This fact sheet was created in 2000; some of the information may be out-of-date. NPIC is not planning to update this fact sheet. More pesticide fact sheets are available here. Please call NPIC with any questions you have about pesticides at 800-858-7378, Monday through Friday, 7:30 am to 3:30 am PST.

NPTN General Fact Sheets are designed to answer questions that are commonly asked by the general public about pesticides that are regulated by the U.S. Environmental Protection Agency (US EPA). This document is intended to be educational in nature and helpful to consumers for making decisions about pesticide use.

Sulfuryl Fluoride

(General Fact Sheet)

For technical information please refer to the Technical Fact Sheet

The Pesticide Label: Labels provide directions for the proper use of a pesticide product. *Be sure to read the entire label before using any product.* A signal word on each product label indicates the product's short-term toxicity.

CAUTION - low toxicity **WARNING - moderate toxicity** **DANGER - high toxicity**

What is sulfuryl fluoride?

- Sulfuryl fluoride is an insecticide and rodenticide first registered 1959. After meeting current health, safety, and product labeling requirements sulfuryl fluoride was eligible for re-registration in 1993 by the U.S. Environmental Protection Agency (EPA) (1).

- Sulfuryl fluoride is a gas used to fumigate closed structures and their contents for drywood and Formosan termites, wood infesting beetles, bedbugs, carpet beetles, clothes moths, cockroaches, and rodents.

- Sulfuryl fluoride is an odorless, colorless gas (2). It is non-flammable, non-corrosive, and does not react with materials to produce odors or residues (3, 4).

- As a result of the knowledge required to use fumigants appropriately EPA has classified sulfuryl fluoride as a "Restricted Use Pesticide," i.e., one that may be purchased and used only by certified applicators (1,5). Although sulfuryl fluoride is only slightly toxic in inhalation studies an acute hazard is associated with this chemical because it is an odorless, colorless gas (1). Therefore, product labels contain the signal word "DANGER," EPA's highest toxicity category because of the chemical's acute inhalation hazard (6). See the ***Pesticide Label*** box above.

How does sulfuryl fluoride work?

- Sulfuryl fluoride is introduced into structures as a gas intended to fill all air spaces in the enclosed area and penetrate cracks, crevices, and pores in the wood (7). It penetrates materials quickly and rapidly dissipates during the ventilation process (3, 4). To be effective, sulfuryl fluoride must be contained for a sufficient period of time; therefore, workers place a tent around the structure during the fumigation (7).

- Sulfuryl fluoride kills pests by interfering with the metabolism they need to maintain a sufficient source of energy (8). Their remaining energy is slowly used up; therefore, death may not occur for several days (8, 9).

- Sulfuryl fluoride reduces the amount of oxygen taken up by insect eggs (10). Eggs, however, tend to be less susceptible than adults because the egg shell limits the passage of sulfuryl fluoride (3, 10). Control of insect eggs may require an increased exposure time or, increased concentration of sulfuryl fluoride (3, 10, 11). Larvae of social insects (ants and termites) are unable to survive without adult care; therefore, additional control measures may not be necessary (11).

What are some products that contain sulfuryl fluoride?

- Vikane®
- Termafume®

Will I be exposed to sulfuryl fluoride?

- Sulfuryl fluoride is a substance that can kill all living organisms including people, animals, and plants if exposed for a sufficient period of time and at a high enough concentration. For this reason, occupants must leave the structure before the fumigation begins and remain absent until the gas is removed from the structure.

- Sulfuryl fluoride is an odorless, colorless gas that does not cause skin or eye irritation at the concentrations used by applicators (2,5, 12). Therefore, prior to the fumigation, applicators introduce trace amounts of a warning agent, ***chloropicrin***, into the structure (12, 13).

Chloropicrin has a strong odor and will cause respiratory and eye irritation. Symptoms include tears, burning eyes, difficulty breathing, coughing, headaches, and nausea (12,14). Structures should be completely aired before re-entry is allowed because chloropicrin dissipates more slowly from structures than sulfuryl fluoride (12,13).

