Flumioxazin

HERBICIDE FACT SHEET

U.S. DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions. A list of definitions is included in Section VIII of this fact sheet.

I. BASIC INFORMATION

COMMON NAME: flumioxazin

CHEMICAL NAME: (2-[7-fluoro-3,4-dihydro-3-oxo-4-(2-propynyl)-2*H*-1,4-benzoxazin-6-yl]-4,5,6,7-tetrahydro-1*H*-isoindole-1,3(2*H*)-dione

Cas No. 103361-09-7

CHEMICAL TYPE: N-phenylphthalimide

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: General Use Pesticide.

FORMULATIONS: Commercial herbicide products generally contain one or more ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, EPA announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52FR13305). This policy focuses on the regulation of inert ingredients. EPA's strategy for implementing this policy included the development of four lists of inerts, based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3, and inerts of minimal and no concern were placed on List 4A and 4B, respectively.

The contents of the flumioxazin formulation Payload® are listed below:

Payload® Herbicide		
Active Ingredient	flumioxazin	51.0 %
Inert	kaolin clay*	16.0 %
	titanium oxide**	<1.0 %
	silica, crystalline***	<1.0 %
	other	32.0 %

* List 4A
** List 4B
*** CA Prop 65, IARC Group 1

RESIDUE ANALYTICAL METHODS: Foods: Valent Method RM-30A-1.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND AND RIGHT-OF-WAY USES: Flumioxazin is registered for use in crop and non-crop sites for selective pre- and post-emergent weed control. For terrestrial use only.

OPERATIONAL DETAILS:

TARGET PLANTS: Selective, pre- and post-emergent herbicide for control of annual and perennial weeds.

MODE OF ACTION: Inhibits protoporphyrinogen oxidase required for chlorophyll biosynthesis. (Sunlight activates this process after being absorbed by the plant.)

METHOD OF APPLICATION AND RATES: Ground broadcast spray, spot and localized spray applications. Eight to twelve ounces per acre.

SPECIAL PRECAUTIONS:

TIMING OF APPLICATION: Timing is dependent on the target plant.

DRIFT CONTROL: Care should be exercised not to overspray or apply the herbicide to adjacent non-target areas. Drift control is achieved by observing weather conditions and following label and sprayer instructions. Spray droplet size should be 150 microns or larger.

Restrictions/Warnings/Limitations:

Do not apply more than 12 oz per acre per application.

Do not apply more than 24 oz per acre per year.

Do not apply to wet or moist plant foliage.

Do not incorporate into soil.

Do not apply this herbicide via any type of irrigation system.

Groundwater/Surface Water Advisory.

Do not apply within 50 feet of wells or other surface waters.

Do not apply in situations or soils favorable to runoff.

Do not contaminate irrigation ditches or water used for irrigation or domestic purposes.

Do not graze treated areas.

T&E toxicity warning for ALL plants.

T&E toxicity warning for aquatic species.

III. Environmental Effects/Fate

Solubility: 1.79 mg/l in water (pH 7 at 25° C).

Hydrolysis: 4.2 days at pH 5; 1 day at pH 7; 0.01 days at pH 9.

Photolysis in Water: 1 day at pH 5.

Photolysis on Soil: Average 5.8 days.

Aerobic Soil Metabolism: Average: 14.7 days

Anaerobic Aquatic Metabolism: 0.2 days

Mobility-Unaged Leaching: Moderately mobile

Mobility-Aged Leaching: Generally not found below 3 inches of soil depth.

Persistence and Agents of Degradation: Flumioxazin is moderately persistent in the plant and soils. The primary route of degradation is microbial activity.

Metabolites/Degradation Products and Potential Environmental Effects: Flumioxazin degrades to 6-Amino-7-fluoro-4-(2-propynyl)-1,4,-benzoxazin-3(2H)-one (APF) and 3,4,5,6-tetrahydrophthalic acid (THPA). The toxicity of these metabolites is not described but appear to be more soluble and persistent in water. APF and THPA were very minor degradates from fate processes in soil.

Potential for Leaching into Surface and Ground water: There is a low potential for flumioxazin to leach into groundwater when applied as directed. The potential for degradation products APF and THPA to leach into groundwater is high. Flumioxazin could potentially reach surface waters via spray drift and/or runoff when certain conditions exist.

Volatilization: 2.41×10^{-6} mm Hg.

Potential for Byproducts from Burning of Treated Vegetation: Not known.

IV. Ecological Toxicity Effects on Non-Target Species

Terrestrial:

Avian Acute Oral Toxicity: LD_{50} (bobwhite quail) >2250 mg/kg

Avian Subacute Dietary Toxicity: LC_{50} (bobwhite quail) >5620 mg/kg

Avian Subacute Dietary Toxicity: LC_{50} (mallard duck) >5620 mg/kg

Small Mammal Acute Oral Toxicity: LD_{50} (rat) >5000 mg/kg

Acute Contact Toxicity: LD_{50} (honey bee contact) >105 g/bee

Overall Toxicity: Practically Non-Toxic

Plants: Contact will injure or kill target and non-target plants.

