Toluene diisocyanate (TDI). Toluylene diisocyanate (mixture of isomeres) for synthesis.

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TDI is a clear, colorless to pale yellow liquid. There are several forms of TDI, which are called isomers. The two most common TDI isomers are 2,4-TDI and 2,6-TDI [ATSDR].

Usage and exposure:

Commercial-grade TDI (which represents more than 95% of TDI industrial usage) is an 80:20 mixture of the two chemical isomers 2,4- and 2,6-TDI [CDC].

TDI is widely used in the manufacture of flexible polyurethane foams, elastomers, surface coatings, fibers, sealants, and adhesives. Applications and uses for these products include packaging, insulation materials, upholstery, and shoe soles [CDC].

TDI is used to make many household products. It combines with other chemicals to produce various polyurethanes. Some of the products made with these polyurethanes include foam for furniture cushions and carpet padding and waterproof sealants [ATSDR].

TDI can be released into the air, water, and soil at places where it is produced or used. TDI is extremely reactive chemicals and is not likely to stay in the environment. In air, TDI have half-lives of less than 1 day.

Occupational exposure normally occurs during the production and use of TDI, particularly during the mixing and foaming processes in the polyurethane foam industry. Exposures to airborne TDI may also occur as a result of the melting or burning of polyurethane foams during firefighting [CDC].

Routs of exposure:

The major route of occupational exposure to TDI is by inhalation of the vapor; exposure may also occur through dermal contact during the handling of liquid TDI [CDC].

Target organ:

Respiratory system

Health hazards:

Toluene diisocyanate is a powerful irritant to mucous membranes of the eye and upper and lower respiratory tract. Acute changes in pulmonary function have been observed in exposed workers during the course of a work shift. Exposure to toluene diisocyanate may cause chronic restrictive pulmonary disease. Chronic bronchitis has been reported to be more frequent in workers exposed to high concentrations or repeatedly to low concentrations of toluene diisocyanate. Exposure to very high concentrations of toluene diisocyanate results in long-term sequelae that affect the central nervous system, and symptoms such as headache, poor memory, difficulty in concentrating, confusion, changes in personality, irritability and depression have been reported. No data were available to evaluate the reproductive effects or prenatal toxicity of toluene diisocyanate to humans [IARC].

There is sufficient evidence for the carcinogenicity of toluene diisocyanate to experimental animals. There is inadequate evidence for the carcinogenicity of toluene diisocyanate to humans- Group 2B (possibly carcinogenic to humans).

References:

- ATSDR. Agency for Toxic Substances & Disease Registry. Public Health Statement for Toluene Diisocyanate and Methylenediphenyl Diisocyanate. https://www.atsdr.cdc.gov/phs/phs.asp?id=1450&tid=245
- CDC. Center for Disease Control and Prevention. Current Intelligence Bulletin 53. December 1989. Toluene Diisocyanate (TDI) and Toluenediamine (TDA): Evidence of Carcinogenicity. https://www.cdc.gov/niosh/docs/90-101/default.html

- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 71. Re-evaluation of Some Organic Chemicals, Hydrazine and Hydrogen Peroxide (Part 1, Part 2, Part 3). https://publications.iarc.fr/89