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TECHNICAL BULLETIN

HEALTH EFFECTS INFORMATION

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ENVIRONMENTAL TOXICOLOGY SECTION

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Methyl Tertiary Butyl Ether (MTBT)

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SYNONYMS

Methyl tertiary butyl ether; *tert*-butyl methyl ether; *t*-butyl methyl ether; 2-methoxy- 2-methylpropane; methyl *t*-butyl ether; methyl 1,1-dimethylethyl ether; 2-methyl- 2-methoxypropane.

USES

MTBE is a chemical that has been added to gasoline at low concentrations (2-7% by volume) since the late 1970s to increase octane. Since 1990, higher MTBE concentrations (up to 15%) have been used in some areas to meet requirements of the Clean Air Act (CAA). MTBE is an "oxygenate" that promotes more complete burning of gasoline, thereby reducing engine emissions of ozone and carbon monoxide. While other oxygenates (such as ethanol) can be used, MTBE has generally been the most popular because of its low cost, ease of production, and blending characteristics.

In Oregon, MTBE has been used in gasoline at low concentrations as an octane booster. Although oxygenated fuels have been required in a few areas of the state, ethanol rather than MTBE has been used. A small percentage of Oregon gasoline may contain higher MTBE concentrations because the gasoline originated in a state like California, where MTBE has been used extensively as an oxygenate.

The Environmental Protection Agency (EPA) recently proposed a rule that would limit or eliminate use of MTBE as a fuel additive.

CHEMICAL AND PHYSICAL PROPERTIES

MTBE is a colorless, volatile liquid that is very soluble in water. It has an unpleasant, turpentine-like taste and odor and can be detected at low concentrations by most people. Although the low taste threshold for MTBE can be useful as an indicator of its presence, people vary in their ability to detect MTBE and the taste of MTBE can be masked by other natural or water treatment chemicals.

HOW DOES MTBE ENTER THE ENVIRONMENT?

MTBE is a common contaminant of groundwater and surface waters. A national study conducted by the U.S. Geological Survey detected MTBE in 21% of groundwater samples in areas where MTBE has been used to meet requirements of the CAA. In Oregon, a recent Department of Environmental Quality (DEQ) groundwater survey of areas impacted by gasoline found MTBE at half the sites

tested, with 48% having one or more samples with levels above 20 micrograms per liter (DEQ's current MTBE target cleanup level).

Most groundwater contamination of MTBE is caused by releases from point sources, including gasoline spills, leaking fuel tanks and pipes, and improper disposal of old gasoline. MTBE contamination of surface water supplies like lakes and reservoirs occurs through atmospheric precipitation, urban runoff, and exhaust from motorboats and other watercraft.

WHAT HAPPENS TO MTBE IN THE ENVIRONMENT?

MTBE will quickly evaporate from open containers and from soil exposed to the air. In the air, MTBE rapidly breaks down to other chemicals. Atmospheric MTBE and its breakdown products can return to earth by precipitation.

Because of its high water solubility and small molecular size, MTBE can move rapidly through soils to groundwater. Once in groundwater, MTBE can travel faster than other gasoline chemicals. MTBE is resistant to degradation and can remain in groundwater for a long time. Because MTBE can move faster in groundwater and is more resistant to biodegradation than other gasoline chemicals, it is possible for MTBE to be present when BTEX (benzene, toluene, ethylbenzene, xylenes) and other gasoline constituents are not detected.

HOW CAN PEOPLE BE EXPOSED TO MTBE?

People can be exposed to MTBE in the air when they are fueling cars and from car and watercraft exhaust. They can also be exposed to MTBE in groundwater through ingestion of contaminated drinking water or by skin absorption and inhalation of volatilized MTBE while showering and bathing.

WHAT ARE THE HEALTH EFFECTS OF MTBE?

People exposed to high concentrations of MTBE in the air while fueling cars have reported respiratory irritation, headaches, dizziness, and nausea. Studies of laboratory animals exposed to high doses of MTBE have found effects on the central nervous system, liver, and kidneys. MTBE has also been shown to cause cancer in rats and mice. The Environmental Protection Agency (EPA) has determined that MTBE is an animal carcinogen and a possible human carcinogen.

The effects of long-term exposure of humans to low levels of MTBE in drinking water are not known. Most of the animal studies conducted with MTBE have

involved exposure to high MTBE concentrations in air and it is not known what relevance these results have for evaluating potential health risks to humans exposed to low concentrations of MTBE in drinking water.

DRINKING WATER STANDARDS

There is currently no federal drinking water standard for MTBE. In 1997 EPA issued a nonenforceable MTBE drinking water advisory of 20-40 micrograms per liter (equivalent to parts per billion, or ppb), based on taste and odor thresholds. EPA believes this level will provide a large margin of safety for toxic effects. MTBE has been included in EPA's Unregulated Contaminant Monitoring Rule, which requires testing for MTBE by certain water systems starting in 2001. MTBE has also been placed on EPA's Drinking Water Contaminant Candidate List, which is a list of chemicals that might occur in public water systems and may require regulation under the Safe Drinking Water Act. For the next several years, EPA will be gathering information on MTBE occurrence, treatment techniques, and health effects as part of its regulatory decision-making process. EPA intends to set a secondary drinking water standard (nonenforceable) for MTBE by the end of 2000.

Several states have adopted drinking water standards or guidelines for MTBE, with levels ranging from 5 to 240 ppb. California has an MTBE primary drinking water standard of 13 ppb and a secondary standard (based on taste and odor) of 5 ppb. Oregon has not developed a state drinking water standard for MTBE.

The Department of Human Services's Drinking Water Program is recommending that all water providers in Oregon test for MTBE.

REMOVAL OF MTBE FROM DRINKING WATER

Because of its high water solubility, resistance to biodegradation, and poor adsorption to activated carbon, MTBE is difficult and expensive to remove from groundwater. Standard water treatment methods such as air stripping, granular activated carbon (GAC) adsorption, and ozonation have limited effectiveness for removal of MTBE.