FRESHWATER AQUATIC SPECIES:

ACUTE TOXICITY: LC_{50} (rainbow trout 96-hour) 2.3 mg/l

ACUTE TOXICITY: LC_{50} (bluegill sunfish 96-hour) >21 mg/l

ACUTE TOXICITY: EC_{50} (Daphnia *pulex* 48-hour) 5.5 mg/l

OVERALL TOXICITY: Moderately Toxic

ESTUARINE/MARINE AQUATIC SPECIES:

ACUTE TOXICITY: LC_{50} (sheepshead minnow 96-hour) >4.7 mg/l

ACUTE TOXICITY: LC_{50} (eastern oyster 96-hour) >2.4 mg/l

ACUTE TOXICITY: LC_{50} (mysid shrimp 96-hour) >0.23 mg/l

OVERALL TOXICITY: Highly Toxic

BIOACCUMULATION POTENTIAL: Slight Potential

THREATENED AND ENDANGERED SPECIES: Federally listed terrestrial and aquatic plants may be adversely affected if the product is applied directly to the plants, or indirectly as the result of drift or leaching.

V. TOXICOLOGICAL DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: LD_{50} (rat) >5000 mg/kg

ACUTE DERMAL TOXICITY: LD_{50} (rabbit) >2000 mg/kg

PRIMARY SKIN IRRITATION: Rabbit – Minor Irritant

PRIMARY EYE IRRITATION: Rabbit – Slight Irritant

ACUTE INHALATION: LC_{50} (rat) >0.969 mg/l

OVERALL TOXICITY: **Category III – Slightly Toxic**

CHRONIC TOXICITY:

CARCINOGENICITY: No evidence of carcinogenicity in test animals.

DEVELOPMENTAL/REPRODUCTIVE: Some effects at highest dose levels.

MUTAGENICITY: No effects.

HAZARD: The end-use product labels for the flumioxazin formulation Payload® carries the *Caution* signal word due to potential eye, skin, and inhalation hazards.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: None reported.

CHRONIC TOXICITY:

REPORTED EFFECTS: None reported.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: EPA reports no toxicological endpoints of concern..

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCTS: This product contains crystalline silica. Repeated inhalation of the dust may cause insidious lung injury and possibly silicosis. The signs and symptoms may include cough, shortness of breath, difficulty in breathing, and loss of weight. IARC classifies crystalline silica as a probable human carcinogen. The California Proposition 65 list of known carcinogens includes crystalline silica.

Users of this product should confirm that their operating, storage, and distribution facilities comply with OHSA 29CFR1910.1200 for all material containing over 0.1 percent crystalline silica. Employee exposures to airborne crystalline silica should be controlled to below the OSHA 8-hour PEL of (250)/(%SiO2 + 5) mppcf (respirable); (10 mg/m^3)/(%SiO2 + 2) (respirable); (30 mg/m^3)/(%SiO2 + 2) (total dust).

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: None reported.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: None reported.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

FLUMIOXAZIN *(Payload®)* - **CAUTION** – HARMFUL IF INHALED OR ABSORBED THROUGH THE SKIN. CAUSES MODERATE EYE IRRITATION. AVOID BREATHING DUST AND SPRAY MIST. AVOID CONTACT WITH SKIN, EYES, AND CLOTHING.

PROTECTIVE PRECAUTIONS FOR WORKERS: Applicators and other handlers must wear chemical-resistant gloves, long-sleeved shirt and long pants, shoes plus socks.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES):

EYES: Flush eyes with water. Call physician.

SKIN: Wash all exposed areas with soap and water, call physician if irritation persists.

INGESTION: Rinse mouth thoroughly with water. Do not induce vomiting. Call physician.

INHALATION: Remove to fresh air. Call a physician if breathing difficulty persists.

HANDLING, STORAGE AND DISPOSAL: Store at room temperature or cooler. Do not reuse container. Rinse container and dispose accordingly.

EMERGENCY SPILL PROCEDURES AND HAZARDS: Contain and sweep up material of small spills and dispose as waste. Do not contaminate water, food, or feed by storage or disposal.

