



Weekly

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Epidemiologic Notes and Reports Fatalities Resulting From Sulfuryl Fluoride Exposure After Home Fumigation -- Virginia

On September 25, 1986, an elderly Virginia couple had their home fumigated by a local pest extermination company for the control of wood-boring insects. Two hundred and fifty pounds of sulfuryl fluoride (SF), a colorless, odorless fumigant gas commonly used for this purpose, was applied in the approximately 80,000-cubic-foot home that day. Before fumigation, the house was vacated, tightly sealed, and externally covered with a tarpaulin to maintain high levels of the gas inside. During fumigation, electric fans were used to circulate the pesticide. Entry into the house was prohibited until approved by the exterminators, and a security guard watched the house from 2 p.m. on September 25 until 7 a.m. on September 26.

At 9 a.m. on September 26, the exterminators removed the tarpaulin and opened the doors and windows to ventilate the house. Afterward, they ran electric fans for 21/2 hours to facilitate air circulation. Reentry was approved at 2 p.m., and reports suggest that the couple returned home between that time and 5 p.m., approximately 5 to 8 hours after the ventilation procedures began. The couple left their home to attend a football game at 7 p.m. and returned for the night at approximately 10 or 11 p.m.

On September 27, within 24 hours of their return, the wife experienced weakness, nausea, and repeated vomiting, and her husband complained of dyspnea and restlessness. By the morning of September 28, the husband had developed severe dyspnea and cough. At 7:15 a.m., he experienced a generalized seizure followed by cardiopulmonary arrest. He was transported to a local emergency room, but resuscitative measures were unsuccessful. Death was presumed to be caused by an acute myocardial infarction, and inhalation of a toxic agent was not suspected.

On October 1, the widow, who was complaining of severe weakness, dyspnea, intermittent chills, and anorexia, consulted her family physician. She had not left her home in 3 days and was unable to walk into the physician's office. She was admitted to the hospital, where a chest x-ray revealed severe hypoxemia and diffuse pulmonary infiltrates. On October 2, ventricular fibrillation occurred, and she died at approximately 11 p.m. Because both deaths occurred within a short

period of time and the wife's illness was compatible with toxic gas inhalation, these deaths were then thought to be related to the recent home fumigation.

Autopsy reports provided by the Office of the Chief Medical Examiner revealed that both decedents died of acute pulmonary edema from exposure to a toxic agent. Toxicologic analysis of blood and other tissues could not be performed on the husband, but analysis of serum obtained from the wife on October 1 (6 days after fumigation) revealed a plasma fluoride level of 0.5 mg/l. No fluoride was detected (at the 1.0 mg/kg concentration) in other tissues, including those from the kidneys, liver, and lungs. No other toxic agents were detected. Although the couple became ill at similar times, the differences in time from exposure till death suggest that their levels of exposure to SF may have differed. Unfortunately, the details of their activities upon reoccupying their home are not known.

On October 6, the district manager of the extermination company notified the Virginia Department of Agriculture and Consumer Services of the deaths. Investigation verified that the cylinders of pesticide contained SF and had been manufactured prior to June 28, 1986. The amount used (250 pounds) was determined to be appropriate, based on the cubic footage of the house, the air temperature, and the relative humidity.

Although the exterminators removed the tarpaulin, opened the windows and doors, and used fans to aerate the home, they failed to measure the air concentration of SF inside the home. This step is necessary to determine the appropriate time for reoccupancy. Air samples taken during the investigation by state officials on October 8 revealed no detectable levels of SF, but levels of this gas would have been expected to have dissipated by that time.

Neither of the two workers who removed the tarpaulin and ventilated the house was licensed, but their supervisor, who had extensive experience with SF, was certified. The presence of a certified applicator was not required by the product labels on the cylinders used during this fumigation, and none was on hand at the time.

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Editorial Note

Editorial Note: SF (chemical formula F₂O₂S) was first introduced in 1957 as an insecticide and has been widely used to exterminate wood-boring insects in buildings. It is applied by fumigation techniques that require the building to be tightly sealed to allow a high concentration to penetrate the wood. In 1986, approximately 200 to 500 homes in Virginia were fumigated with SF (Dow Chemical Company, unpublished data). It is, however, more widely used in other areas of the United States, such as Florida and California.

Background plasma fluoride levels for humans have been reported to be approximately 0.01 mg/l. While peak concentrations of 0.06 to 0.4 mg/l have been noted 30 minutes after ingestion of 10 mg of fluoride, these levels have been noted to decrease to 0.2 mg/l within 2-9 hours (1). Thus, the

concentration of 0.5 mg/l found in serum obtained from the wife 6 days after fumigation suggests that she had experienced acute exposure to an elevated concentration of fluoride.

In short-term toxicologic experiments, inhalation of 1,000 parts per million (ppm) of SF for 3 hours or 15,000 ppm for 6 minutes was fatal to less than 5% of experimental animals (2). However, these studies also indicate that higher concentrations of SF cause respiratory irritation and central nervous system depression, which may be followed by excitation, convulsions, and respiratory arrest (2,3). Animals exposed to low but unspecified doses of SF first had parasympathetic stimulation with vomiting, diarrhea, lacrimation, salivation, and abdominal colic (3). This stage was followed by cardiovascular collapse and pulmonary edema. Similar observations were noted in the two cases reported here.

The scientific literature reports at least four deaths from exposure to SF since its wide usage began 10 to 15 years ago (3-5). However, these two fatalities in Virginia are the first in which the residents had not reentered the structure under unusual or prohibited circumstances. In this situation, there had not been appropriate air monitoring during aeration and before clearance for reoccupancy was given. These precautions are clearly required by the product label.

The product labels on all cylinders manufactured since June 28, 1986, require that two persons trained in the use of SF be present at all times during fumigant introduction, testing, and aeration procedures. After fumigation, the house is to be aerated until the level of SF is less than or equal to 5 ppm, as measured by a Miran* gas analyzer. Measurements should be taken before reoccupancy because the kinetics of SF dissipation depends on many variables including the amount of fumigant applied, the quality of the tarpaulin, the ambient temperature, and the wind speed. No one should enter the house without a self-contained breathing apparatus if the level of SF is greater than 5 ppm. The Occupational Safety and Health Administration's current permissible exposure limit and the American Conference of Governmental Industrial Hygienists' (ACGIH) threshold limit value for SF are 5 ppm (6). The ACGIH short-term exposure limit is 10 ppm. The level considered immediately dangerous to life and health is 1,000 ppm, and persons exposed at this level must use a supplied-air respirator with a full facepiece, helmet, or hood.

The difference in time of death for the couple was striking, but data are not sufficient for interpretation. The only known host factor that may account for this difference is age, since neither the husband nor wife had a prior history of cardiopulmonary disease. The husband was 8 years older than the wife, but it is doubtful that this small age difference could account for the large time difference between their deaths.

Persons who develop illness that may be related to SF exposure require consultation by a physician. Health-care workers should be aware that exposure to highly toxic substances such as SF may occur without warning or detection and may involve persons other than the individual patient. The initial symptoms of illness from SF exposure can be nonspecific and may resemble other common illnesses, even when the dose has been in the lethal range. Early clinical recognition of illness, timely investigation of the source, and appropriate environmental intervention may help prevent fatalities from this type of exposure.

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