

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

ToxGuide™

for

Toluene Diisocyanate
Methylenediphenyl
Diisocyanate

$C_9H_6N_2O_2$ $C_{15}H_{10}N_2O_2$

CAS# 26471-62-5 101-68-8

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U.S. Department of Health and
Human Services
Public Health Service
Agency for Toxic Substances
and Disease Registry
www.atsdr.cdc.gov

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General Populations

- Exposure to toluene diisocyanate (TDI) and methylenediphenyl diisocyanate (MDI) can occur from inhaling air where uncured (unreacted) products such as adhesives, sealants, coatings, paints, craft materials, and insulating foams are present.
- It is unlikely that consumers would be exposed to diisocyanates from cured products, such as cushions.
- Exposure of the general population to TDI or MDI through food or water is unlikely.

Occupational Populations

- TDI and MDI are most frequently detected in occupational settings, mainly by inhalation of aerosol and vapor (TDI only).
- Diisocyanates are used in the production of polyurethane foam during foaming, casting, spraying, and other processes. Exposure may also occur after production when the polymer is processed.
- Thermal degradation of polyurethane foam during processes such as heat cutting of foam blocks, flame lamination with textiles, and welding, cutting, or grinding of polyurethane-coated metal, can also release diisocyanates into the air.
- Another route is through dermal exposure by contact with uncured polyurethane products.

Toxicokinetics

- TDI and MDI in air can be absorbed through the lungs, but quantitative data in humans are not available.
- TDI can also be absorbed through the gastrointestinal tract; there are no data for MDI.
- Small amounts of both chemicals can enter the body through the skin.
- TDI and MDI bind to other chemicals in the body and are widely distributed throughout the body.
- TDI and MDI primarily leave the body in the feces; a small amount also leaves the body in the urine.

Normal Human Levels

- There are no data regarding levels of TDI and MDI in the general population.

Biomarkers

- Urine and plasma levels of breakdown products of TDI and MDI such as toluene diamine and methylenedianiline can indicate exposure to TDI or MDI, but are not specific.
- TDI or MDI bound to albumin in plasma indicates specific exposure to diisocyanates.

Environmental Levels

Air

- No data are available for levels of TDI or MDI in ambient air (non-occupational settings).

Sediment and Soil

- No data are available for levels of TDI or MDI in sediment or soil.

Water

- No data are available for levels of TDI or MDI in water.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2015. Toxicological Profile for Toluene Diisocyanate and Methylenediphenyl Diisocyanate (Draft for public comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Chemical and Physical Information

Routes of Exposure

Relevance to Public Health (Health Effects)

TDI is liquid - MDI is solid

- TDI and MDI are synthetic substances.
- TDI is a clear, colorless to pale yellow liquid. MDI is a light yellow crystalline solid.
- TDI and MDI have several forms or isomers. The two most common TDI isomers are 2,4-TDI and 2,6-TDI. The most common isomer of MDI is 4,4'-MDI.
- TDI and MDI are used to make many household products.
- TDI and MDI combine 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.

- Inhalation – Minor route of exposure for the general population. Important route of exposure for workers who manufacture cured (unreactive) and uncured polyurethane products.
- Oral – Unlikely route of exposure for the general population because they are not found in food or water.
- Dermal – Possible exposure route for the general population if handling products containing uncured diisocyanates. Important route of exposure for workers who manufacture cured and uncured polyurethane products.

TDI and MDI in the Environment

- TDI and MDI can be released into the air, water, and soil at places where they are produced or used.
- TDI and MDI are extremely reactive chemicals and are not likely to accumulate in the environment.
- Half the TDI and MDI in air will disappear in less than 1 day.
- TDI and MDI rapidly react with water to form other compounds. Half the TDI and MDI in water will disappear in a few minutes to a few hours.
- TDI and MDI will not bioaccumulate in the food chain.

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- An MRL of 0.00001 ppm has been derived for acute-duration inhalation exposure (≤ 14 days) to TDI.
- An MRL of 0.000003 ppm has been derived for chronic-duration inhalation exposure (365 days or longer) to TDI.
- An MRL of 0.001 mg/m³ has been derived for chronic-duration inhalation exposure (365 days or longer) to polymeric MDI.

Oral

- No acute-, intermediate- or chronic duration oral MRLs were derived for TDI or MDI.

Health Effects

- Respiratory effects, including a decrease in lung function, have been reported in workers exposed to TDI or MDI.
- Some workers can become sensitized to TDI and MDI and may experience adverse effects at much lower exposure levels than the concentrations that may affect non-sensitized individuals.
- Asthma and symptoms of asthma, such as wheezing and shortness of breath, have been observed in some individuals who are particularly sensitive to the toxicity of TDI and MDI.
- The National Institute of Environmental Health Sciences (NIEHS) considers TDI as reasonably anticipated to be a human carcinogen. EPA has not classified the carcinogenicity of TDI. EPA notes that the carcinogenicity of MDI cannot be determined, but there is suggestive evidence that raises concern for carcinogenic effects.

Children's Health

- There is no information on the effects of TDI or MDI in children.
- Children are expected to experience effects similar to those seen in adults; exposure to TDI or MDI in the air could result in lung damage.