carbaryl

Review Date: 04/28/2011

CAS #: 63-25-2

Type	Broad-spectrum edible and contact insecticide.
Controls	Controls a broad spectrum of insects in many agricultural and non-agricultural settings.
Mode of Action	Cholinesterase inhibition (carbaryl shares the same mode of toxicity as other N-methyl carbamate pesticides).

Thurston County Review Summary:

The insecticide active ingredient carbaryl is rated high in hazard and fails Thurston County's pesticide review criteria. Carbaryl is rated high in hazard because it is classified by the EPA as a "likely human carcinogen," a developmental and reproductive toxicant, a chemical mutagen, and potential endocrine disruptor. It is also considered high in hazard for risk to wildlife.

MOBILITY

Property	Value	Reference	Rating
Water Solubility (mg/L)	9.1	3	Low
Soil Sorption (Kd=mL/g)	0.03	3	High
Organic Sorption (Koc=mL/g)	211	3	High

Mobility Summary:

Carbaryl is not very soluble in water but adheres poorly to all soil types. The hazard for carbaryl to move off the site of application with rain or irrigation water is rated high.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.000041	1	Moderate
Biotic or Aerobic Half-life (days)	16	3	Moderate
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	4 to 5	1	Low
Hydrolysis Half-life (days)	12	1	Moderate
Anaerobic Half-life (days)	60 - 90	1	High
Aquatic Field Test Half-life (days)	3.1	3	Low

Persistence Summary:

After carbaryl is applied it may dissipate slightly into the air but will mainly be degraded by soil microbes. If carbaryl moves deeply into the soil with rain or heavy irrigation, it is likely to be highly persistent, however, in most situations it can be expected to degrade to half of the applied concentration within two weeks. The persistence hazard of carbaryl is rated moderate (expected half-life between 8 and 60 days).

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	44	3	Low
Octanol/Water Partition Coefficient	log Kow = 2.34	1	Low

Bioaccumulation Summary:

The low value for the octanol / water partition coefficient indicates that carbaryl is unlikely to accumulate in fish or animal tissue. The calculated bioconcentration factor for carbaryl also indicates that bioaccumulation is not expected. The hazard for bioaccumulation is rated low.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	301 mg/kg	1	Moderate
Avian (LD50)	>2,000 ppm	1	Low
Honey bee or insect (LD50)	1.1 ug/bee	1	High
Annelida -worms (LC50)	<4 mg/kg	3	High
Fish (LC50)	0.25 mg/L	1	High
Crustacean (LC50)	0.0064 mg/L	3	High
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that carbaryl is low in toxicity to birds, moderately toxic to mammals, and highly toxic to bees, worms, fish, and other aquatic organisms. Label warnings on certain carbaryl insecticides state: "This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds" (Reference 1). After evaluating incident reports regarding potential toxicity to pets from carbaryl exposures, the EPA stated: "Based on limited data, there is some evidence that young kittens may be susceptible to adverse reactions to carbaryl" (Reference 1). In 2009, the EPA and the product manufacturers went into a voluntary cancellation for carbaryl pet collar products - these were the last carbaryl products registered for use on pets. In 2009, the National Marine Fisheries Service (NMFS) issued a biological opinion letter stating that the continued use of carbaryl products will jeapordize the continued existence of 22 of the 26 Pacific listed salmonids (Reference 6). The EPA will (or has) require registrants to adopt product use limitations to comply with the Endangered Species Act. The hazard for toxicity to non-target organisms from exposures to carbaryl is rated high.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Rating
Short-term exposure calculations not provided						
Short-term exposure calculations not provided						
Short-term exposure calculations not provided						
Short-term exposure calculations not provided						

Acute Toxicity Risk Assessment Summary:

To refine the short and intermediate-term exposure risk assessments, the EPA used a Benchmark Dose Limit (BMDL = 30.56 mg/kg) instead of the typically used No Observeable Adverse Effect Level (NOAEL = 20 mg/kg) to establish a dose of concern. The BMDL is intended to be set at the dose that would cause the adverse effect (somewhere between the No Observeable Adverse Effect Level and the Lowest Observeable Adverse Effect Level). The BMDL of 30.56 mg/kg was later re-adjusted to 86 mg/kg to account for a 2.8 times difference between a rat's skin permeability and a human's. The result is risk assessments that are 4 times less protective than previous risk assessments. By changing the dose of concern, carbaryl is allowed to be registered for use.

Although the EPA has allowed these changes, Thurston County still rates applicator and post-application exposures to carbaryl as high in hazard.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	- -	"Likely human carcinogen"	1	High
Mutagenicity	Not found	Unscheduled DNA synthesis, etc.	4	High
Neurotoxicity - (NOAEL)	20 mg/kg/day	Brain ChE inhibition	2	Check risk with BMDL
Endocrine Disruption	- -	"Suspect"	5	Moderate
Developmental Toxicity (NOAEL)	Not found	"evidence of increased susceptibitlity"	1	High
Reproductive Toxicity (NOAEL)	Not found	"evidence of susceptibility"	1	High
Chronic Toxicity (NOAEL)	BMDL = 30.56 mg/kg	Brain ChE inhibition	2	Check risk

Chronic Toxicity Hazard Summary:

A report on the mutagenicity potential of carbaryl indicated that "it is likely to act as a weak mutagen in humans " (Reference 4). The EPA has classified carbaryl as "likely to be a human carcinogen". Chemical mutagenicity and carcinogenicity are unacceptable hazards by Thurston County's review criteria. Carbaryl is also a suspected endocrine disruptor. In evaluating reproductive toxicity, the EPA stated: "There was evidence of increased susceptibility in offspring in the 2-generation reproduction study; however, the Agency believes that the chronic reference dose (RfD) is protective of these effects, principally because the NOAEL used to set the chronic RfD is lower than the NOAEL in the 2-generation rat reproduction study" (Reference 1). Regarding the susceptibility of developing fetuses, the EPA stated: "There was a low level of concern for evidence of susceptibility seen in the developmental neurotoxicity study" (Reference 1). The toxicities associated with long-term exposures to carbaryl are rated high in hazard.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Rating
Long-term risk assessments were not found						
Long-term risk assessments were not found						
Long-term risk assessments were not found						
Long-term risk assessments were not found						

Chronic Toxicity Risk Assessment Summary:

Concerning long-term exposures to carbaryl from insecticide use, the EPA stated; "Long-term assessment is not appropriate for carbaryl due to rapid recovery of ChE inhibition" (Reference 2). The hazard from long-term exposures to carbaryl insecticides is not rated for this review.

Metabolites and Degradation Products:

The major chemical degradates for carbaryl are 1-naphthol, which is further degraded to carbon dioxide, and methylamine (References 1 and 3).

Comments:

Carbaryl is not considered an eye or skin irritant (EPA Toxicity Category IV) and is not a skin sensitizer (Reference 1).

References

1. USEPA. Office of Prevention, Pesticide and Toxic Substances. CARBARYL IRED FACTS [Revised 10/22/04].
2. USEPA. Office of Prevention, Pesticide and Toxic Substances. EPA-738-R-08-010. Amended Reregistration Eligibility Decision for Carbaryl. Case No. 0080. Revised August 2008.
3. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Carbaryl (Ref: UC 7744). Accessed 4/29/2011. http://sitem.herts.ac.uk/aeru/iupac/
4. Vaughan-Dellarco, Preliminary Report on the Mutagenicity of Carbaryl. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/6-81/001 (NTIS PB81200768).
5. Illinois EPA. "Endocrine Disruptors Strategy". February, 1997.