fears. Science and industry alike are looking to the IARC study to provide a firm foundation for either assuaging public fears or enacting measures to protect against whatever health risks may come to light.

Lowering Water's Octane

Liquid carbon dioxide (CO_2) is a powerful solvent used for purposes such as extracting the peanut flavor from peanuts and decaffeinating coffee. Now, two scientist–entrepreneurs in Berkeley, California, say that it may also be the best way to remove the possibly carcinogenic fuel additive methyl tertiary butyl ether (MTBE) from groundwater.

Marc Sims, a chemical engineer, and his partner Jim Robinson, a molecular biologist, developed a device called PoroCrit that uses thin, microporous polypropylene tubes to expose the polluted liquid to pressurized liquid CO_2. Originally, the device was designed to extract food flavorings. Then, says Sims, "We realized just how similar MTBE is to all the flavor compounds that we were extracting."

PoroCrit works well on MTBE, says Sims, because the pollutant is about 100 times more soluble in CO_2 than it is in water. The membranous tubes in the device create over 50 m^2 of surface area through which the MTBE is drawn off through the micropores by the CO_2. The end result is cleaner, slightly carbonated water. Other water pollutants such as gasoline, benzene, and chlorinated solvents, which are also highly soluble in carbon dioxide, may also be removed from water by the device.

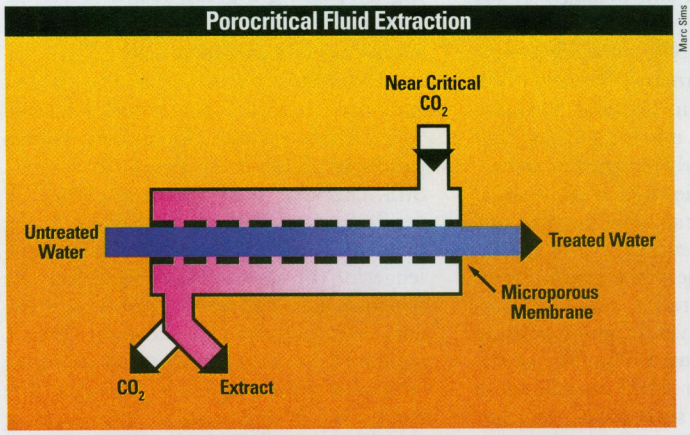
Originally introduced in 1979 as a way to boost the octane in gasoline, MTBE came into widespread use as a fuel additive because of its apparent ability to protect the public health by reducing automobile carbon monoxide emissions. In 1990, the Clean Air Act was amended to require the use of cleaner-burning fuels in areas with high carbon monoxide levels (those in nonattainment for National Ambient Air Quality Standards) in winter months. Oxygenated gasoline programs, including the use of MTBE, became the most popular means of meeting the new requirement. MTBE is currently found in about 25% of the gasoline used in the United States.

In 1996, however, it was discovered that the additive had found its way into the groundwater in Santa Monica, California, prompting the city to shut down half its water supply wells. Other studies found traces of MTBE in 5% of the wells across the United States. Scientists suspect that in most cases the chemical is released into the environment by leaking fuel storage tanks and is washed into wells by rainwater, which readily dissolves the chemical.

In December 1997, the EPA issued a health advisory alerting people to the possible danger of MTBE in water. The health effects of ingesting MTBE in the concentrations being found in drinking water are not known, but at high concentrations the chemical has been shown to cause cancer in animals. Even if the chemical does not pose a serious health risk, its strong taste and smell can seriously deteriorate the quality of the water in which it is found.

Once MTBE gets into water, it becomes very difficult to remove. MTBE is extremely soluble in water—about 30 times more soluble than benzene—and very resistant to biodegradation. Because it does not readily adsorb to soil particles (unlike other fuel constituents), it tends to travel with groundwater plumes, as fast as the water travels.

These characteristics of MTBE seriously hamper the effectiveness of traditional groundwater remediation techniques on the pollutant. Granular activated carbon filters, for example, do not work at all. Up until now, the best remediation technology for MTBE in water has been air stripping, an aeration technique in which MTBE concentrations of 20 parts per million (ppm) can be reduced to 10 ppm for about $16 per 1,000 gallons of water, including treatment of offgases. But Sims says his device can achieve much greater reductions in MTBE for around $5 per 1,000 gallons. And, he says, "It can be water that is saturated with MTBE, which is at [concentrations of] about 4%."



Marc Sims

Anti-MTBE membrane. A new process that uses a microporous membrane shows promise for removing MTBE from drinking water.

The biggest challenge facing the researchers right now is scaling the device up from something that was used to extract flavors to something that can handle huge plumes of polluted groundwater. The device they've developed will be most effective where the volume of polluted groundwater is low and the MTBE concentration is high. They are testing a pilot version that can handle a few liters of water per minute. "What we want is a device that can handle about 20 gallons of water per minute, and that is portable so that you can put it on the back of a truck and take it to the site," Sims says. "If you [treat] the contaminant upstream, you don't have to deal with as many gallons. What we want to do is treat water at the source."

New System for Seafood Safety

In April, the U.S. General Accounting Office (GAO) released a disturbing report entitled *Food Safety: Federal Efforts to Ensure the Safety of Imported Foods Are Inconsistent and Unreliable.* The GAO report charges that the Food and Drug Administration (FDA) inspects less than 2% of all food imports, including seafood imports, adding fuel to public concerns about food safety. Imports now account for more than 55% of total U.S. seafood consumption, according to U.S. Department of Agriculture statistics.

The criticism came several months into the FDA's switch to a new program for seafood safety, known as the Hazard Analysis and Critical Control Point (HACCP, pronounced "hassip") system. First developed in the early 1960s to ensure good quality food for U.S. astronauts, HACCP was put forward by the FDA in 1995 as a process for ensuring better food quality for all consumers. The program became mandatory for the seafood industry in December 1997.

HACCP focuses on preventing hazards rather than relying on spot-checks and random sampling of products to catch them later. Under the new system, each food processor and importer prepares a plan for identifying the points in their operations most vulnerable to health hazards, depending on the product. The plan also describes the plant's procedures for preventing problems at each control point—that is, each point at which a potential hazard can be averted (for example, refrigeration)—and for monitoring them.

"On a pound-for-pound basis, seafood