MTBE in gasoline

MTBE faces a ban in the USA—can its use in Europe still be justified?

The abbreviation MTBE refers to methyl tertiary butyl ether—a volatile, water-soluble, oxygen-containing, colourless liquid with an ethereal odour. In Europe, it is used mainly to boost octane rating, especially in unleaded and lead-replacement grades. It is being used in increasing amounts to compensate for octane rating lost with the reduction of benzene, aromatics and olefin contents of gasoline and the phase-out of leaded gasoline which are required by new EU fuels legislation.

MTBE is one of a number of oxygenated compounds (including other ethers and alcohols) which can be used in gasoline. EU Directive 98/70/EC permits gasoline to contain up to 15% v/v MTBE. In fact, although the use of MTBE is widespread, the concentrations used in Europe are nearly always much lower than this, on average approximately 2–3% v/v.

Although MTBE has been used in gasoline for some years, its use was first publicized widely when reformulated gasoline, designed to reduce carbon monoxide (CO) emissions, was mandated over large areas of the USA. Subsequently, MTBE has been found in drinking water supplies and in groundwater wells. This, together with the contamination of Lake Tahoe (also a drinking water resource) by watercraft using 2-stroke fuel, led the Governor of California to announce a year ago a phase out of the use of MTBE by end 2002. The concerns over the use of MTBE have been largely supported by a Blue Ribbon Panel set up by the US EPA who, on 20 March, took the first steps towards restricting its use. It is expected that these decisions will prompt public debate in Europe over the use of MTBE in gasoline, and CONCAWE member companies will participate constructively in dialogue with interested parties in order to determine the best way forward.

Extensive studies have been carried out to determine the health effects of MTBE. Reviews of these studies include a CONCAWE report (no. 97/54) which concludes that 'MTBE has a low order of acute toxicity, and is not teratogenic, mutagenic, neurotoxic, nor a reproductive toxicant.' Subsequently, the International Agency for Research on Cancer (IARC) has reviewed the carcinogenicity data on MTBE and concluded that there was a lack of evidence to justify any classification as a human carcinogen.[1]

Concerns about water supplies arise because the odour and taste thresholds of MTBE are low. In December 1997, the US EPA Office of Water released the document *Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on MTBE,* which recommends that MTBE concentrations less than 20 to 40 microgrammes per litre (µg/l or ppb) would not normally give rise to unpleasant taste and odour effects for a large majority of people. It also concludes that there is little likelihood that these MTBE concentrations would cause adverse health effects because they are tens of thousands of times lower than the range of exposure levels that caused observable health effects in animals.

The most common ways that MTBE enters the environment are by accidental releases of gasoline containing MTBE and use of gasoline two-stroke-powered watercraft. Spills can occur at all

[1] *Carcinogenicity data include disputed cancer claims based on non-standard animal tests and partly published work.*

stages of the manufacturing/distribution system but leaks from underground storage tanks at retail sites, storage tanks and operations at distribution depots, and product pipelines give rise to the most concern. Two-stroke engines emit unburned fuel from their exhausts, which in the case of watercraft results in MTBE dissolving in the water.

In the case of filling stations, standards for storage tanks, site design, and leak monitoring continue to improve, with many sites rebuilt in recent years. Double-skinned tanks, leak detection, leak-proof pavements and reconciliation of volumes are being used to improve containment and monitor for leaks. Nevertheless, the volumes of MTBE that could give rise to problems are very small—perhaps a single overfill—and total containment is unlikely to be achievable without radical redesign.

MTBE is much more soluble in water (43 g/l) than gasoline hydrocarbons (e.g. benzene at 1.8 g/l is one of the most soluble); biodegrades only slowly (and perhaps not at all in the absence of air); and is only weakly adsorbed on soil particles. MTBE therefore tends to persist in groundwater, to travel further and faster through the ground than hydrocarbons and is likely to be present in higher concentrations. The properties of MTBE also make it more difficult to treat if it contaminates soil or water. The difference is mainly one of degree—contamination has been remediated using similar techniques to those used in normal gasoline clean-up, but it is more costly.

Although MTBE is resistant to biodegradation, it does slowly degrade given sufficient air, nutrients and suitable bacteria. If necessary, naturally-isolated bacteria can be grown in the laboratory and introduced to the contaminated site or used in a biotreater. Given the appropriate conditions, MTBE can be degraded. Biodegradation in the absence of air has not been confirmed, although in an eight-year experiment 90 per cent disappeared. Many authorities now accept natural remediation of spills and leaks of gasoline containing the aromatics benzene, toluene, ethylbenzene and xylene (BTEX) as appropriate, but not in the case of MTBE.

As MTBE is volatile, some will evaporate into the atmosphere during distribution and use. Small amounts are also emitted from four-stroke vehicle exhausts. Any MTBE emitted degrades in the air, so concentrations in the atmosphere remain low. But, because of its solubility in water, some MTBE will be washed out by rain and enter surface and shallow ground waters. As a result, MTBE can often be detected in shallow ground waters at concentrations of less than 1 µg/l.

To sum up, MTBE in gasoline can pose problems, but given its low toxicity it does not pose a direct health threat. It will be found at low concentrations in many environmental compartments, but will not accumulate if sufficient air is available. Where higher levels exist from accidental spills, methods are available to treat them. The question is whether the benefits of continuing to use MTBE in gasoline outweigh the odour and taste effects on water resources, or whether a phase out, as seems likely in the USA, is justified. The oil industry cannot answer these questions alone, not least because no short-term alternative appears to be acceptable to all parties. A constructive dialogue is therefore required between the key parties concerned in order to determine the best way forward.