

Methyl tert-butyl ether

1634-04-4

Hazard Summary

Methyl tert-butyl ether is used as a gasoline additive. Exposure may occur by breathing air contaminated with auto exhaust or gasoline fumes while refueling autos. Respiratory irritation, dizziness, and disorientation have been reported by some motorists and occupationally exposed workers. Acute (short-term) exposure of humans to methyl tert-butyl ether also has occurred during its use as a medical treatment to dissolve cholesterol gallstones. Chronic (long-term) inhalation exposure to methyl tert-butyl ether has resulted in central nervous system (CNS) effects, respiratory irritation, liver and kidney effects, and decreased body weight gain in animals. Developmental effects have been reported in rats and mice exposed via inhalation. EPA has not classified methyl tert-butyl ether with respect to potential carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (2), which contains information on inhalation chronic toxicity of methyl tert-butyl ether and the RfC and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Methyl t-Butyl Ether. (4)

Uses

- Nearly all methyl tert-butyl ether produced in the United States is used as an additive in unleaded gasoline to increase octane levels and reduce carbon monoxide emissions. (1,4,5)
- It was used in the past to produce isobutene. (1,5)

Sources and Potential Exposure

- The general population may be exposed to methyl tert-butyl ether by breathing air contaminated with auto exhaust or gasoline fumes while refueling cars. (1,4)
- Workers may be occupationally exposed via inhalation or dermal contact. (1)

Assessing Personal Exposure

- No information was located regarding the measurement of personal exposure to methyl tert-butyl ether. (4)

Health Hazard Information

Acute Effects:

- Acute exposure of humans to methyl tert-butyl ether has occurred via injection into the gallbladder during its use as a medical treatment to dissolve cholesterol gallstones. Nausea, vomiting, and sleepiness have been observed; in one case renal failure was reported. (1,2,4)
- Acute inhalation exposure has resulted in CNS effects including ataxia and abnormal gait in rats. (2,4)
- Acute animal tests in rats have demonstrated methyl tert-butyl ether to have **low** acute toxicity via inhalation and **moderate** acute toxicity via ingestion. (3)

Chronic Effects (Noncancer):

- Motorists and gas station attendants have reported symptoms of coughing, burning sensations in the nose and throat, headache, dizziness, and feelings of spaciness and disorientation that may have been associated with methyl tert-butyl ether exposure. (4)
- CNS effects observed in animals following inhalation or oral exposure to methyl tert-butyl ether include ataxia, incoordination, loss of righting reflex, decreased startle and pain reflexes, prostration, drowsiness, and hypoactivity. (4)
- Other effects noted in rats and/or mice chronically exposed by inhalation include liver and kidney effects, respiratory irritation, and decreased body weight gain. (4)
- The Reference Concentration (RfC) for methyl tert-butyl ether is 3.0 milligrams per cubic meter (mg/m^3) based on increased liver and kidney weights, increased prostration in females, and swollen periocular tissues in male and female rats. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (2)
- EPA has medium confidence in the study on which the RfC was based because it was well designed (e.g., with respect to exposure protocol, number of animals, and exposure duration), identified a consistent lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) for a number of organ systems, and involved extensive histopathology on both sexes. However, the results of the rat study are confounded by the high mortality in the males, which is presumed to be the result of rat chronic nephropathy. EPA has medium to high confidence in the database because of the existence of chronic and subchronic bioassays in more than one species, developmental studies in several different species, and the existence of single- and two-generation reproductive studies in the rat; and, consequently, medium to high confidence in the RfC. (2)
- EPA has not established a Reference Dose (RfD) for methyl tert-butyl ether. (2)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of methyl tert-butyl ether in humans.
- In rats exposed via inhalation, reduced body weight and body weight gain in pups and decreased pup viability have been reported. (2,4)
- Developmental effects have been reported in mice. A decreased number of viable implantations, increased maternal toxicity, late resorptions, and skeletal variations were observed in mice exposed via inhalation. (2,4)

Cancer Risk:

- No information is available on the carcinogenic effects of methyl tert-butyl ether in humans.
- In inhalation studies, an increased incidence of liver tumors was reported in mice. In male rats, increased incidences of renal tubular adenoma and carcinoma and interstitial cell adenoma in the testes were reported; however, the renal tumors may have resulted from accumulation of a protein unique to male rats and testicular tumors are common in the strain of rats used. (4)
- Lymphomas, leukemia, and testicular Leydig cell tumors were reported in orally exposed rats. (4)
- EPA has not classified methyl tert-butyl ether with respect to potential carcinogenicity. (2)

