ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

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Methyl t-Butyl Ether (MtBE): Health Information Summary

Methyl tertiary-Butyl Ether (MtBE) is a colorless, synthetically produced liquid. Most people can smell MtBE in water at relatively low concentrations. Depending on the level in water, the odor has been described as “sweet, solvent-like, alcohol, or turpentine.” MtBE is produced primarily for the petroleum industry and is blended into gasoline to increase the octane rating. A small quantity of MtBE is used by the petroleum industry in the synthesis of other organic chemicals. MtBE has also been used by the medical profession experimentally to treat gallstones by dissolving them.

MtBE has been added to fuels since the 1970s in concentrations less than 1 percent by volume in regular gasoline, and 2-9 percent by volume in premium gasoline. To achieve requirements of the 1990 Clean Air Act Amendments, Congress required the use of reformulated gasoline (RFG) in certain areas of the country to help reduce levels of other pollutants such as ozone. RFG contains 11 percent by volume of MTBE. MTBE was the most popular fuel oxygenate blended with gasoline to make RFG, and nearly all the MTBE produced in the United States was for use in RFG. However, as of January 1, 2007, MTBE has been banned from gasoline sold in NH at a concentration exceeding 0.5 percent; it has been replaced by ethyl alcohol. Gasoline containing MTBE has also been banned in New York, New Jersey and the New England states other than Massachusetts, where a ban is under consideration. A small percentage of MtBE is allowed in the ethyl alcohol containing gasoline because gasoline of all types may be transported in the same tanker trucks or pipelines. Therefore, some low level cross contamination cannot be avoided.

The large-scale use of MtBE-containing gasoline resulted in an inadvertent introduction of low concentrations of MtBE to surface and groundwater. Localized exposures to relatively high concentrations arose when MtBE entered the environment as a component of gasoline spills, for example from underground storage tanks. Once MtBE enters the groundwater, it spreads more quickly than other components of gasoline because it is substantially more water-soluble than some of the other common gasoline groundwater contaminants. It is also much more resistant to environmental breakdown than other gasoline components.

Health Effects

Short-Term (Acute) Effects

Oral exposure to high levels of MtBE has been observed to have an anesthetic effect on rats, which lasted about two hours. Other short-lived symptoms included lack of coordination and reduced activity.

There have been some reports of acute symptoms, such as headaches, nausea, dizziness, and difficulty breathing, from people exposed during refueling to gasoline with higher levels of MtBE, such as in reformulated gasoline. While surveys have indicated that most people have not noted any increase in acute health effects when exposed to RFG, the complaints may indicate that a small portion of the population is sensitive to inhaled MtBE. A study was conducted on humans who were exposed to 1.39 parts per million (ppm) of MtBE in air for one hour. There were no differences in reported nervous system effects (headache, fatigue, dizziness) than when they were exposed to uncontaminated air. As a comparison, MtBE air concentrations measured for a two-minute period in the breathing zone of persons refueling at a self-service station averaged in the range of 4 ppm to 6 ppm, although levels measured for individual exposure ranged from 0.1 ppm to 38 ppm.

Long-Term (Chronic) Effects

No studies of human populations have been conducted to assess the potential health effects from prolonged exposure to MtBE. Two laboratory animal studies exposing either rats or mice were conducted to assess toxicity from long-term exposure via *inhalation.* Adverse non-carcinogenic effects to the kidneys were observed at elevated exposure levels in male and female rats, and increased liver weights were observed in female rats.

Carcinogenic (cancer-causing) Effects

No human studies relating cancer incidence and exposure to MtBE were found in the literature. However, three different animal studies were conducted that have assessed the carcinogenic potential of this compound.

Upon repeated *oral* exposure to rats, females showed a dose-related increase in the combined tumor types lymphoma and leukemia. Male rats developed an increase in testicular tumors. Results from each of the two long-term *inhalation* studies in laboratory rats and mice, respectively, showed an increased occurrence of kidney and testicular tumors in male rats and liver tumors in female and male mice.

