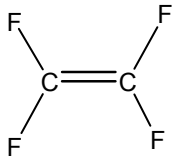
TETRAFLUOROETHYLENE
CAS No. 116-14-3
First Listed in the *Ninth Report on Carcinogens*



CARCINOGENICITY

Tetrafluoroethylene (TFE) is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of malignant tumor formation at multiple sites in multiple species of experimental animals (NTP 1997). When administered by inhalation to F344 rats, TFE induced renal tubule neoplasms, hepatocellular neoplasms, liver hemangiosarcoma, and mononuclear cell leukemia. When administered by inhalation to $B6C3F_1$ mice, TFE induced liver hemangiomas and hemangiosarcomas, hepatocellular neoplasms, and histiocytic sarcomas.

No adequate human studies of the relationship between exposure to TFE and human cancer have been reported (IARC 1999).

ADDITIONAL INFORMATION RELEVANT TO CARCINOGENESIS OR POSSIBLE MECHANISMS OF CARCINOGENESIS

In prokaryotic systems, TFE was negative for the induction of gene mutations in *Salmonella typhimurium* with and without S9 activation. In mammalian systems *in vitro*, TFE was also negative for the induction of gene mutations in Chinese hamster ovary cells (HSDB 2001). No increases in the frequency of micronucleated erythrocytes were observed in peripheral blood samples obtained from TFE-exposed mice (NTP 1997).

The frequency of H-*ras* codon 61 mutations observed in TFE-induced hepatocellular neoplasms (15%) was significantly less than the corresponding frequency (56 to 59%) in spontaneous liver neoplasms of $B6C3F_1$ mice, suggesting that TFE induces liver neoplasms via a *ras*-independent pathway (NTP 1997).

The kidney-specific toxicity and carcinogenicity of TFE is most likely related to the selective uptake and subsequent processing of TFE-glutathione conjugates by renal β-lyase (Miller and Surh 1994, Anders *et al*. 1988). In rats, a TFE cysteine conjugate is bioactivated in the kidney to a difluorothionacetyl fluoride, the putative reactive metabolite for TFE-induced nephrotoxicity (NTP 1997).

No data were available that would suggest that the mechanisms thought to account for tumor induction by TFE in experimental animals would not also operate in humans.

PROPERTIES

TFE is a colorless gas, generally odorless or with a faint odor (Lewis 1992, NTP 2001). It is insoluble in water and has a melting point of -142.5°C (Kennedy 1990, Lewis 1992). TFE is highly flammable when exposed to heat or flame. When heated to decomposition, it emits highly toxic fluorocarbon fumes. At ambient room temperature and pressure, air and TFE will form a flammable mixture when the TFE molar percentage is between 6.5 and 46% (Fiumara 1989) or the volume percentage is between 14 and 43%. It will explode at pressures above 2.7 bar (39.15 lb/in^2, 27540 kg/m^2) if a terpene inhibitor is not added. Examples of terpene inhibitors used are *d*-limonene and terpene B (Gangal 1980). TFE will also react violently with oxygen (Lewis 1992). In the absence of oxygen, the violent thermal decomposition of TFE produces carbon and carbon tetrafluoride (Gangal 1980).

USE

TFE is used primarily in the synthesis of polytetrafluoroethylene (Kennedy 1990). It is also used to produce copolymers with monomers such as hexafluoropropylene and ethylene (Carson *et al*. 1986).

PRODUCTION

TFE is primarily produced by the pyrolysis of chlorodifluoromethane or trifluoromethane (NTP 1997). In 1996, there were two producers of TFE (SRI 1996). No current production volumes have been found. Chem Sources (2001) listed four current U.S. suppliers for TFE.

EXPOSURE

The primary route of exposure to TFE is inhalation. TFE has been reported to be present, along with several other low-molecular weight halogenated compounds, in volcanic emissions (Gribble 1994). Environmental exposure may occur due to releases of TFE through various waste streams; these releases may occur during its production and use in the production of fluoropolymers, nitroso rubbers, and low molecular mass compounds and intermediates (HSDB 2001).

Potential occupational exposure to TFE may occur with workers involved in the production of polymers and copolymers of products containing the chemical. The National Occupational Exposure Survey (NOES), conducted by NIOSH between 1981 to 1983, listed a total of 14,963 employees, including 325 females, potentially exposed to TFE in 870 facilities (NIOSH 1990). The National Occupational Hazard Survey (NOHS), conducted between 1972 to 1974, estimated that 5,326 workers were potentially occupationally exposed to the chemical in 622 facilities. Of the total, 224 employees were in 28 plants reporting under industrial classification for the manufacture of chemicals and allied products (SIC Code 28), and 365 workers were in 99 plants reporting under industrial classification for manufacture of rubber and plastics products (SIC Code 30) (NIOSH 1976).

REGULATIONS

EPA regulates TFE under the Clean Air Act (CAA). It considers the compound a regulated flammable substance and designates a threshold quantity of 10,000 lb for accidental release prevention. It has placed TFE in its list of toxic and reactive highly hazardous chemicals that have a potential for a catastrophic event at or above a designated threshold quantity (TQ); for TFE, the TQ is 5,000 lb.

FDA approves TFE polymers and copolymers for food-related uses.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 2 ppm (8.2 mg/m^3). OSHA regulates the compound under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 170.

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