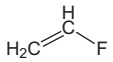
Vinyl Fluoride
CAS No. 75-02-5

Reasonably anticipated to be a human carcinogen
First Listed in the *Tenth Report on Carcinogens* (2002)



Carcinogenicity

Vinyl fluoride is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals. Both male and female rats exposed to vinyl fluoride by inhalation showed increased incidences of hepatic hemangiosarcoma, hepatocellular adenoma or carcinoma, and Zymbal gland carcinoma. Both male and female mice exposed to vinyl fluoride by inhalation showed increased incidences of hepatic hemangiosarcoma, bronchiolar-alveolar adenoma or adenocarcinoma, hepatocellular adenoma, and harderian gland adenoma. Female mice also showed an increased incidence of mammary gland adenocarcinoma (Bogdanffy *et al.* 1995, IARC 1995).

The tumor responses of laboratory animals to vinyl fluoride are similar to their responses to vinyl chloride, a known human carcinogen (IARC 1987), and to vinyl bromide, a probable human carcinogen (IARC 1986). A unique feature of vinyl chloride carcinogenicity is that vinyl chloride induces rare hepatic hemangiosarcomas in experimental animals and is causally associated with excess risk of liver hemangiosarcoma in epidemiological studies of exposed workers. The fact that vinyl fluoride, vinyl chloride, and vinyl bromide all induce rare hemangiosarcomas of the liver in experimental animals and induce the formation of similar DNA adducts suggests a possible common mechanism of carcinogenicity for all three of these chemicals.

No adequate human studies of the relationship between exposure to vinyl fluoride and human cancer were found.

Additional Information Relevant to Carcinogenicity

Vinyl fluoride is mutagenic in *Salmonella typhimurium* with the addition of a rat liver homogenate metabolic activation system. In addition, vinyl fluoride induces gene mutations and chromosomal aberrations in Chinese hamster ovary cells (with metabolic activation), sex-linked recessive lethal mutations in *Drosophila melanogaster*, and micronuclei in bone marrow cells of female mice (IARC 1995).

Vinyl fluoride likely is metabolized in a manner similar to vinyl chloride: oxidation via cytochrome P450 to fluoroethylene oxide, followed by rearrangement to 2-fluoroacetaldehyde, which is oxidized to fluoroacetic acid. Human, rat, and mouse liver microsomes metabolize vinyl fluoride at similar rates (Cantoreggi and Keller 1997).

Vinyl fluoride metabolites form covalent DNA adducts. Inhalation exposure of rats and mice to vinyl fluoride produced a dose-related increase in the formation of the promutagenic adduct N^2,3-ethenoguanine in their liver DNA (Swenberg *et al.* 1995).

No available data suggest that mechanisms by which vinyl fluoride induces tumors in experimental animals would not also operate in humans.

Properties

Vinyl fluoride is a colorless gas with a faint ether-like odor. It is insoluble in water and soluble in alcohol, ether, and acetone. Vinyl fluoride is extremely flammable and will form explosive mixtures with air. It can form hazardous polymers when heated. A fire containing vinyl fluoride can generate highly toxic hydrogen fluoride gas (HSDB 2001). Vinyl fluoride reacts with alkali and alkaline earth metals, powdered aluminum, zinc, and beryllium (IARC 1995).

Use

Vinyl fluoride is used primarily in the production of polyvinyl fluoride and other fluoropolymers. Polymers of vinyl fluoride are resistant to weather and have great strength, chemical inertness, and low permeability to air and water. Polyvinyl fluoride is laminated with aluminum, galvanized steel, and cellulose materials and is used as a protective surface for the exteriors of residential and commercial buildings. Polyvinyl fluoride laminated with various plastics has been used to cover walls, pipes, and electrical equipment and inside aircraft cabins (IARC 1995).

Production

Vinyl fluoride was first prepared in the early 1900s by reaction of zinc with 1,1-difluoro-2-bromoethane. Modern preparation of vinyl fluoride involves reaction of acetylene and hydrogen fluoride in the presence of a mercury-based or aluminum-based catalyst (IARC 1995). Annual U.S. production is approximately 3.3 million lb (HSDB 2001). The U.S. Environmental Protection Agency (EPA), through the Office of Pollution Prevention and Toxics, listed vinyl fluoride in the high production volume chemical list in 1990, indicating that annual production exceeded 1 million lb (EPA 1990). Only one U.S. manufacturer of vinyl fluoride was identified (HSDB 2001).

Exposure

Exposure to vinyl fluoride in the environment will occur by inhalation, because vinyl fluoride released into the environment exists as a gas (IPCS 1993).

Occupational exposure to vinyl fluoride occurs primarily by inhalation (HSDB 2001). Skin and eye contact can occur among workers handling liquid vinyl fluoride. Handling liquid vinyl fluoride also would cause frostbite (IPCS 1993).

Occupational exposure to vinyl fluoride was studied in a manufacturing and polymerization facility in the United States. In eight personal air samples taken at the manufacturing facility, concentrations of vinyl fluoride generally were less than 2 ppm (3.76 mg/m^3). In one personal sample, however, the concentration of vinyl fluoride was 21 ppm (39.5 mg/m^3). Vinyl fluoride concentrations in seven personal samples taken in the polymerization facility ranged from 1 to 4 ppm (1.88 to 7.52 mg/m^3). In four general working areas, the vinyl fluoride concentrations ranged from 1 to 5 ppm (1.88 to 9.4 mg/m^3) (IARC 1995).

Regulations

DOT

Vinyl fluoride is considered a hazardous material and special requirements have been set for marking, labeling, and transporting this material

EPA

Clean Air Act

Prevention of Accidental Release: Threshold Quantity (TQ) = 10,000 lbs

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 1 ppm

NIOSH

Ceiling Recommended Exposure Limit = 5 ppm
Recommended Exposure Limit (REL) = 1 ppm

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