VIII. DEFINITIONS

adsorption – the process of attaching to a surface

avian – of, or related to, birds

CAEPA – California Environmental Protection Agency

carcinogenicity – ability to cause cancer

CHEMTREC – Chemical Transportation Emergency Center

dermal – of, or related to, the skin

EC_{50} - median effective concentration during a bioassay

ecotoxicological – related to the effects of environmental toxicants on populations of organisms originating, being produced, growing or living naturally in a particular region or environment

FIFRA – Federal Insecticide, Fungicide and Rodenticide Act

formulation – the form in which the pesticide is supplied by the manufacturer for use

half-life – the time required for half the amount of a substance to be reduced by natural processes

herbicide – a substance used to destroy plants or to slow down their growth

Hg – chemical symbol for mercury

IARC – International Agency for Research on Cancer

K(oc) – the tendency of a chemical to be adsorbed by soil, expressed as: K(oc) = conc. adsorbed/conc. dissolved/% organic carbon in soil

LC_{50} – the concentration in air, water, or food that will kill approximately 50% of the subjects

LD_{50} – the dose that will kill approximately 50% of the subjects

leach – to dissolve out by the action of water

mg/kg – weight ratio expressed as milligrams per kilogram

mg/l – weight-to-liquid ratio expressed as milligrams per liter

microorganisms – living things too small to be seen without a microscope

mPa – milli-Pascal (unit of pressure)

mutagenicity – ability to cause genetic changes

NFPA – National Fire Protection Association

NIOSH - National Institute for Occupational Safety and Health

NOEL - no observable effect level

non-target – animals or plants other than the ones that the pesticide is intended to kill or control

OSHA - Occupational Safety and Health Administration

Pa – Pascal (unit of pressure)

persistence – tendency of a pesticide to remain to remain in the environment after it is applied

pesticides – substances including herbicides, insecticides, rodenticides, fumigants, repellents, growth regulators, etc., regulated under FIFRA

PPE – personal protective equipment

ppm – weight ratio expressed as parts per million

residual activity – the remaining amount of activity as a pesticide

T&E – Threatened and Endangered Species (from the Endangered Species Act)

µg – micrograms

volatility – the tendency to become a vapor at standard temperatures and pressures

IX. INFORMATION SOURCES

California, State Department of Pesticide Regulation, Public Report2003-6, Flumioxazin, Tracking ID Number 191861 N, post 2001

California, State Department of Pesticide Regulation, Summary of Toxicology Data, Flumioxazin, Revised: January 31, 2003

New York, State Department of Environmental Conservation, Flumioxazin, Registration of Valor Herbicide the New Active Ingredient, December 5, 2003

USEPA, Pesticide Fact Sheet, Flumioxazin Conditional Registration, April 12, 2001

Valent USA Corporation, Payload® Herbicide, Specimen Product Label, 2004-PAY-0001 11/03 AV mf, 2004

Valent USA Corporation, Payload® Herbicide, Material Safety Data Sheet, 0228, Revision 3, November 13, 2003

X. TOXICITY CATEGORY TABLES

TABLE I: HUMAN HAZARDS

Category	Signal Word	Route of Administration			Hazard	
		Acute Oral LD_{50} (mg/kg)	Acute Dermal LD_{50} (mg/kg)	Acute Inhalation LC_{50} (mg/l)	Eye irritation	Skin irritation
I (Highly Toxic)	**DANGER (poison)**	0–50	0-200	0-0.2	corrosive: corneal opacity not reversible within 7 days	corrosive
II (Moderately Toxic)	**WARNING**	>50–500	>200-2000	>0.2-2	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III (Slightly Toxic)	**CAUTION**	>500-5000	>2000-20.000	>2-20	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV (Practically Non-toxic)	**NONE**	>5000	>20,000	>20	no irritation	moderate irritation at 72 hours

After *Pesticide User's Guide*, Ohio State University, Extension Bull. No. 745, 1998.

TABLE II: ECOTOXICOLOGICAL RISKS TO WILDLIFE (TERRESTRIAL AND AQUATIC)

Risk Category	Mammals Acute Oral LD_{50} mg/kg)	Avian Acute Oral LD_{50} (mg/kg)	Avian Acute Dietary LC_{50} (mg/kg)	Fish or Aquatic Invertebrates Acute Concentration LC_{50} (mg/l)
Very Highly Toxic	<10	<10	<50	<0.1
Highly Toxic	10-50	10-50	50-500	0.1 – 1
Moderately Toxic	51-500	51-500	501-1,000	>1 – 10
Slightly Toxic	501-2,000	501-2,000	1,001-5,000	>10 – 100
Practically Non-toxic	>2,000	>2,000	>5,000	>100

Table II created from information contained in *Pesticides and Wildlife*, Whitford, Fred, et al., Purdue University Cooperative Extension Service PPP-30, 1998.

Disclaimers and Other Legal Information:

Mention of a trademark, vendor, technique, or proprietary product does not imply or constitute an endorsement of the product by the United States Department of Energy - Bonneville Power Administration (USDOE-BPA), its employees, and its contractors, and does not imply or endorse any product to the exclusion of others. In all cases, the user is required by law to follow all pesticide label instructions and restrictions.

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