

A Multimedia Issue: *Methyl tertiary butyl ether (MTBE)*

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MTBE – How a Chemical Intended to Clean the Air Has Contaminated the Water

Methyl tertiary butyl ether (MTBE) is a multimedia issue, affecting both air and water quality. Since the 1990s MTBE has been an effective tool in helping to reduce vehicle emissions and clean the nation's air.



MTBE is providing clean air benefits; however, it is also being found in drinking water supplies throughout the country. The causes of this contamination are often associated with leaking underground storage tanks (UST) and spills. The majority of MTBE detections are at low levels, although contamination at high concentrations does occur. MTBE's presence in the environment at any level, and the resulting public concern, has brought up the issue of how to keep the clean air benefits of MTBE while preventing the potential threats to drinking water supplies. As a result, numerous state, local, and federal governments are taking action to address this contaminant.

Background

MTBE is a chemical compound used as a fuel additive to increase the oxygen content in gasoline. First introduced in the late 1970s to replace lead as an octane enhancer, it has been

used in increasing quantities to meet the 1990 Clean Air Act (CAA) Amendments requirement that oxygenated gasoline be used in areas with unhealthy levels of air pollution. Since 1995, the CAA requires reformulated gasoline (RFG) year-round in cities with severe ozone problems. RFG must contain 2% oxygen by weight, and MTBE is the primary oxygenate used by refiners to meet this requirement because of cost and its blending characteristics. Approximately 30% of the country's gasoline is reformulated gasoline, of which about 87% contains MTBE. In addition to the RFG program, the CAA also requires the establishment of the Wintertime Oxygenated Fuel Program. Under this program, gasoline must contain 2.7% oxygen by weight during the cold months in cities that have elevated levels of carbon monoxide due to increased emissions from cold vehicles. Ethanol is the primary oxygenate used in this program, but in some cases MTBE is used to fulfill this requirement.

While MTBE does provide clean air benefits, it is showing up increasingly in drinking water supplies. These releases of MTBE to ground and surface waters occur in a number of ways. Leakage from underground gasoline storage tanks is a major source of contamination, although spills, and emissions from marine engines into lakes and reservoirs contribute to the contamination. Sources of low-level contamination are often associated with stormwater runoff and air deposition. Its chemical characteristics of high solubility in water, resistance to biodegradation, and ability to move quickly in the subsurface cause MTBE to stand apart from other gasoline

constituents. Treatment of drinking water sources contaminated by MTBE is possible, but it is often difficult and expensive compared to other gasoline components.

Effects of MTBE

MTBE also poses other challenges concerning its health and organoleptic (taste and odor) effects. Although there have been a number of studies completed on the inhalation effects of MTBE, there are no studies on the ingestion effects of MTBE in drinking water. At high doses via the inhalation route, MTBE has caused non-cancer health effects and tumors in laboratory animals. There are a number of studies underway to better characterize the health effects of MTBE through the ingestion route. EPA is currently awaiting the results of a pharmacokinetic study that will be used to assess health risks via different routes of exposure. These studies will allow for extrapolation from the inhalation studies to an assessment of risks associated with the ingestion of drinking water. Additionally, MTBE's offensive taste and odor can render drinking water supplies unusable at concentrations as low as 20 to 40 parts per billion (ppb).

Occurrence

There have been scattered incidents of localized water contamination by MTBE, but the U.S. Geological Survey (USGS) National Ambient Water Quality (NAWQA) program was the first to indicate the possibility of widespread occurrence. MTBE was reported by USGS as the second most frequently detected VOC in ambient

groundwater (Squillace et al. 1999). Other occurrence data from the joint U.S. Geological Survey/EPA 12 Northeastern state study show that MTBE was detected in 7.8% of public drinking water supplies at a detection level of 1.0 ppb (Grady 2000). This study analyzed finished drinking water samples from 2,110 randomly selected community water systems.

In surface water, sampling at surface water reservoirs by the East Bay Municipal Utility District, California, resulted in a detection of less than 5 ppb, in November 1996 in San Pablo Reservoir (Tikkanen and Sykes 2000). Continued sampling on the reservoir at various locations and depths, resulted in 155 detections out of 196 samples of MTBE at concentrations as high as 8 ppb. For sampling from November 1996 to March 2000, increases in MTBE detection concentrations can be correlated to motorized boating activity. Once activity ceased, concentrations typically dropped to non-detect levels. In other surface water monitoring from reservoirs in the Santa Clara Valley Water District, California, MTBE concentrations from November 1996 to August 2000, ranged from nondetectable levels (>0.5 ppb) to levels as high as 24 ppb (Santa Clara Valley Water District 2000). Most of the higher concentrations occurred during the spring and summer boating months, with levels dropping off during the non-boating season.

