

Type	Organophosphate insecticide.
Controls	Selective insecticide especially effective on sucking insects - aphids, beetles, billbugs, borers, grasshoppers, leafhoppers, leafminers, mealybugs, midge, mites, moths, psyllids, scale, thrips, webworm, wireworm, and whiteflies.
Mode of Action	Systemic insecticide that is absorbed through plant roots and is an acetylcholinesterase (AChE) inhibitor in insects.

Thurston County Review Summary:

The insecticide active ingredient disulfoton is rated high in hazard and products containing it fail Thurston County's pesticide review criteria. Disulfoton is rated high in hazard for its mutagenic potential. Risk to humans and wildlife from the use of disulfoton insecticides is rated moderate for the only remaining EPA registered product.

According to the EPA's January 2010 registration review decision document for disulfoton, the registrants of all pesticide products containing disulfoton were voluntarily cancelled. No new products will be manufactured but existing products can be sold (Reference 3). As of the date of this review, the only existing product containing disulfoton registered for use in the states of Washington and Oregon has the EPA registration number 72155-49, which is a granular product for use on residential ornamentals including rose bushes, shrubs, and flowerbeds.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	25	4	Moderate - low
Soil Sorption (Kd=mL/g)	Value not found		
Organic Sorption (Koc=mL/g)	383 to 888	1	Moderate - high

Mobility Summary:

Disulfoton is not very soluble in water and is expected to adhere moderately to organic soil. The hazard for disulfoton to move off the site of application with rain or irrigation water is rated moderate if the product is left on the surface soil, and low if it is incorporated into the soil and watered in.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.000054	4	Moderate
Biotic or Aerobic Half-life (days)	6 (259 for degradates)	1	Low (high for degradates)
Abiotic Half-life (days)	Rapid photodegradation	1	Low
Terrestrial Field Test Half-life (days)	Value not found		
Hydrolysis Half-life (days)	300	4	High
Anaerobic Half-life (days)	Value not found		
Aquatic Field Test Half-life (days)	15	4	Moderate

Persistence Summary:

Although disulfoton can be expected to degrade fairly rapidly in soil (less than 7 days to reach half of the applied concentration), it degrades to chemicals of toxic concern that the EPA estimated could take over 250 days to degrade to half of their original concentration (Reference 1). The hazard of persistence for all chemicals of concern is rated high.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	460	4	Moderate
Octanol/Water Partition Coefficient	3.95	4	Moderate

Bioaccumulation Summary:

The octanol/water partition coefficient (log Kow = 3.95) indicates that disulfoton has a moderate potential to bind to fish and animal tissue and accumulate. The calculated bioconcentration factor also indicates a moderate potential for accumulation. Rats dosed with disulfoton eliminated nearly all of it between 3 to 10 days (References 5 and 7). This rapid elimination greatly reduces its bioaccumulation potential in animals. It is unknown how well fish depurate or eliminate disulfoton. The hazard for bioaccumulation is rated low for animals and conservatively rated moderate for fish.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Toxicity Rating
Mammalian (LD50)	1.9 mg/kg	1	Very highly toxic
Avian (LD50)	6.5 mg/kg	6	Very highly toxic
Honey bee or insect (LD50)	4.1 ug/bee	4	Moderately toxic
Annelida -worms (LC50)	180 mg/kg	4	Moderately toxic
Fish (LC50)	0.039 ppm	4	Very highly toxic
Crustacean (LC50)	0.013 mg/L	4	Very highly toxic
Mollusk (LC50)	0.72 ppm	6	Highly toxic
Amphibian (LD50 or LC50)	Value not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that disulfoton is highly toxic to animals, birds, fish and other aquatic organisms but moderately toxic to worms and honeybees (although degradation chemicals disulfoton sulfone and disulfoton sulfoxide are very highly toxic to honeybees). Due to the risk to bees toxicity from these degradation chemicals, the EPA requires that all liquid products containing disulfoton have a precautionary statement about the hazard to bees (Reference 1).

When the EPA evaluated risk to wildlife from different application rates and methods, they focused on agricultural applications because they represented the worst-case risks. The EPA found that the lowest application rate (1 pound of active ingredient per acre) of granular product exceeded the level of concern even if the product is incorporated into the ground (Reference 6). Since there is only one product remaining that contains disulfoton, the risks to wildlife evaluated for different application types are not applicable to the risk associated with the granular product being sold for use around ornamental plants. The granular product contains 1% disulfoton and is expected to be mixed into the soil after it is applied, which will minimize the potential for a bird or animal to eat it. If it is watered in and dissolved after it is mixed into the soil, then the risk is even less. So, although there are no numerical risk assessments to evaluate, the risk to birds from the use of granular products would be rated high if the granules are left on the ground surface and low if they are mixed into the soil and watered in. Overall, the risk is rated moderate because of the need to mix and water in the product to reduce the hazard (which may not always happen). Risk to fish and other aquatic organisms would also be rated low for the use of the remaining product due to the expected small use areas.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Applying 1% granular product with cup to 25 shrubs	Skin + inhalation	0.005 and 0.00045 mg/kg	0.0003 mg/kg and 0.000046 mg/kg	4.9	1	Moderate
Applying 1% granular product with cup to 1000sq.ft	Skin + inhalation	0.005 and 0.00045 mg/kg	0.00009 mg/kg and 0.00004 mg/kg	9.6	1	Moderate
Applying 1% granular product with cup to 50 bushes	Skin + inhalation	0.005 and 0.00045 mg/kg	0.000085 mg/kg and 0.000012 mg/kg	19	1	Low
Child's hand-to-mouth exposure	Incidental ingestion	0.0003 mg/kg/day	0.00013 mg/kg/day	2.3	1	Moderate

