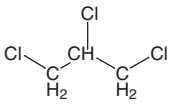
1,2,3-Trichloropropane
CAS No. 96-18-4

Reasonably anticipated to be a human carcinogen
First Listed in the *Eighth Report on Carcinogens* (1998)



Carcinogenicity

1,2,3-Trichloropropane (TCP) 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 1993, Irwin *et al.* 1995).

TCP administered by gavage for 2 years induced multiple tumors in mice and rats. Increased incidences of tumors of the forestomach, liver, and harderian gland were observed in both male and female mice, and increased incidences of tumors of the uterus and oral mucosa were observed in female mice. In male rats, increased incidences of tumors were observed in the preputial gland, kidney, and pancreas. Female rats had increased incidences of tumors in the clitoral gland and mammary gland, and both male and female rats had increased incidences of tumors in the forestomach, oral mucosa, and Zymbal gland (NTP 1993, Irwin *et al.* 1995, IARC 1995).

No adequate human studies of the relationship between exposure to TCP and human cancer have been reported (IARC 1995).

Additional Information Relevant to Carcinogenicity

TCP, when tested *in vitro,* induced gene mutations in bacteria, yeast, and mammalian cells; further, TCP induced sister chromatid exchanges, chromosomal aberrations, micronuclei, and morphological transformation in mammalian cells (Dean and Brooks 1979, Sawin and Hass 1982a,b, IARC 1995, Doherty *et al.* 1996). TCP was active almost exclusively in the presence, but not the absence, of metabolic activation or when tested using metabolically competent cells. In *in vivo* rodent studies, TCP induced DNA damage, including DNA adducts in multiple tissues of rats and mice receiving the chemical by gavage or by intraperitoneal injection (IARC 1995, La *et al.* 1995). TCP also induced cell proliferation in multiple tissues of rats and mice receiving the chemical by gavage or by inhalation (rats only) (Johannsen *et al.* 1988, NTP 1993, Irwin *et al.* 1995). TCP has been reported as negative for the induction of dominant lethal mutations in male rats (IARC 1995). Several metabolites of TCP, including 1,3-dichloroacetone, induce genetic damage in a variety of short-term test systems (IARC 1995). This metabolite is produced by human liver microsomes, although its rate of formation is less than in rats (Weber and Snipes 1992).

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

Properties

TCP is a clear, colorless to straw-colored liquid with a strong acrid odor similar to that of chloroform or trichloroethylene. It has a melting point of -14.7°C and a boiling point of 156.8°C. TCP is soluble in ethanol, ether, and chloroform, and it is slightly soluble in water. It reacts with active metals, strong caustics, and oxidizers. It is sensitive to prolonged exposure to light and to heat. TCP is flammable, and when heated to decomposition, it yields highly toxic fumes of hydrogen chloride gas (IARC 1995, HSDB 2000).

Use

In the past, TCP has been used primarily as a solvent and extractive agent. As a solvent, it has commonly been used as a paint and varnish remover, a cleaning and degreasing agent, and a cleaning and maintenance solvent. No current information is available to indicate that it continues to be used for these purposes. Currently, TCP is used as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a crosslinking agent in the synthesis of polysulfides. No data were available to indicate to what extent TCP is currently used for these purposes (ATSDR 1992). TCP has been formulated with dichloropropenes in the manufacture of a soil fumigant D-D (IARC 1995). According to the Farm Chemicals Handbook 1991 (Sine 1991), this soil fumigant is no longer available in the United States.

Production

No current production volume information is available for TCP; however, the estimated production in 1977 ranged from 21 to 110 million lb (ATSDR 1992). In 1985, two manufacturing facilities had a combined annual production greater than 10,000 pounds (NTP 1993). There are currently two U.S. facilities that produce TCP and nine suppliers (ATSDR 1992, HSDB 2000, Chem Sources 2001). No data were available on imports or exports of TCP.

TCP may also be produced in significant quantities as a by-product of the production of other chlorinated compounds such as dichloropropene, propylene chlorohydrin, dichlorohydrin, and glycerol (ATSDR 1992). In addition, TCP is formed as a by-product of epichlorohydrin production (IFIS 1985).

Exposure

The primary routes of potential human exposure to TCP are inhalation of vapors, dermal contact, or ingestion of contaminated water. TCP is not a naturally occurring chemical. Releases to the environment are likely to occur as a result of its manufacture, formulation, and use as a solvent and extractive agent, paint and varnish remover, cleaning and degreasing agent, cleaning and maintenance reagent, and chemical intermediate. TCP has been detected in low concentrations in surface, drinking, and ground waters in various parts of the United States (ATSDR 1992, NTP 1993).

The National Occupational Exposure Survey (1981-1983) indicated that 492 workers, including 9 women, were potentially exposed to TCP (NIOSH 1984). This survey did not contain information on the frequency, concentration, or duration of exposure. The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 490 workers were potentially exposed to TCP in the US (NIOSH 1976). TCP is manufactured in closed systems; therefore, occupational exposures are more likely to occur at facilities where the chemical is used rather than at facilities where it is produced. Direct handling of TCP or products containing TCP may occur during purification, formulation of products, sampling and quality control, packaging and storage, leakage of equipment, startup and shutdown procedures, maintenance, cleanup, spills, and other facility emergencies (ATSDR 1992).

In the past, inhalation and dermal exposures likely occurred during the use of consumer products, such as certain paint removers, that contained TCP; however, TCP is no longer used in consumer products. The general population may be exposed to low levels of TCP by ingestion of contaminated well water or by inhalation of contaminated air. Individuals that live near facilities that use or produce the compound or hazardous waste disposal facilities are more likely to be exposed (ATSDR 1992). EPA's Toxic Chemical Release Inventory (TRI99 2001) contains data on environmental releases of TCP from 1995 to 1999. Seven facilities reported releasing 28,860 lb of TCP to the environment in 1999. Total air emissions and releases

to land contributed 48% and 28%, respectively, to the total release estimates. Approximately 44% of the total was reported by one waste disposal facility. Historical releases ranged from a low of 2,091 lb in 1996 to a high of 20,895 lb in 1998.

Regulations

EPA

Clean Air Act

NSPS: Manufacture of substance is subject to certain provisions for the control of Volatile Organic Compound (VOC) emissions

Emergency Planning and Community Right-To-Know Act

Toxics Release Inventory: Listed substance subject to reporting requirements

Resource Conservation and Recovery Act

Listed as a Hazardous Constituent of Waste

OSHA

Permissible Exposure Limit (PEL) = 50 ppm (300 mg/m^3)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 10 ppm

NIOSH

Recommended Exposure Limit (REL) = 10 ppm (60 mg/m^3)
Immediately Dangerous to Life and Health (IDLH) = 100 ppm
Listed as a potential occupational carcinogen

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