

Sources of Exposure

Toxicokinetics and Biomonitoring Levels

Biomarkers/Environmental Levels

General Populations

- People who use products that contain naphthalene (e.g., mothballs, inks, plastics, and coal tar driveway sealants), smoke tobacco, live or work where tobacco smoke is present, or burn organic material indoors may be exposed to naphthalene.
- For the general public, the most likely route of exposure to naphthalene and methylnaphthalenes is through inhalation.
- People who live near current or former wood treatment facilities may be exposed to naphthalene and/or methylnaphthalenes.

Occupational Populations

- High naphthalene exposure levels could also occur in certain work environments in industries that produce and use naphthalene such as wood preserving, tanning, coal distillation, polyvinyl chloride plastics manufacture, and production of inks, dyes, and resins.
- Workers who are in close proximity to smoke during combustion, such as firefighters, may be exposed to higher naphthalene levels.

Toxicokinetics

- Based on the presence of adverse effects following exposure, humans and animals can absorb naphthalene by pulmonary, gastrointestinal, and cutaneous routes.
- Gastrointestinal and pulmonary absorption of 1-methylnaphthalene and 2-methylnaphthalene have been demonstrated in animals.
- Naphthalene has been detected in adipose tissues and breast milk of humans and is known to cross the placenta at sufficient doses to cause toxicity in newborns.
- Naphthalene and 1-methylnaphthalene are widely distributed in animals after oral and dermal exposure.
- Naphthalene metabolism begins with cytochrome P450 (CYP)-mediated epoxidation to 1,2 naphthalene epoxide.
- Unlike naphthalene, 1- and 2-methylnaphthalenes are preferentially metabolized via oxidation of the methyl group, yielding hydroxymethyl-naphthalenes.
- Naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene are primarily excreted in urine as metabolites; small quantities are excreted in exhaled air and feces.

NHANES Levels

- The geometric mean concentrations of metabolites, 1-hydroxynaphthalene and 2-hydroxynaphthalene, in the urine were 1.36 and 5.23 $\mu\text{g/L}$, respectively (NHANES 2015–2016).

Biomarkers

- Naphthalene and its metabolites can be detected in urine.
- 2-Methylnaphthalene and its metabolites can be detected in rat urine and most likely could be analyzed in human urine.
- There are no specific biomarkers for 1-methylnaphthalene.

Environmental Levels

Air

- In 2022, the average naphthalene concentration in 32 ambient air samples across the United States was 0.02 $\mu\text{g}/\text{m}^3$. Data on methylnaphthalenes were limited.

Water

- The average concentrations of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene in surface water in the United States in 2022 were 0.04, 0.03, and 0.03 $\mu\text{g}/\text{L}$, respectively.

Sediment and Soil

- In 2022, the average sediment and soil concentrations of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene across the United States were 4.08, 1.22, and 5.96 $\mu\text{g}/\text{kg}$, respectively.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2024. Toxicological Profile for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene. (Draft for Public Comment) Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™

for

Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene

CAS # 91-20-3; 90-12-0; and
91-57-6

May 2024

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



ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

Chemical and Physical Information

Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene

- Naphthalene and methylnaphthalenes occur naturally in fossil fuels such as petroleum and coal, and are produced when organic materials (e.g., fossil fuels, wood, tobacco) are burned.
- Naphthalene is also produced commercially from either coal tar or petroleum.
- Naphthalene is a white solid with a strong odor that evaporates easily. For more information on environmental odors, see <https://www.atsdr.cdc.gov/odors/index.html>.
- Commercially produced naphthalene is predominantly used in the production of phthalic anhydride, which is used as an intermediate in the production of phthalate plasticizers, resins, phthalic acids, dyes, pharmaceuticals, insect repellents, and other materials.
- Crystalline naphthalene is used as a moth repellent. It is also used in products designated as small mammal, snake, and bat repellents.
- 1-Methylnaphthalene is a clear liquid and 2-methylnaphthalene is a solid.
- 1-Methylnaphthalene and 2-methylnaphthalene are used to make other chemicals such as dyes and resins.
- 2-Methylnaphthalene is also used to make vitamin K.

Routes of Exposure

- Inhalation – Predominant route of exposure for the general and occupational populations.
- Oral – Not likely route of exposure for the general or occupational populations.
- Dermal – Not likely route of exposure for the general or occupational populations.

Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene in the Environment

- Most of the naphthalene and methylnaphthalenes entering environmental media is released to soil, while combustion of wood and fossil fuels results in substantial releases to air.
- The coal-tar industry is also a primary source of the small amounts of naphthalene that are directly discharged to land.
- Naphthalene and methylnaphthalenes are expected to primarily volatilize to air. They may be removed from the water column by sorption or retained in soil and sediment depending on the organic carbon content.
- Naphthalene and methylnaphthalenes are readily degraded by indirect photolysis in air and water.
- Biodegradation in water, soil, and sediment is slow, but proceeds readily in historically contaminated media where microorganisms are adapted.

Relevance to Public Health (Health Effects)

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

Minimal Risk Levels (MRLs)

Inhalation

- A provisional acute-duration inhalation MRL of 6×10^{-5} ppm was derived for naphthalene.
- Provisional intermediate-duration inhalation MRLs of 9×10^{-5} ppm for 1-methylnaphthalene and 3×10^{-4} ppm for 2-methylnaphthalene were derived.
- No provisional chronic-duration inhalation MRLs were derived.

Oral

- A provisional acute-duration oral MRL of 0.2 mg/kg/day was derived for naphthalene.
- Provisional intermediate-duration oral MRLs of 0.2 mg/kg/day for naphthalene and 0.6 mg/kg/day for 1-methylnaphthalene were derived.
- Provisional chronic-duration oral MRLs of 0.07 mg/kg/day for 1-methylnaphthalene and 0.06 mg/kg/day for 2-methylnaphthalene were derived.

Health Effects

- In humans, nasal irritation and inflammation have been reported in workers exposed to naphthalene. Decreases in lung function have been associated with airborne naphthalene.

- Neurological symptoms (headache, confusion, lethargy, and vertigo) have been seen in humans exposed to vapors or from ingestion of naphthalene.
- Hemolytic anemia has been reported in humans after naphthalene exposure.
- In animals, respiratory lesions were seen after acute-, intermediate-, and/or chronic-duration inhalation exposure to naphthalene and methylnaphthalenes.
- Chronic inhalation of naphthalene increased incidences of neoplastic lesions in the respiratory tracts of rats and mice.
- Increased incidences of lung adenomas or carcinomas were seen in male mice orally exposed to 1-methylnaphthalene.
- The National Toxicology Program concluded that naphthalene is reasonably anticipated to be a human carcinogen, and did not evaluate 1- or 2- methylnaphthalene. The U.S. Environmental Protection Agency (EPA) concluded that naphthalene is a possible human carcinogen (Group C) and that data for 2- methylnaphthalene are inadequate to assess human carcinogenicity. The EPA Provisional Peer-Reviewed Toxicity Value assessment for 1-methylnaphthalene concluded there is “suggestive evidence of carcinogenicity.” The International Agency for Research on Cancer concluded naphthalene is possibly carcinogenic to humans (Group 2B) and has not assessed the carcinogenicity potential of the methylnaphthalenes.

Children’s Health

- It is not known if children are more sensitive to these chemical than adults.