

MTBE

(methyl tertiary-butyl ether)



Fact Sheet

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY - STORAGE TANK DIVISION

Recently, there has been increased public interest in information on MTBE. The interests include its use, occurrence in the environment, and potential to cause harm. MTBE has been and continues to be the subject of many investigations and reports. What is generally known about MTBE is summarized in this Storage Tank Division fact sheet.

What is MTBE?

MTBE belongs to a class of chemical compounds known as ethers. MTBE is a fuel additive made by combining isobutylene, a hydrocarbon refined from crude oil, with methanol, which is derived from natural gas.

How is MTBE used?

Since 1979, MTBE has been used in some regions of the United States as an octane-enhancing replacement for lead and to increase the oxygen content of gasoline. Concentrations of MTBE in reformulated gasoline range from 2 to 15 percent. The Michigan Department of Agriculture (MDA) reports that 4 percent of all the Michigan fuel tested in 1999 had MTBE added as an octane booster. MTBE content of those fuels is generally 6 percent or less. It is also used in other areas in the country at higher concentrations to raise the oxygen content of gasoline.

MTBE and EPA's Clean Air Program

The U.S. Environmental Protection Agency (EPA) initiated the Oxygenated Fuel (Oxyfuel) and Reformulated Gasoline (RFG) Programs in 1992 and 1995, respectively, to meet requirements of the 1990 Clean Air Act Amendments (CAAA).

The Oxyfuel Program requires 2.7 percent oxygen (by weight) in gasoline during fall and winter months to reduce carbon monoxide emissions. To meet this requirement, gasoline producers must use oxygen containing compounds termed "fuel oxygenates" (e.g., ethanol, MTBE). When MTBE is used to meet the Oxyfuel requirements, it is added at a concentration of approximately 15 percent (by volume) to gasoline.

The RFG Program requires 2 percent oxygen (by weight) year-round in the most polluted metropolitan areas to reduce ozone and smog. When MTBE is used to meet the RFG requirements, its concentration in gasoline is 11 percent (by volume).

Why put more oxygen in gasoline?

In certain cars, mostly older ones, higher octane and more oxygen in gasoline results in more complete burning of fuel, reducing carbon monoxide emissions, a goal of the Clean Air Act. In addition, MTBE is a key ingredient in satisfying the mandated oxygenate requirements for the RFG. RFG reduces hydrocarbon emissions and oxides of nitrogen that contribute to summertime smog. Michigan does not require the use of RFG.

What is the composition of fuels sold in Michigan?

In 1996, Michigan began enforcing a summertime fuel requirement to control ozone levels. Low-vapor pressure fuels were required to be sold between June 1 and September 15 in seven southeastern Michigan counties. Refiners supplying gasoline to Michigan have opted to meet the low-vapor pressure requirement by removing some of the more volatile compounds of gasoline rather than supplying RFG containing MTBE or other oxygenates.

Gasoline fuels are transported into the state primarily through pipelines and by barges from refineries located south of Michigan, principally in Ohio, Indiana, and Illinois. There is one refinery in Michigan. Tanker trucks transfer gasoline from one of the many petroleum terminals located around the state to local service stations.

The MDA collects random samples of fuels sold in Michigan throughout the year to analyze fuel composition. Ethanol and MTBE were the only two oxygenates identified in the fuels sampled in 1998. According to the MDA, 8 percent of the fuels sampled in Michigan in 1998 contained ethanol. The ethanol content ranged from 9 to 10 percent by volume. Only 5 percent of the fuel samples collected in Michigan contained MTBE. Only a very small fraction of the fuel samples containing MTBE exceeded a concentration of 12 percent by volume. The MDA indicated that low concentrations of MTBE, below 2.2 percent by volume, are probably due to small amounts of lingering MTBE fuels in the pipeline getting commingled with the next fuel to be transported. The MTBE at levels higher than 2.2 percent by volume in Michigan fuels are primarily found in the premium blends as an octane enhancer. Fuels containing MTBE are not confined to a specific geographic area, but are found throughout the state.

Has MTBE been detected in the environment?

The Michigan Department of Environmental Quality (MDEQ) has identified MTBE as a contaminant at several gasoline release sites in the state. However, benzene, a common gasoline component, is most often the contaminant of concern in gasoline because of its relatively high solubility and its known carcinogenicity. MTBE is difficult to trace in water and soil samples because it dissolves very easily in water and does not adhere to soils. MTBE is extremely mobile in the environment and its concentration is diluted as it is transported. The MDEQ Storage Tank Division (STD), maintains a comprehensive database of all regulated aboveground and belowground petroleum storage facilities. The database records all releases reported from regulated underground facilities and reports must be filed with the STD on the nature and extent of contamination. These reports include monitoring for the common petroleum contaminants (*i.e.*, benzene, toluene, xylene, etc.) including MTBE. These reports are available at the STD offices.

The MDEQ has criteria for determining whether remediation is necessary when MTBE is present. The health-based concentration for residential use is 240 parts per billion (ppb) of MTBE. Drinking water samples with MTBE concentrations exceeding 240 ppb may pose a health risk. In

comparison, the health-based criteria for benzene is 5 ppb. Although MTBE is known to be less toxic than many gasoline constituents, including benzene, it also has a much lower taste and odor threshold with a pungent unpleasant smell. Therefore, the MDEQ has also established an aesthetic drinking water concentration of 40 ppb. Aesthetic criteria established levels are protective of taste and odor thresholds. Since the aesthetic criteria are significantly lower than the health-based criteria, a person should taste or smell MTBE long before MTBE poses a health risk.

