

Sources of Exposure

Toxicokinetics and Normal Human Levels

Biomarkers/Environmental Levels

ToxGuide™

for

Dinitrotoluenes

$C_7H_6N_2O_4$

CAS RN 25321-14-6

February 2016

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

- Most people will not be exposed to dinitrotoluene (DNT).
- Exposure to DNTs can occur via ingestion of contaminated water or skin contact with contaminated soil near hazardous waste sites containing DNT or munitions facilities using DNT.
- Washing or bathing with contaminated water can also be a source of exposure.
- Inhalation exposure of the general population is expected to be low.
- DNT is not used extensively in consumer products and is not often detected in food samples.

Occupational Populations

- Exposure to DNT may occur from its use in the manufacture of toluene diisocyanate, in the production of explosives, in the manufacture of azo dye intermediates, and in organic synthesis in the preparation of toluidines and dyes.
- Exposure may also occur at facilities that store or dispose the substance.

Toxicokinetics

- Absorption of DNT occurs following exposure via the inhalation, oral, and dermal routes of exposure.
- Studies of 2,4-DNT in rats showed that the parent compound and/or metabolites distribute preferentially to the liver and kidneys.
- Analysis of urine from workers exposed to DNT showed that the major metabolites are dinitrobenzoic acids and 2-amino-4-nitro nitrobenzoic acid.
- Metabolites of DNT are eliminated in the urine within 24 hours. Small amounts of DNTs may also be present in the feces.

Normal Human Levels

- There are no data regarding normal levels of DNT in the general population.

Biomarkers

- Results of occupational studies support the use of 2,4-DNT, 2,6-DNT, and their metabolites in urine as biomarkers of exposure.

Environmental Levels

Air

- DNT is rarely detected in ambient air.

Sediment and Soil

- Concentrations of DNT of approximately 100 mg/kg have been reported at ammunition sites and military firing ranges.

Water

- DNT is rarely detected in public drinking water supplies.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2016. Toxicological profile for dinitrotoluenes. 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)

DNTs are solids

- There are 6 DNT isomers: 2,3-, 2,4-, 2,5-, 2,6-, 3,4-, and 3,5-DNT which have the same chemical structure, but differ in the position of the nitro groups on the benzene ring.
- The technical-grade mixture is composed mostly of 2,4-DNT (76%) and 2,6-DNT (19%).
- DNT is a synthetic substance used primarily as chemical intermediate for the production of toluene diisocyanate. DNT is also used in the production of trinitrotoluene (TNT), dyes, and polyurethane foams. 2,4-DNT is used in the air bags of automobiles.

- Inhalation** – Predominant route of occupational exposure. Not an important route for the general population.
- Oral** – Incidental route of exposure for those living near ammunition or explosive manufacturing facilities.
- Dermal** – Important route of occupational exposure. Incidental route of exposure for those living near ammunition or explosive manufacturing facilities.

DNT in the Environment

- DNT has been found in the soil, surface and ground water, but rarely in ambient air. Most commonly found around manufacturing facilities or contaminated waste sites.
- DNT is slowly broken down in water by microbial organisms and it can be broken down by sunlight in surface water.
- DNT does not adsorb strongly to soil. Therefore, it can move from soil into groundwater, where it can contaminate drinking water.

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

Minimal Risk Levels (MRLs)

Inhalation

- No inhalation MRLs were derived for dinitrotoluenes.

Oral

- MRLs for acute-duration oral exposure (≤ 14 days):
 - 0.09 mg/kg/day for 2,3-DNT
 - 0.05 mg/kg/day for 2,4-DNT
 - 0.007 mg/kg/day for 2,5-DNT
 - 0.09 mg/kg/day for 2,6-DNT
 - 0.03 mg/kg/day for 3,4-DNT
 - 0.03 mg/kg/day for 3,5-DNT
- MRLs for intermediate-duration oral exposure (15-364 days):
 - 0.007 mg/kg/day for 2,4-DNT
 - 0.004 mg/kg/day for 2,6-DNT
- MRLs for chronic-duration oral exposure (≥ 365 days):
 - 0.001 mg/kg/day for 2,4-DNT

Health Effects

- Acute and prolonged oral exposure of animals to DNT has caused anemia, and damage to the nervous system, male reproductive system, and liver.
- Breathing or ingesting very high levels of DNTs may cause death.
- A study of workers reported a relationship between heart disease and long-term exposure to DNT.
- Occupational exposure to DNT has been associated with increased risk of kidney and bladder cancer.
- The EPA determined that technical grade DNT is a probable human carcinogen (Group B2) based on sufficient evidence of carcinogenicity in animal studies. The International Agency for Research on Cancer (IARC) determined that 2,4- and 2,6-DNT are possibly carcinogenic to humans (Group 2B) and 3,5-DNT is not classifiable as to its carcinogenicity to humans (Group 3).

Children's Health

- It is not known whether children are more susceptible than adults to DNT effects.
- It is not known whether DNT can affect the fetus.
- Newborns of animals exposed to DNT during pregnancy can have anemia and nervous system damage at birth.