- Residues do not remain following a proper ventilation process. Although the uptake of sulfuryl fluoride by materials within the structure is low, the fumigant needs sufficient time to diffuse during ventilation (7, 13). When applicators remove the tent, the gas quickly moves outside the home dissipating to very low levels within 24 hours (1). The EPA requires that prior to re-entry applicators must continue to ventilate the structure until the concentration of sulfuryl fluoride is measured to a pre-determined level that will not cause adverse health effects (1, 6).

- Dietary exposure is unlikely because sulfuryl fluoride is not approved for use on food (1). Refer to the last section for ***necessary preparations prior to fumigation***.

What is the toxicity of sulfuryl fluoride?

Animals (*Refer to Technical Fact Sheet for LD_{50} values*)

- Sulfuryl fluoride is moderately toxic when "fed" to rats and guinea pigs (1). See boxes on **Laboratory Testing**, **Toxicity Categories, and LD50**.

- Sulfuryl fluoride is slightly toxic to rats and mice in short term inhalation studies (1).

Laboratory Testing: Before the U.S. EPA registers pesticides, they must undergo laboratory testing for short-term and long-term health effects. Laboratory animals are purposely fed high enough doses to cause toxic effects. These tests help scientists judge how these chemicals might affect humans, domestic animals, and wildlife in cases of overexposure. When pesticide products are used according to the label directions, toxic effects are not likely to occur because the amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

- Scientists exposed rats, rabbits, and dogs to sulfuryl fluoride by inhalation daily for a period of 13 weeks. Exposed animals exhibited decreased body weights, discolored teeth, and damage to the brain, nervous system, liver, kidney, lung, and nasal area (1).

- Rats had no adverse nervous system effects when they were exposed to sulfuryl fluoride for two days. However, researchers observed some effects when rats were repeatedly exposed over a longer period of time (chronic exposures) (1).

- Rats exposed to higher concentrations of sulfuryl fluoride died within a shorter period of time than rats exposed to lower concentrations (16).

LD50/LC50: A common measure of toxicity is the lethal dose (LD50) or lethal concentration (LC50) that causes death (resulting from a single or limited exposure) in 50 percent of the treated animals. LD50 is generally expressed as the dose in milligrams (mg) of chemical per kilogram (kg) of body weight. LC50 is often expressed as mg of chemical per volume (e.g., liter (l)) of medium (i.e., air or water) the organism is exposed to. Chemicals are considered highly toxic when the LD50/LC50 is small and practically non-toxic when the value is large. However, the LD50/LC50 does not reflect any effects from long-term exposure (i.e., cancer, birth defects, or reproductive toxicity), that may occur at doses below those used in short-term studies.

Humans

- Symptoms of sulfuryl fluoride poisoning include nose, eye, throat and respiratory irritation, shortness of breath, numbness, weakness, nausea, abdominal pain, and slowed speech or movements (5,12,17).

- Sulfuryl fluoride depresses the central nervous system. Signs of sulfuryl fluoride poisoning include coughing, vomiting, restlessness, muscle twitching, seizures, and accumulation of fluid in the lungs (5, 17). Repeated exposures to high concentrations of sulfuryl fluoride may cause lung and kidney damage (5).

- People have died when they entered structures during the fumigation process or when sulfuryl fluoride had not dissipated to appropriate levels prior to re-entry (1,5, 18).

Toxicity Category

	High Toxicity (*Danger*)	Moderate Toxicity (*Warning*)	Low Toxicity (*Caution*)	Very Low Toxicity (*Caution*)
Oral LD50	Less than 50 mg/kg	50 - 500 mg/kg	500 - 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.2 mg/l	0.2 - 2 mg/l	2 - 20 mg/l	Greater than 20 mg/l
Dermal LD50	Less than 200 mg/kg	200 - 2000 mg/kg	2000 - 5000 mg/kg	Greater than 5000 mg/kg
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

Does sulfuryl fluoride cause reproductive or birth effects?

Animals

- Inhalation of sulfuryl fluoride did not cause birth defects in rats or rabbits. Scientists observed decreased body weights in the offspring of rabbits at levels that produced a decreased weight gain in the mothers (1, 19).