Acute Toxicity Risk Assessment Summary:

"To address potential risks associated with the residential use of disulfoton, EPA required registrants to implement a number of mitigation measures, including child resistant packaging and deletion of indoor and home garden use" (Reference 2). Residential use limitations include; that all products must be soil incorporated or watered in, not applied with a belly grinder, and products intended for hand application must be in child resistant packaging with a self-contained measuring cup/lid, which clearly measures correct amount to apply (Reference 1).

Risk to residential applicators of the remaining 1% disulfoton granular product is greatly reduced by using the measuring cup/lid as the applicator. The risk from inhalation and dermal exposures combined were calculated for treating 25 ornamental shrubs, 1,000 square feet of flowerbeds, or 50 rose bushes. The hazard is rated moderate for the potential exposures from the shrub or flower bed applications and low for the rose bush application.

The EPA calculated the potential risk to children from incidental ingestion of soil with granular product incorporated into it. The resulting exposure was just below half of the EPA's calculated dose of concern and is rated moderate in hazard. No other post-application exposures were evaluated because this child exposure scenario was considered the worst-case exposure.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	No evidence of carcinogenicity	- -	5 and 7	Low
Mutagenicity	Mutagenic in	Reverse and forward gene mutations	5 and 7	High
Neurotoxicity - (NOAEL)	0.25 mg/kg bw	Inhibition of AChE activity	7	Check risk
Endocrine Disruption	Value not found			
Developmental Toxicity (NOAEL)	1 mg/kg/day	Incomplete bone development	5	Low
Reproductive Toxicity (NOAEL)	0.5 mg/kg/day	Reduced litters and pregnancies	5	Low
Chronic Toxicity (NOAEL)	0.013 mg/kg/day	Cholinesterase inhibition	1	Check risk

Chronic Toxicity Hazard Summary:

Disulfoton has been shown to be mutagenic in in vitro studies but not genotoxic (References 5 and 7). An evaluation of toxicity studies indicated that disulfoton was not carcinogenic (Reference 5 and 7). Dose-related reproductive and developmental toxicity studies could not be found although a review of toxicity studies indicates that reproductive toxicity was observed along with significant red blood cell cholinesterase inhibition of the dams and litters. The interpretation was that reproductive toxicity in humans is not likely at the expected environmental concentrations of disulfoton (Reference 5). The EPA has included disulfoton as one of the chemicals that will be evaluated for endocrine disruption potential. Being included on the list does not infer that it is an endocrine disruptor; the testing has not been published by the date of this review. It is currently unknown if disulfoton effects the endocrine system.

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Long-term applicator exposure was not evaluated						
Long-term post-application exposure not evaluated						
Long-term post-application exposure not evaluated						
Long-term combined exposures not evaluated						

Chronic Toxicity Risk Assessment Summary:

On-going life long exposure to disulfoton is not expected from the one remaining product and its expected use in home flower gardens and around ornamental plants.

Metabolites and Degradation Products:

The chemicals of concern that disulfoton metabolizes or degrades to include; disulfoton sulfoxide, disulfoton sulfone, disulfoton oxygen analogue (demeton-S), disulfoton oxygen analogue sulfoxide, and disulfoton oxygen analogue sulfone (Reference 1).

Comments:

The EPA determined that disulfoton was too toxic to test for eye and skin irritation and for skin sensitization, so they assumed that it is in the Toxicity Category I as a severe eye and skin irritant and sensitizer (Reference 1).

References

1. USEPA. Office of Pesticide Programs. Interim Reregistration Eligibility Decision for Disulfoton, List A Case 102. July 31, 2006.
2. USEPA. Office of Pesticide Programs. Addendum to the 2002 Interim Reregistration Eligibility Decision (IRED) for Disulfoton. December 20, 2008.
3. USEPA. Office of Pesticide Programs. Disulfoton, Registration Review Decision. January 2010.
4. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Disulfoton (Ref: ENT 23347). Date accessed 10/29/2013.
5. TOXNET. Toxicology Data Network. National Library of Medicine, Hazardous Substance Database. Disulfoton. Revised June 1996. <http://toxnet.nlm.nih.gov>.
6. USEPA. Office of Prevention, Pesticides and Toxic Substances. Corrected version of EFED's eco portion of SRRD's April 2001 Disulfoton IRED. March 25, 2002.
7. Health Council of the Netherlands, Committee on Updating of Occupational Exposure Limits. Disulfoton (CAS No: 298-04-4). Health-based Reassessment of Administrative Occupational Exposure Limits. The Hague: Health Council of the Netherlands, 2003; 2000/15OSH/071.