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MtBE in Drinking Water[1]

What is MtBE?

MtBE is the abbreviation for the compound methyl tertiary butyl ether. This compound is a colorless liquid at room temperature and pressure. MtBE is a manmade material and thus its presence in water would indicate that manmade contamination exists in the recharge area of the well. MtBE degrades very slowly, is highly soluble in water, has a very small molecular structure, and has very low taste and odor thresholds.

Where Is MtBE Used?

MtBE increases the octane rating of gasoline and reduces air pollution by also increasing the gasoline's oxygen content. It was first introduced into gasoline in the early 1980s as lead was removed. The 1990 Clean Air Act Amendments required the reformulation of some gasoline. This requirement prompted an increase in the percentage of MtBE used in gasoline in the New England area currently to approximately 11 percent. There are few other uses of MtBE in normal commerce or industry.

What are the Health Effects?

The U.S. Environmental Protection Agency (EPA) has not set a formal **health-based** drinking water standard for MtBE in the federal Safe Drinking Water Act (SDWA). The N.H. Department of Health and Human Services, Bureau of Health Risk Assessment (BHRA) has recently developed a health-based drinking water standard for MtBE of 13 micrograms per liter (ug/L) for community public water systems. DES plans to adopt that value as a maximum contaminant level (MCL) in New Hampshire's Safe Drinking Water Act Program during the spring of 2000.

Studies with animals suggest drinking water with high levels of MtBE may cause stomach irritation, liver and kidney damage, and nervous system effects. An increased amount of liver and kidney cancer was found in rats and mice breathing high levels of MtBE. Because of the animal studies on MtBE, the BHRA considers MtBE a possible human carcinogen. A health information summary for MtBE can be obtained by calling BHRA at 271-4664.

The EPA's public water supply program has recently made a nonhealth-based recommendation to limit MtBE in drinking water to 20-40 ug/L. This recommendation is based on preventing taste and odor complaints. MtBE has a very low odor threshold at 20 ug/L, while the threshold for taste is 40 ug/L.

1. The material contained in this fact sheet was excerpted from the New Hampshire Department of Environmental Services web site (http://www.des.state.nh.us/ws.htm).

Assistance from DES

If you have MtBE in your water supply, DES may be able to provide assistance to you in two areas.

1. DES may assist in identifying the origin of the contamination. Please call the DES Oil Remediation and Compliance Bureau at 271-3644 concerning this assistance.
2. New Hampshire has special funds which may be able to provide financial assistance to abate pollution from hydrocarbon contaminants, such as from heating oil fuel or gasoline that includes MtBE. Information regarding these funds is contained in the Petroleum Reimbursement Funds information packet. These funds are also administered by the DES Oil Remediation and Compliance Bureau.

How Can MtBE be Removed from Drinking Water?

Unlike many other constituents associated with hydrocarbons, MtBE is difficult to remove from water. There are generally three treatment methods that have been shown to be effective in removing general hydrocarbon organics from drinking water. They are aeration, adsorption using activated carbon, and oxidation. These treatment methods are discussed below.

If the concentration of the contaminants is high, two treatment units (typically using different methods) are often installed. The first device is used to remove the "heavy" contaminant load while the second provides a "polishing step" to assure full removal of the contaminant(s) and to address "breakthrough." Aeration is often the first method used while activated carbon is often used as the polishing step.

A treatment system should not be purchased until sufficient water quality testing has been done to identify all the following:

1. The short-term variability of the contaminant(s).
2. Whether the contaminant concentrations are rising or falling over the long term.
3. What other contaminants are in your general area and how many are predicted to affect your well in the future.

If contaminants are present in a **pure product** state in the well, a recovery method is also necessary. This will reduce the size of the water treatment equipment needed.

Activated Carbon Treatment: Advantages and Disadvantages

Activated carbon has enormous surface area within each granule. One pound of activated carbon has a surface area greater than the size of a football field. Activated carbon is a material that attracts many types of organic contaminants to its surface. Once the removal capacity of the carbon is used up, then it may be returned to the manufacturer for rejuvenation (for very large users) or can be disposed of appropriately for smaller situations.

If activated carbon is used, the radon and mineral radioactivity concentrations of the water should be determined. Activated carbon concentrates radioactivity, potentially creating a low level radionuclide waste and possible source of increased radiation within the home. Activated carbon can also foster the growth of bacteria by concentrating other organics (such as food sources) on its surface. A final concern with activated carbon is the possible release of contaminants after they have been initially adsorbed.

This action is known as desorption or dumping. This could occur if other ambient water quality characteristics change.

To address breakthrough and desorption, the overall amount of activated carbon could be divided into two treatment tanks and the two devices installed in "series." In such an arrangement any breakthrough from the first unit can be adsorbed by the newer carbon in the second unit. The advantage of activated carbon treatment compared to other methods is that the water does not need to be repressurized and is less likely to become contaminated by dust and other airborne contaminants. The disadvantage is that carbon attracts organic matter from the water and thus typically supports an elevated level of bacteria on its surface.

Aeration Treatment: Advantages and Disadvantages

Aeration treatment consists of passing large amounts of air through the contaminated water. The efficiency of the device is improved by breaking up the bulk of the water into many small droplets. The goal is to allow the contaminants to volatilize into the air. When aeration is used, two operational problems are possible:

1. If there are elevated levels of iron or manganese in the water, rusty precipitate staining of fixtures and clothing is likely. Iron/manganese pretreatment may be necessary.
2. Bacterial slime may grow in aerators requiring continuous or periodic chlorination. The advantage of aeration is that there is no disposal or regeneration of the treatment media necessary.

OTHER POSSIBLE TREATMENTS OF MtBE

New methodologies still in the trial or experimental stage at the time of this publication include:

Oxidation Treatment: Advantages and Disadvantages. Certain organic contaminants will chemically react with oxygen and oxygen-like compounds. After the oxidation treatment, the resultant compounds may be fully neutralized, may have a lower level of hazard, or be more amenable to treatment by other means. Further treatment may still be necessary, however. Oxidizing chemicals could include potassium permanganate, ($KMnO_4$), hydrogen peroxide (H_2O_2), ozone (O_3) and sodium hypochlorite (NaOCl).

UV Destruction. One newer treatment technique, which is now being evaluated, is the use of ultraviolet radiation to break down MtBE. This treatment would then be followed by either hydrogen peroxide or ozone to oxidize the by-products of the UV breakdown. Presently, there are few instances of this treatment and thus costs and operational effectiveness are still being determined.

Monitoring Program After Installation of a Treatment System

Periodic laboratory testing should be done of both the raw and finished water to determine treatment effectiveness. The frequency of this monitoring would be determined based on variability and duration of the past sampling record and other site-specific conditions. Where activated carbon is used, the carbon will lose its removal capacity and will need to be replaced in time. A monitoring program will be needed to predict the expected longevity of each new carbon recharge.

TESTING YOUR WATER

EAI Analytical Labs will provide you with your free water testing kit containing: sample bottles, detailed sampling instructions and a tracking form. Bacteria samples bottles are distributed pre-sterilized and all sample bottles contain their necessary preservatives. Kits are available for pickup or they can be mailed to you. If you are interested or have any questions regarding the analysis of your water, please give us a call.