Although the current data suggest contamination at low levels (typically below EPA's drinking water advisory level of 20 parts per billion [ppb]), there are a limited number of detections at higher levels. For example, in 1996 the City of Santa Monica, California discovered that two of its drinking water well fields, Charnock and Arcadia, were contaminated with MTBE at levels as high as 610 ppb and 86 ppb respectively. In response, the two well fields, representing 50% of the city's drinking water supply were shut down and the City began purchasing replacement water. After completing investigations of the area, leaking underground storage tanks were identified as contributing to the contamination of the drinking water supply.

EPA's Actions on MTBE

The Agency is acting on several fronts to address the MTBE issue. In response to the growing concern about MTBE, in January of 1999, Administrator Browner established a group of leading professionals in the automotive, health, and water utilities industries, and local and state officials to look at the issues surrounding MTBE. This blue-ribbon panel met for six months and in July 1999, released a report with their findings and recommendations. The panel recommended a substantial reduction in the use of MTBE. They also recommended that EPA remove the oxygen mandate, which currently requires reformulated gasoline (RFG) to contain 2% oxygen by weight. The panel concluded that these actions would allow more flexibility for refiners while maintaining air quality, and reducing the use of MTBE. Another recommendation of the panel included encouraging EPA to coordinate with states and localities to enhance their efforts to protect lakes and reservoirs that serve as drinking water sources by restricting the use of recreational watercraft and older two-stroke engines.

At this time, the Agency currently does not regulate MTBE in drinking water.

On March 20, 2000, the Agency released a legislative framework which, if fully adopted, will significantly reduce or eliminate MTBE while preserving the clean air benefits of the reformulated gasoline (RFG) program. This framework encourages immediate Congressional action to reduce or eliminate MTBE and promote consideration of renewable fuels like ethanol as a potential oxygenate.

As the Agency works with Congress to craft legislation addressing MTBE, it is also pursuing other avenues to reduce or eliminate MTBE at the source. On March 24, 2000, an

advanced notice of proposed rulemaking was published in the Federal Register (65 FR 16094) indicating EPA's intent to issue a rule under Section 6 of the Toxic Substances Control Act (TSCA) to either require the reduction or ban the use of MTBE in gasoline. The Agency believes the current use of MTBE as a gasoline additive poses an unreasonable risk to the environment. This is due to the number of public drinking water supplies that have been shut down because of concern about drawing MTBE plumes into their wells, taste and odor acceptability for consumers, and unknown health effects.

In December 1997, EPA issued a *Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary Butyl Ether (MTBE)*. This advisory recommends that keeping concentrations of MTBE in the range of 20 to 40 ppb or below in water will likely avert unpleasant taste and odor effects. The advisory notes that some more sensitive members of the population may detect MTBE below this range. Keeping MTBE below these levels should also protect against adverse health effects. These concentrations are about 20,000 to 100,000 times lower than the range of exposure levels in which cancer or non-cancer effects were observed in rodent tests. This margin of exposure is in the range of margins of exposure typically provided to protect against cancer effects by the National Primary Drinking Water Standards under the Safe Drinking Water Act (SDWA).

At this time, the Agency currently does not regulate MTBE in drinking water. SDWA's criteria to regulate a contaminant states that National Primary Drinking Water Standards must be based on known adverse health effects, whether it will occur at levels posing a threat to public health, and if it presents a meaningful opportunity for health risk reduction. As a means of fulfilling these criteria, the Agency has developed the Contaminant Candidate List (CCL). The CCL helps the Agency prioritize drinking water contaminants, by listing contaminants known or anticipated to occur in drinking water. It centers on contaminants posing the greatest risk and focuses and defines ➡

Non-EPA Actions to Address MTBE

Other actions are on-going as well, particularly within states and local governments. A number of states have established drinking water standards for MTBE and, in the instance of California, banned the use of MTBE beginning at the end of 2002.

While the states and EPA work to handle MTBE through regulatory action, there are a number of other ways MTBE can be addressed. For example, focus needs to shift to sources of drinking water, such as lakes and reservoirs, and what preventative action can be taken. States are currently working on Source Water Assessments, which includes the delineation of the area to be protected and an inventory of the potential contaminants within that area, however, proper guidance for marine owners and boating users are critical to prevent further contamination