

copper sulfate

Review Date: 07/28/2011

CAS #: 12527-76-3

Type	Fungicide and terrestrial herbicide.
Controls	Fungal and disease control (mildew, leaf spots, blights, and apple scab). Also used to kill roots with direct contact applications.
Mode of Action	The copper (cupric ion) denatures cell proteins and causes "cell leakage" (Reference 1).

Thurston County Review Summary:

Chemical data specific to copper sulfate is provided in this review although it will dissociate to the cupric ion after application. The cupric ion (copper II) is the common chemical of toxicological interest for a number of copper compounds used in pest control, including copper sulfate.

Copper sulfate fungicide and terrestrial herbicide products pass Thurston County's review criteria although several products have warning labels because they can cause serious eye injury. Some of the products with warning labels contain only 10% copper sulfate and other products contain up to 99%. Please read and follow all label directions and precautions for these and all pesticide products.

The EPA lists copper as one of the priority pollutants and regulates their discharge into water bodies. So, although many copper sulfate and other copper based pesticides are considered low in hazard by Thurston County, they can contribute to the overall copper content in our water bodies.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	3.42	3	Low
Soil Sorption (Kd=mL/g)	Not found		
Organic Sorption (Koc=mL/g)	9,500	3	Low

Mobility Summary:

Copper sulfate is not very soluble in water and adheres strongly to soil with organic matter. The hazard of copper sulfate to move off the site of application with rain or irrigation water is rated low.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.0000000000000025	3	High
Biotic or Aerobic Half-life (days)	10,000	3	High
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	1,600	3	High
Hydrolysis Half-life (days)	Stable	3	High
Anaerobic Half-life (days)	Not found		
Aquatic Field Test Half-life (days)	Not found		

Persistence Summary:

Copper sulfate is expected to dissociate to the cupric ion which is not expected to degrade. The persistence of copper sulfate products is rated high.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	10 - 100	5	Low
Octanol/Water Partition Coefficient	log Kow = 0.44	3	Low

Bioaccumulation Summary:

Copper is an essential trace element in our bodies but limited amounts are able to be stored. The EPA stated that copper has a low potential to accumulate in fish but there is a high potential for accumulation in mollusks (Reference 4). The hazard for bioaccumulation is rated moderate due to the potential for accumulation in shellfish and because people with Wilson's disease, chronic liver disease, or haemodialysis patients may be more sensitive to excess copper.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	>300 mg/kg	3	Moderate
Avian (LD50)	>72 mg/kg	3	Moderate
Honey bee or insect (LD50)	> 23.5 ug/bee	3	Low
Annelida -worms (LC50)	>155 mg/kg	3	Moderate
Fish (LC50)	13.2 mg/L	3	Moderate
Crustacean (LC50)	2.3 mg/L	3	Moderate - high
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that copper sulfate is moderately toxic to mammals, birds, worms, and fish (but is higher in toxicity to other aquatic organisms).

"The screening-level ecological assessment indicated that copper can pose acute risks to various organisms, with the greatest risk to aquatic organisms resulting from direct water applications and runoff from fields adjacent to water bodies" (Reference 1). Large-scale agricultural applications to fields bordering a waterbody may produce runoff concentrations that are hazardous to aquatic organisms. Residential uses of copper sulfate products for fungus control is not expected to create exposures of concern for non-target organisms. Large-scale applications of fungicides are not expected from residential or Thurston County uses and are not considered in this rating of copper sulfate products.

The risk of adverse effects to non-target organisms from expected County or residential uses of fungicide or terrestrial herbicide products, containing copper sulfate as the sole active ingredient, is rated low in hazard.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Short-term risk assessments were not calculated						
Short-term risk assessments were not calculated						
Short-term risk assessments were not calculated						
Short-term risk assessments were not calculated						

Acute Toxicity Risk Assessment Summary:

The EPA concluded that there are no residential or occupational risks of concern resulting from short-term exposures to copper products (Reference 1). Acute dietary (food and drinking water) risks from copper pesticides are not of concern to the EPA (Reference 2). However, there are several copper sulfate products that can cause severe eye, skin, or inhalation injury. The EPA believes that the specific product labels advise applicators to wear appropriate protective clothing to minimize these hazards.

The risk of toxicity from short-term exposures to copper from fungicidal use is rated low in hazard although caution is warranted when using any product with "WARNING" or "DANGER" on the label due to their potential to cause eye or skin injury.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Not listed	- -	5	Low
Mutagenicity	400 and 1,000 ppm	"mutations in microorganisms"	7	Low
Neurotoxicity - (NOAEL)	Not found			
Endocrine Disruption	Not found	Affects to testes and endocrine gland	7	Moderate
Developmental Toxicity (NOAEL)	65-80 mg copper/kg - bw/day	Adverse foetal development	8	Low
Reproductive Toxicity (NOAEL)	11.7 mg/kg-bw	Reduced survivorship of offspring	1	Check risk
Chronic Toxicity (NOAEL)	11.7 mg/kg-bw	Reduced survivorship of offspring	1	Check risk

Chronic Toxicity Hazard Summary:

The EPA stated that there has been no systemic toxicity resulting from copper (Reference 2). Mutagenicity testing with copper sulfate caused mutations in microorganisms but the evaluation of the testing indicated that the effects are not expected in humans under normal circumstances (Reference 7). Toxicity testing indicated that copper sulfate only produced developmental and reproductive toxicity at maternally toxic doses (References 1 and 8).

CHRONIC TOXICITY - Risk Assessment

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

Chronic Toxicity Risk Assessment Summary:

The EPA believes that there are no residential or occupational risks of concern resulting from long-term exposures to copper pesticide products (Reference 1). Chronic dietary (food and drinking water) risks from copper pesticides are not of concern to the EPA (Reference 2).

The risk of toxicity from long-term exposures to copper from fungicidal use is rated low in hazard.

Metabolites and Degradation Products:

Copper sulfate is expected to dissociate to the cupric ion.

Comments:

Copper sulfate is a potentially severe eye, skin, and inhalation irritant, and is considered a skin sensitizer (References 2 and 7).

References

1. USEPA. Office of Prevention, Pesticides, and Toxic Substances. Reregistration Eligibility Decision for Coppers. EPA 738-R-06-020. July 2006.
2. USEPA. Office of Prevention, Pesticides, and Toxic Substances. Reregistration Eligibility Decision for Coppers. EPA 738-R-09-304. Revised May 2009.
3. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Copper sulphate. Accessed 7/8/11. <http://sitem.herts.ac.uk/aeru/iupac/>
4. USEPA. Region 5 Superfund. Ecological Risk Assessment - Ecological Toxicity Information. Copper.
5. National Research Council (U.S.). Mineral Tolerance of Animals, Second Revised Edition. 2005. National Academy of Sciences.
6. International Agency for Research on Cancer. Agents Classified by the IARC Monographs, Volumes 1-102. (Accessed 7/13/2011). <http://monographs.iarc.fr>
7. E X T O X N E T. Extension Toxicology Network - Pesticide Information Profiles. Copper sulfate. 1996.
8. Food Standards Agency, UK. Expert Group on Vitamins and Minerals. Risk Assessment - Copper. 2003.