Effects of **sulfuryl fluoride** on human health and the environment depend on how much sulfuryl fluoride is present and the length and frequency of exposure. Effects also depend on a person's health or the condition of the environment when exposure occurs.

Humans

- Data is not available from work-related exposures, accidental poisonings, or other human studies to indicate whether sulfuryl fluoride is likely to cause reproductive or developmental effects in humans.

Does sulfuryl fluoride cause cancer?

Cancer: The U.S. EPA has strict guidelines that require testing of pesticides for their potential to cause cancer. These studies involve feeding laboratory animals large *daily* doses of the pesticide over most of the lifetime of the animal. Based on these tests, and any other available information, EPA gives the pesticide a rating for its potential to cause cancer in humans. For example, if a pesticide does not cause cancer in animal tests, then the EPA considers it unlikely the pesticide will cause cancer in humans. Testing for cancer has not been done on human subjects.

Animals

- Based on the current use of sulfuryl fluoride, EPA did not require cancer tests. Therefore, the EPA has not classified the potential for sulfuryl fluoride to cause cancer. See the **Cancer** box.

- Researchers often screen substances that may cause cancer using studies that test the chemical's ability to produce changes in the genetic material. Sulfuryl fluoride does not produce changes in genetic material (1).

Humans

- Data is not available from work-related exposures, accidental poisonings, or other human studies to indicate whether sulfuryl fluoride is likely to cause cancer in humans.

Does sulfuryl fluoride break down and leave the body?

Animals

- Limited data is available on mammals, however, when researchers exposed termites to concentrations below those which caused death, the insect's broke sulfuryl fluoride down into fluoride and sulfate (8, 20).

- Scientists observed increased levels of fluoride in the circulating blood of rabbits and rodents that were repeatedly exposed to sulfuryl fluoride. The toxicity of sulfuryl fluoride is due, in part, to the increased fluoride levels, however, other factors may also be involved (16, 21).

- Animal studies show that fluoride binds to teeth and bones following long term exposures, resulting in discolored teeth (12, 21).

Humans

- An elevated fluoride level was measured in one death after the home was fumigated with sulfuryl fluoride. Air samples were taken in the home; however, the gas had dissipated and the previous levels of sulfuryl fluoride were no longer detectable (1, 17, 18).

What happens to sulfuryl fluoride in the environment?

- Sulfuryl fluoride quickly dissipates in the atmosphere once the gas moves outside the structure during the ventilation process (11).

- Sulfuryl fluoride does not contribute to local ozone formation (smog) or ozone depletion, nor does it contribute significantly to acid rain (12).

- Sulfuryl fluoride is broken down by interaction with water (1,12). It is also broken down by sunlight and reactions with solid particles in the atmosphere (12).

- Groundwater contamination is unlikely because sulfuryl fluoride is presently used inside structures and dissipates during the ventilation process.

How does sulfuryl fluoride affect fish and wildlife?

- Exposure to fish and wildlife is unlikely because sulfuryl fluoride is presently used inside structures and dissipates during the ventilation process. (1).

- Wildlife may be exposed to low concentrations of sulfuryl fluoride for a short period of time during the ventilation process. Adverse effects are unexpected based on current toxicity data (22).

What preparations are necessary prior to fumigation?

- The pesticide label requires that pest control companies provide an information sheet to an adult occupant of the structure, prior to fumigation. The pesticide fact sheet contains important information on health risks, safety precautions, and preparations (1,6). A product label may also be available from the applicator.

- People, animals, plants, water proof covers and items covered with plastic (plastic can slow down the aeration process) should be removed from the structure. In addition, food, feed, and medicines that no longer have the manufacturer's air-tight seal intact should also be removed or double bagged in special bags (available from the pest control company). Don't forget to remove items in refrigerators and freezers. Turn off all flames: e.g., pilot lights and electric heating elements (6).

- Wetting the soil around the perimeter of the structure will help prevent loss of the fumigant near the base of the tent and reduce exposure to plant roots (3,12,13). Sulfuryl fluoride is harmful to plants (2,3,4).

- Please check with your **Pest Control Company** for additional preparations that may be required.

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