Method removes MTBE from water

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A researcher has discovered an effective way to remove a troubling new pollutant from our nation's water sources.
Pratim Biswas, The Stifel and Quinette Jens Professor of Environmental Engineering Science and director of the Environmental Engineering Science Program at Washington University in St. Louis, has found a method for removing the toxin MTBE from water. MTBE (methyl tertiary butyl ether) has been detected at low levels in municipal water sources around the nation and in several cases has made its way into citizens' tap water.
Biswas discovered that a nanostructured form of a compound called titanium dioxide causes MTBE to react with dissolved oxygen so that it yields the harmless gas carbon dioxide.

This reaction proceeds via oxidation of MTBE on the surface of the titanium dioxide to produce a harmful end product. Biswas then designed nanostructure configurations of this catalyst to optimally degrade the pollutant.

"These photo-catalysts can be powered by an artificial light source or can be designed to run on solar power," said Biswas.

Biswas presented his research at the American Chemical Society's annual meeting, held Aug. 23-25 in Philadelphia.

One of the researcher's innovations was developing a special micro-lamp (corona) that emits a glow after a current is run through it. But that's not all: This system also can be tailored to produce ozone, which speeds up

the oxidation of MTBE to carbon dioxide.

Biswas felt it was important to find a way to remove this pollutant because "[It] is a toxin and has been implicated as a carcinogen (cancer-causing agent)," he said.

Even more immediately obvious, the chemical's presence in water produces an offensive taste and a slight odor.

Problem of tank leakage

MTBE has been used in American fuels since 1979 -- even more so in recent years in California -- as an alternative to octane-enhancing lead additives because it helps fuel to be completely combusted. Thus, MTBE decreases the environmentally harmful byproducts of incomplete burning without containing the toxic element lead.

The one drawback is that MTBE can be harmful to human health, too, through exposure via groundwater sources.

"One doesn't know why, but underground gas tanks consistently leak, and this problem should really be taken care of," said Biswas.

Unfortunately, when gasoline leaks out, the MTBE is very soluble in water, and even localized leaks can allow MTBE to spread widely in a relatively short amount of time.

Biswas set out to design a compact unit for MTBE removal — and he succeeded. The original device was only 18 by six inches and held three to four gallons of water. The reactor removed all of the MTBE within a couple hours. Companies such as Salt Lake City-based Ceramatec have collaborated with him on scaling up the purifying unit, a process that he anticipates to be rather straightforward.

Biswas is optimistic that his technology can be used around the country to removed MTBE from water.

MTBE levels in gasoline started to increase after the Clean Air Act of 1990, which mandated lower levels of harmful emissions in car exhaust. MTBE seemed like the perfect alternative, and it wasn't until high levels were detected in a Santa Monica well in California in 1996 that people began to take notice of the pollutant.

The U.S. Environmental Protection Agency (EPA) has said that levels of the pollutant below 20 to 40 parts per billion (ppb) are considered non-toxic, but water with considerably lower levels of the toxin can be foul tasting.

Biswas discovered that titanium dioxide catalyzes the oxidation of MTBE , as a follow up on his work related to removing pollutants like mercury from coal combustion exhausts. He said that titanium dioxide is proving to be an exciting compound because it also oxidizes dirt and scum, and is already the active constituent in products like self-cleaning bathroom tiles. He calls it a "wonder chemical" with a variety of applications in environmental technologies.

Nanoparticles are also an active area of research, and Biswas is excited to be working in this field. These particles have many potentially beneficial applications, for example, drug delivery via aerosol spray, and production of novel materials -- work that is being conducted through the auspices of the Washington University Center for Materials Innovation.

There is some concern about the health risks of these nanoparticles.

"One needs to address the problem at the beginning, rather than discover the problems years later," said Biswas. "Our take is that [nanoparticles]

could be made safe. They can be engineered to be safe. But it is important to be careful from the start, and we are doing so."

Source: Washington University in St. Louis