	21 (13-35) mg/kg	1	Fails
Avian (LD50)	12 to 13.9 mg/kg	1	High
Honey bee or insect (LD50)	Data gap		
Annelida -worms (LC50)	>1,000 mg/kg	5	Low
Fish (LC50)	>21.7 mg/L	5	Moderate
Crustacean (LC50)	114 mg/L	5	Low
Mollusk (LC50)	No found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that zinc phosphide is very highly toxic to mammals and birds but moderately toxic to fish and low in toxicity to worms and aquatic invertebrates. The lethal dose concentration to mammals is so low that it is considered too high in hazard by Thurston County's review criteria. There have been a number of deaths to wildlife animals and birds as a result of ingesting applied baits containing zinc phosphide (primarily from treated agricultural land). The risk to small non-target animals and birds from exposures to zinc phosphide rodenticide products is considered high in hazard. Secondary poisoning to a predator eating a baited animal or bird is not likely but, may occur depending on the amount of zinc phoshide ingested and the timing between the pest eating the product and the pest being eaten.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Rating
Child eating 5 grams of bait product	Ingestion	0.05 mg/kg	10 mg/kg bw	<1	1	High
Dietary exposures are not expected						
Drinking water exposures are not expected						
Combined routes of exposures are not expected						

Acute Toxicity Risk Assessment Summary:

The EPA believes that the most likely post application exposure will be from accidental ingestion. In 1996, the EPA reports that over 60 children were accidently exposed to zinc phosphide and over half of them ingested it. Because a single swallow of zinc phosphide bait (about 5 grams) could be fatal, the risk to children is rated high in hazard by Thurston County.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Not listed by IARC and waived by EPA	Unknown	1 and 2	Data gap
Mutagenicity	10 through 80 Fg/ml	Positive gene mutation in mouse	1	High
Neurotoxicity - (NOAEL)	5 mg/kg	Vacuoles in peripheral nerves	1	Check risk
Endocrine Disruption	Not listed	- -	3 and 4	Low
Developmental Toxicity (NOAEL)	4 mg/kg	Death to the mothers	1	Low
Reproductive Toxicity (NOAEL)	Waived	- -	1	Low
Chronic Toxicity (NOAEL)	0.1 mg/kg	Death	1	Check risk

Chronic Toxicity Hazard Summary:

Zinc phosphide was positive for gene mutation in a mouse lymphoma assay. Pesticide active ingredients that are known chemical mutagens are considered high in hazard and fail Thurston County's review criteria. In developmental toxicity testing, the mothers died before developmental toxicity occurred. Carcinogenicity and reproductive toxicity testing were waived by the EPA. The toxicity hazards associated with long-term exposures to zinc phosphide are rated high.

CHRONIC TOXICITY - Risk Assessment

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

The EPA believes that the exposure to workers handling these pesticides will be mitigated by the use of required personal protection equipment, including: long-sleeve shirt and long pants, shoes plus socks, chemical resistant gloves made of any waterproof material, and a dust/mist filtering respirator (Reference 1). Long-term exposures to zinc phosphide are not expected and no long-term risk assessments could be located for zinc phosphide. The risk of toxicity from long-term exposures is rated low.

Metabolites and Degradation Products:

Zinc phosphide rapidly degrades to zinc and phosphine which sorbs to soil and oxidizes to phosphate ions and phosphorus. Animal metabolites include phosphite and hypophosphite (References 1 and 5).

Comments:

Zinc phosphide is considered a mild eye irritant (EPA Toxicity Category IV), but is not considered a skin irritant. The requirement for a skin sensitization test was waived by the EPA.

References

1. USEPA. Office of Prevention, Pesticides and Toxic Substances. Reregistration Eligibility Decision (RED) - Zinc Phosphide. EPA 738-R-98-006. July 1998.
2. International Agency for Research on Cancer. Agents Classified by the IARC Monographs, Volumes 1,100. (Accessed 2/8/2011). http://monographs.iarc.fr
3. Scorecard - The Pollution Information Site. Health Effects / Endocrine Toxicants (Accessed 2/8/2011). http://www.scorecard.org/health-effects.
4. Illinois EPA. "Endocrine Disruptors Strategy". February, 1997.
5. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Zinc phosphide. Accessed 2/7/11. http://sitem.herts.ac.uk/aeru/iupac/