ENVIRONMENTAL FATE OF SULFURYL FLUORIDE

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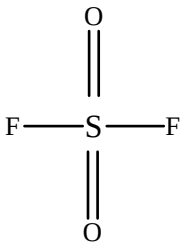
▪ Chemical Description



Common Name:	sulfuryl fluoride
Chemical Names:	sulfuryl fluoride; sulfuric oxyfluoride
Trade Name:	Vikane®
CAS Registry Number:	2699-79-8
Molecular Formula:	F_2O_2S
Molecular Weight:	102.1

Sulfuryl fluoride is a colorless, odorless gas belonging to the chemical family of inorganic acid halides. It is non-corrosive to metals, stable to light, and stable up to 400 °C when dry. When heated to decomposition, very toxic hydrogen fluoride and sulfur dioxide fumes are emitted. Sulfuryl fluoride is soluble in water without hydrolysis, but is rapidly hydrolyzed in aqueous alkaline media. It is also soluble in common organic solvents such as ethanol, toluene, and carbon tetrachloride (British Crop Protection Council, 1994; Lewis, 1991; O'Neil, 2001; Royal Society of Chemistry, 1994; U.S. Environmental Protection Agency Office of Toxics, 1985). Additional physical and chemical properties are summarized in Table 1.

Fish and wildlife data on the ecological effects to non-target organisms are not available. Because sulfuryl fluoride is a gas, it is not feasible to develop such data in accordance with U.S. Environmental Protection Agency guidelines. Therefore, basic wildlife toxicology tests and ecological effects risk assessments were not required (U.S. Environmental Protection Agency, 1985).

Table 1. Physical and chemical properties of sulfuryl fluoride (Dow Agro Sciences, 2001; Kenaga, 1957).

Physical/Chemical Property	Value
Melting Point	-136 °C
Boiling Point	-55 °C
Vapor Pressure	1.16×10^{4} mm Hg (20 °C)
Water Solubility	750 ppm
Soil Adsorption Coefficient (K_{oc})	6.1 days
Henry's Law Constant (K_h)	3.28×10^{-2} atm-m^3/mol
Octanol-water Partition Coefficient (K_{ow})	2.57

- **Regulation**

Sulfuryl fluoride has been classified as a federally restricted use pesticide for the acute inhalation hazard and possible acute toxicity hazard in humans criteria (U.S. Environmental Protection Agency, 2002a). Consequently, it was designated a restricted material pursuant to section 14005.5 of the Food and Agricultural Code. Other criteria for a restricted material designation in this section include posing a danger to public health, or a hazard to crops, domestic animals, farm workers, or the environment. Restricted materials are possessed and used by persons only under permit of the county agricultural commissioner.

The Birth Defect Prevention Act (Stats. 1984, Ch. 669, § 1) mandates the listing of sulfuryl fluoride in section 6198.5 of Title 3, California Code of Regulations. The 200 priority pesticide active ingredients listed in this section are suspected of being hazardous to people, and have widespread use and significant data gaps. All data requirements for sulfuryl fluoride have been submitted to the Department of Pesticide Regulation (DPR).

- **Use Profile**

Sulfuryl fluoride is a non-systemic insecticide/rodenticide used for the fumigation of sealed structures and their contents (construction materials, furnishings, and household effects) such as dwellings (including mobile homes), buildings, barns, vehicles, fumigation chambers, rail cars, and surface ships in port. There are no registered uses involving direct application of sulfuryl fluoride to agricultural crops, edible commodities, or feed. The U.S. Environmental Protection Agency, however, has issued temporary tolerances for its use in post-harvest fumigation of walnuts and raisins (U.S. Environmental Protection Agency, 2002b). Sulfuryl fluoride is registered to control existing infestations of insects and related pests such as drywood termites, powder post beetles, old house borers, death watch beetles, bedbugs, cockroaches, clothes moths, rats, and mice (Dow Agro Sciences, 2000; Thomson, 2000). Vikane®, the only end-use

product as of November 2002, is marketed as a liquefied gas in pressurized steel cylinders (99.8 % sulfuryl fluoride).

Full pesticide use reporting in California was implemented by DPR in 1990. All agricultural use must be reported monthly to the county agricultural commissioners. The county agricultural commissioners forward these data to DPR, who annually compiles and makes available a pesticide use report. Agricultural use is defined as including applications to parks, golf courses, cemeteries, rangeland, pastures, and rights-of-way. Although use in structural pest control is excluded from the definition, the use of pesticides designated as restricted materials pursuant to section 14005.5 of the Food and Agricultural Code must be reported. Sulfuryl fluoride use reported in 2001 and 2002 is summarized in Table 2.

Table 2. Sulfuryl fluoride use in 2001 and 2002 (DPR, 2001; DPR, 2002).

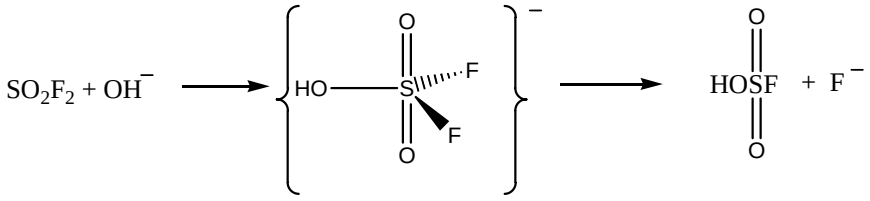
	Pounds Applied	
Site	**2002**	**2001**
Fumigation	0	24
Landscape Maintenance	1,045	3,391
EUP[1]	0	17
Regulatory Pest Control	0	162
Rights of Way	39	265
Structural Pest Control	3,044,000	2,581,982
Total	**3045084**	**2,585,841**

[1]Experimental Use Permit: olives. This most likely an error in the Use Report. There are no registered use on olives in California.

- **Environmental Fate**

Fate in Water

Sulfuryl fluoride is slowly hydrolyzed in water under neutral conditions (U.S. Environmental Protection Agency, 1993). Under alkaline conditions, however, it undergoes rapid hydrolysis. Fluorosulfuric acid (HSO_3F) is formed via nucleophilic attack on the S atom, with displacement of an F ion (Cotton and Wilkerson, 1988):



Fate in Soil and Biota

Data addressing the fate of sulfuryl fluoride in soil and biota is not available. That data was not required for re-registration due to sulfuryl fluoride's chemical properties and its registration for strictly indoor uses (U.S. Environmental Protection Agency, 1985).

Following application and aeration of treated structures, sulfuryl fluoride is dissipated into the atmosphere in the gaseous state. There would be little likelihood that residues would leach to ground water.

- **References**

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