Physical Properties

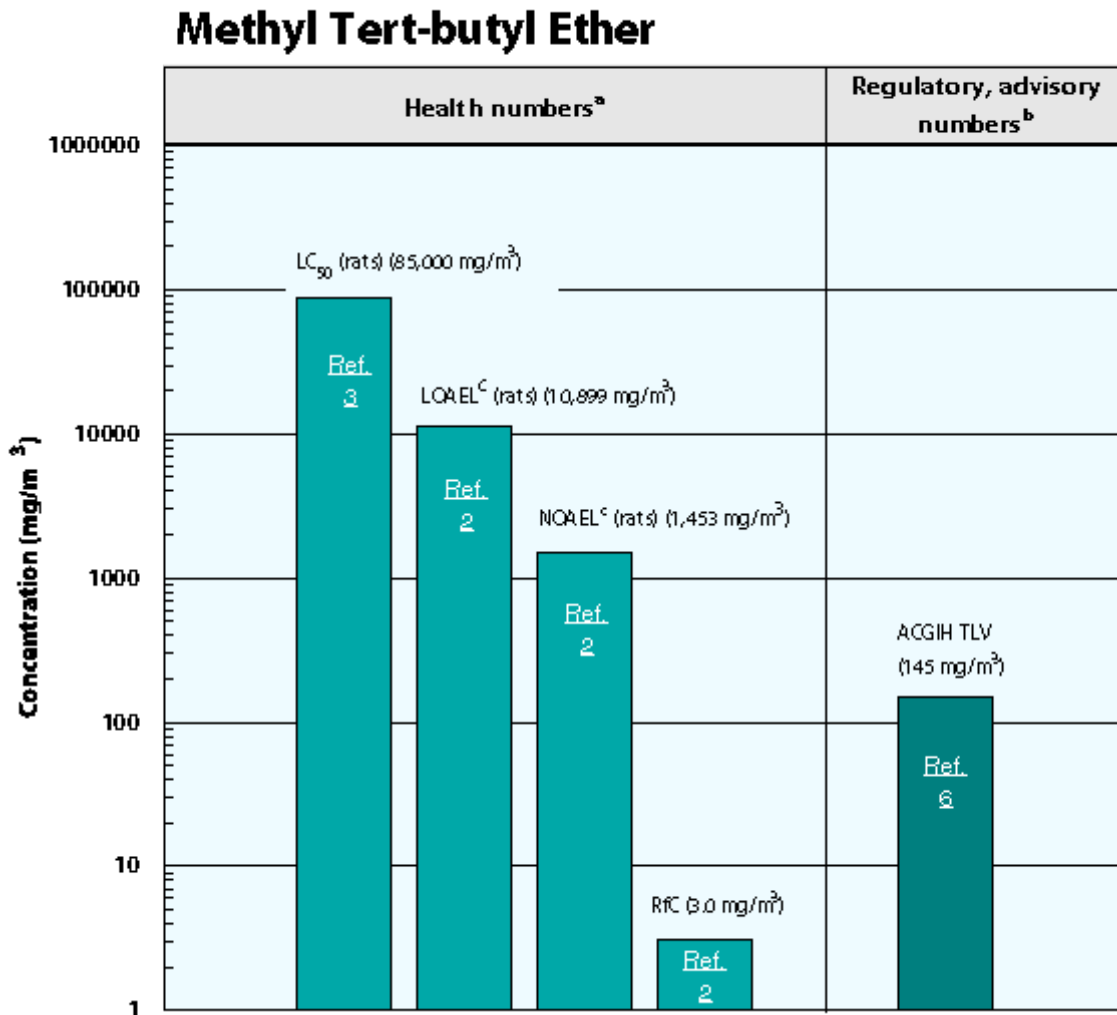
- Methyl tert-butyl ether is also called MTBE and tert-butyl methyl ether. (1,3)
- The chemical formula for methyl tert-butyl ether is $\text{C}_5\text{H}_{12}\text{O}$, and its molecular weight is 88.15 g/mol. (1,4,5)

- Methyl tert-butyl ether occurs as a colorless liquid, with a vapor pressure of 245 mm Hg at 25 °C. (1,4,5)
- It has a log octanol/water partition coefficient ($\log K_{ow}$) of 1.24. (5)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For methyl tert-butyl ether: $1 \text{ ppm} = 3.61 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC₅₀ (Lethal Concentration₅₀)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. ACGIH numbers are advisory.

^c The LOAEL and NOAEL are from the critical study used as the basis for the EPA RfC.

References

Summary created in April 1992, updated January 2000

1. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, [online database](#)). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
2. U.S. Environmental Protection Agency. [Integrated Risk Information System \(IRIS\) on Methyl tert-Butyl Ether](#). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
3. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, [online database](#)). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
4. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Methyl t-Butyl Ether. Public Health Service, U.S. Department of Health and Human Services. Atlanta, GA. 1996.
5. The Merck Index. An Encyclopedia of Chemicals, Drugs, and Biologicals. 11th ed. Ed. S. Budavari. Merck and Co. Inc., Rahway, NJ. 1989.
6. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.