The MDEQ Surface Water Quality Division conducted two preliminary studies in 1999 to assess the presence of MTBE in several of Michigan's lakes and rivers. No MTBE was present in any of the samples analyzed. Continued monitoring for MTBE will be conducted this year. In addition, MTBE usage will continue to be tracked to determine what additional monitoring may be necessary.

Has MTBE been detected in drinking water?

The MDEQ's Drinking Water and Radiological Protection Division (DWRPD) tests water quality in public community wells, public non-community wells (*i.e.*, hospitals, schools, and libraries), and private water wells. This responsibility for monitoring the quality of public drinking water is separate from the state cleanup program. The DWRPD has been compiling data on MTBE since 1987. The DWRPD, Water Analysis Section, analyzed 31,557 water samples from 18,046 community, non-community, and private water wells between October 1, 1987, and September 30, 1999. Of this total, 903 samples from 542 locations were positive for MTBE. This represents 3 percent of the total number of samples analyzed for MTBE.

The DWRPD uses the same MDEQ criteria to evaluate the potential hazard of MTBE detected in drinking water samples. Of the 3 percent of samples that were positive for MTBE, 29 samples (3.1 percent) were greater than 240 ppb, 82 samples (9.1 percent) were between 40 ppb and 240 ppb, and 792 samples (87.8 percent) were between 1 ppb and 40 ppb. MTBE was not detected in 30,654 samples (97 percent). These tests indicate that MTBE was not found in many drinking water wells. Additionally, where MTBE was detected, it is predominately found in low concentrations.

What are the health affects from MTBE?

Reports of adverse health effects from inhaling fumes at a gas station have not been validated by scientific studies to date. In areas using MTBE-oxygenated fuels or RFG, consumers have complained of headache, nausea, dizziness, and eye or throat irritation while they were refueling their cars. Scientific studies of these complaints have been unable to detect any increase of symptoms above the rate normally experienced by consumers as they pump gasoline (*i.e.*, background). Consumers have been unaware that MTBE has been used in gasoline for years as an octane enhancer. The EPA continues to conduct studies on the potential health effects of MTBE.

Public concerns have also been expressed about the detection of MTBE in groundwater and in some drinking water supplies. MTBE is highly mobile in the environment and is assumed to move at the same rate as water in soils. Thus, MTBE can migrate very quickly to groundwater. Still, concentrations detected in groundwater tend to be below the taste and odor threshold of 40 ppb. In 1997, the EPA issued a Health Advisory to guide the response of public drinking water authorities when MTBE is detected in their water supplies. In 1998, the EPA added MTBE to the list of chemicals requiring further investigation of its occurrence in the nation's drinking water supplies and potential health effects.

The EPA has launched an extensive research agenda to investigate the occurrence and impact of MTBE and other fuel oxygenates on water resources. The research agenda will characterize sources; environmental occurrence, transport and fate; exposure and toxicity; and remediation methods. Other government and private agencies are also investigating MTBE and other fuel oxygenates, including the U.S. Geological Survey, the independent Health Effects Institute, Rutgers University, the University of California, and the petroleum industry.

What is Michigan doing to prevent the spread of MTBE in Michigan?

In response to a growing nationwide public health and environmental concern about groundwater contamination from MTBE, the EPA formed a Blue Ribbon Panel (Panel) in November 1998, to investigate concerns associated with MTBE and other gasoline additives. The findings of the Panel were released in July 1999. Michigan has already implemented several of the recommendations of the Panel including accelerated enforcement to upgrade substandard gasoline underground storage tanks (USTs), strengthening release detection requirements, installation of double-walled tanks near drinking water wells, establishing cleanup criteria for MTBE in groundwater, and the monitoring of MTBE in the groundwater at all UST release sites. The STD has required the monitoring for MTBE at UST release sites for more than four years and, where those levels exceed safe criteria, have taken action to address those sites.

Michigan is not required to use gasoline reformulated with MTBE, like some of the western and northeastern states that have serious ozone-related air pollution problems. Our research has shown, however, that MTBE is an incidental additive to gasoline distributed in Michigan. The MDA will continue to monitor the use of all oxygenates used in the fuel to ensure they do not exceed federal and state standards. We have and will continue to require sampling of groundwater for MTBE contamination. Sampling results for MTBE to date have not identified any significant threat to public health or the environment in Michigan. The MDEQ and the MDA will continue to take a leadership role and work with the petroleum distribution and marketers to address this issue.

Where can I get more information on MTBE?

A vast amount of information on MTBE is available on the World Wide Web. Several federal agencies have posted reports and fact sheets on their Internet sites including, the EPA, the U.S. Geological Survey, and the Congressional Research Service. Several states have posted reports including California, Maine, and New Jersey. The petroleum industry has also posted a considerable amount of information on MTBE. If you are interested in the findings and recommendations of the Blue Ribbon Panel, this document can be found on the EPA Office of Underground Storage Tanks website at: <https://archive.epa.gov/mtbe/web/html/storage.html>.