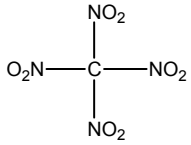
TETRANITROMETHANE
CAS No. 509-14-8
First Listed in the *Seventh Annual Report on Carcinogens*



CARCINOGENICITY

Tetranitromethane is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals. Exposure to tetranitromethane in a two-year inhalation bioassay caused a dose-related increase in alveolar/bronchiolar neoplasms to nearly all mice and rats exposed to concentrations of 2 and 5 ppm respectively. The incidences of these neoplasms in lower exposure concentration groups (2 ppm for rats and 0.5 ppm for mice) were 66% and 44% in male and female rats, respectively, and 54% and 48% in male and female mice, respectively (NTP 1990). The majority of animals with alveolar/bronchiolar neoplasms had neoplasms diagnosed as carcinomas, and these neoplasms frequently metastasized to a variety of organs. Squamous cell carcinomas of the lung were also markedly increased in rats exposed to 5 ppm. This particular type of neoplasm has been found in only 3 of approximately 1,600 untreated control male rats and in none of a similar number of untreated female controls (NTP 1990).

No adequate human studies of the relationship between exposure to tetranitromethane and human cancer have been reported (IARC 1996).

PROPERTIES

Tetranitromethane is a colorless to pale yellow, oily liquid with a pungent odor. It is soluble in alcohol and ether, but it is insoluble in water. It is sensitive to heat, friction, and shock. It is prepared by nitration of acetic anhydride with anhydrous nitric acid (Merck 1989). It is an oxidizer and is highly explosive in the presence of impurities. In addition, tetranitromethane is the principal volatile contaminant of TNT and may constitute as much as 0.12% of the crude material (NTP 1990).

USE

Tetranitromethane is used as an oxidizer in rocket propellants and explosives, and as an additive to increase the cetane number of diesel fuel (NTP 1990, IARC 1996, HSDB 2000). It is also used as a reagent for detecting the presence of double bonds in organic compounds, and as a mild nitrating reagent, reacting with tyrosine residues in proteins.

PRODUCTION

No current estimates of the amount of tetranitromethane commercially produced were found in the literature. Chem Sources (2001) lists six current suppliers of tetranitromethane in the U.S. In Germany during World War II, attempts were made to synthesize large amounts for

use as a substitute for nitric acid in rocket fuel. This method, involving the nitration of acetic anhydride with nitric acid, allowed a production rate of up to 10 tons within a few weeks, but the process was costly. By the end of the war, a less-costly method was devised using acetylene and nitric acid, with a reported capacity of 10 kg/day (NTP 1990).

EXPOSURE

The primary route of potential human exposure to tetranitromethane is inhalation. Historically, human exposure to tetranitromethane presumably occurred during the manufacture and use of TNT (NTP 1990). Tetranitromethane may be released into the environment during its manufacture and use as a rocket fuel, diesel fuel booster, organic reagent, or as an explosive in mixture with toluene (HSDB 2000). During the early part of World War I, there was a high incidence of "TNT intoxication" in U.S. and British facilities involved in TNT production; an additional step involving washing the crude material with a sodium sulfite solution to hydrolyze the tetranitromethane was introduced to alleviate this problem. Tetranitromethane has been reported to be an atmospheric pollutant emitted as a by-product of explosives produced in factories owned by the U.S. Government. The estimated "worst-case" pollutant level of tetranitrotoluene in the vicinity of the factories was 20 mg/m^3 (approximately 2.5 ppm). The National Occupational Exposure Survey, conducted by NIOSH from 1981 to 1983, indicated that 1,445 workers, including 230 women, were potentially exposed to tetranitromethane. This estimate was based on observations of the actual use of the compound (NIOSH 1984).

REGULATIONS

EPA regulates tetranitromethane under the Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). EPA has established water quality criteria for tetranitromethane, effluent guidelines, rules for regulating hazardous spills, general threshold amounts, and requirements for handling and disposal of tetranitromethane wastes. A reportable quantity (RQ) of 1 lb has been established for tetranitromethane under CWA and RCRA, while a RQ of 10 lb for tetranitromethane was established under CERCLA. Tetranitromethane is regulated as a hazardous constituent of waste under RCRA.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 5 ppb (40 $\mu g/m^3$) for tetranitromethane. NIOSH has a recommended exposure level (REL) of 1 ppm as a 10-hr time-weighted average (TWA). OSHA has set the permissible exposure limit (PEL) of 1 ppm (8 mg/m^3). OSHA regulates tetranitromethane under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 171.

REFERENCES

Chem Sources. Chemical Sources International, Inc. http://www.chemsources.com, 2001.

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Merck. The Merck Index, Eleventh Edition. Rahway, NJ: Merck & Co., Inc., 1989.

NIOSH. National Institute for Occupational Safety and Health. National Occupational Exposure Survey (1981-83). Cincinnati, OH: Department of Health and Human Services, 1984.

NTP. National Toxicology Program. Technical Report Series No. 386. Toxicology and Carcinogenesis Studies of Tetranitromethane (CAS No. 509-14-8) in F344/N Rats and B6C3F$_1$ Mice (Inhalation Studies). NIH Publication No. 90-2841. 207 pp. National Toxicology Program, Research Triangle Park, NC, and Bethesda, MD, 1990.