The opinions of experts in the field are divided as to whether the results of these animal studies are relevant to humans at concentrations likely to be found in the environment. The animal results applicability to humans are questioned in part because of the high doses administered to the animals and because an understanding of the way in which MtBE causes tumors in these animals is not currently known. However, based on the strength of the evidence, demonstrating that MtBE is an animal carcinogen in two species, in both sexes, and at multiple sites in the body, the DES Environmental Health Program (EHP) concludes that MtBE is an animal carcinogen. In the interests of protecting public health, we are assuming that the animal study results are relevant to humans until additional research can confidently demonstrate otherwise.

The EHP believes that MtBE may best be classified according to the Environmental Protection Agency guidelines for carcinogen risk assessment as having a weight of evidence for

carcinogenicity on a continuum between “likely to be carcinogenic to humans” and “suggestive evidence of carcinogenic potential.”

The weight of evidence provided by a variety of different mutagenicity (the ability to cause alterations in genetic material) studies conducted for MtBE indicate that it has little or no mutagenic activity. Mutagenic compounds are theorized to play a role in the initiation of cancer. However, current evidence indicates that MtBE is metabolized to another chemical, formaldehyde, which has shown mutagenic activity in a variety of experimental systems.

Developmental/Reproductive Effects

MtBE concentrations have been observed to cause reproductive or developmental effects in animals only at levels that are greater than the lowest level reported for any non-cancer effect (kidney toxicity) in animal studies. The state drinking water standard, which is based on cancer effects, is also protective against all non-cancer effects (see “Health Standards and Criteria” section). Reproductive effects have not been observed in studies in which animals were exposed to MtBE orally. Reproductive effects were not noted in several animal studies in which exposure was by inhalation, other than one in which toxicity in reproductive tissues was observed at very high MtBE exposures.

Several animal studies investigating developmental effects have been conducted. Most of the studies in which animals were exposed to MtBE at high concentrations during pregnancy did not report any developmental effects. A few longer-term studies (16 weeks) reported decreased weight and survival of offspring. The highest MtBE exposure level in developmental or reproductive studies at which no effect was observed exceeds by more than 150,000-fold what a human is likely to be exposed to from drinking water at the state MtBE standard of 13 micrograms per liter (ug/L; equivalent to parts per billion (ppb)).

Health Standards and Criteria

The state primary drinking water standard of 13 ug/L is protective for ingestion exposure at an excess lifetime cancer risk of one in one million. The MtBE standard provides an adequate margin of safety for potential noncancer adverse effects to the kidneys and nervous system as they are not a potential hazard for MtBE exposures from drinking water at concentrations below 50 ug/L. The MtBE standard is calculated, in part, based on standard exposure factors including an average intake of two liters (0.53 gallon) of water per day by a 70 kg (154 lb.) adult for 70 years.

The MtBE odor and taste thresholds from several studies fall within the range of 20-40 ppb, identified by the EPA as an approximate threshold for aesthetic effects. EPA states that this range can be used as advisory guidance to help ensure consumer acceptance of the taste and odor of MtBE in drinking water. The state secondary standard of 20 ppb for MtBE is based on the lower end of EPA’s recommended odor and taste threshold range. This value is anticipated to provide protection for most individuals.

The EPA has developed a Reference Concentration (RfC) of 3 milligrams per cubic meter in air (mg/m3) at or below which no adverse noncarcinogenic health effects would be anticipated from continuous inhalation exposure over a lifetime. To protect workers, the American Conference of Governmental Industrial Hygienists recommends that MtBE air levels in occupational settings be limited to 40 parts per million or 144 mg/m3.

For more environmental health information, please contact the DES Environmental Health Program, 29 Hazen Drive, Concord, NH 03302-0095; (603) 271-4608. For more information on MtBE, please go to http://des.nh.gov/organization/divisions/air/tsb/tps/msp/gas_nh.htm .

Suggested Reading and References

1. Toxicological Profile for Methyl T-Butyl Ether. U.S. Department of Health & Human Services. August,1996.
2. The Potential Health Effects of Oxygenates Added to Gasoline. A Review of the Current Literature. Health Effects Institute. April, 1996.
3. *Casarett and Doull's Toxicology: The Basic Science of Poisons*, Sixth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co. Inc., New York, 2001.
4. Technical Support Document: Derivation of Proposed Primary and Secondary Drinking Water Standards for Methyl tert-Butyl Ether in New Hampshire Drinking Water Supplies. N.H. Department of Health and Human Services, Office of Community and Public Health. February, 2000.