Putting microbes to work at gasoline spills

By Martman Cohen
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Campus researchers have devised a unique and relatively inexpensive method to clean up some of the dangerous contaminants contained in gasoline by encouraging microorganisms already in the ground or water to degrade them. The project is outlined in a recent issue of the journal Environmental Science and Technology.

Derek Lovley, head of the Department of Microbiology, and graduate assistant Robert T. Anderson have shown it is possible to spur microbes to degrade benzene in petroleum-contaminated underground water, even where oxygen has been depleted by massive or long-term contamination. Benzene, a major constituent of many fuels, is a known carcinogen, according to Lovley. Now, Lovley and graduate assistant Kevin Finneran are conducting a similar project to degrade methyl tertiary butyl ether, or MTBE (another hazardous gasoline component that is hazardous to health) at contaminated sites.

Lovley and Anderson received funding from the American Petroleum Institute and Conoco to determine what they could accomplish in a site near Ponca City, Okla., that had been contaminated with various forms of petroleum for over 50 years. Traditional approaches to clean up the area, which included more than 25 million gallons of contaminated water in an underground aquifer, had been unsuccessful.

"We were faced with a massively contaminated site," explains Lovley.

Anaerobic process proves effective

badly contaminated soil and water like this to get the microbial remediation process started, but that approach is costly, and then you end up with other problems, including plugging up the aquifer with iron oxides. We've shown it's not only possible but it's also easier and cheaper to remove benzene from these contaminated wells anaerobically, or, without oxygen, by pumping sulfate into the sediment below an aquifer. This encourages microorganisms deep in the soil to finish the remediation process for us."

To accomplish this feat, Lovley and Anderson set up 40 injection wells over a section of the aquifer, as well as a series of observation wells along the groundwater's flowpath. Sulfate was dripped into the contaminated area through the injection wells over a period of 200 days. Tests run in the observation wells demonstrated how well benzene was removed from the water.

"When we added sulfate to the aquifer, we saw virtually immediate stimulation of benzene removal. The bacteria oxidized benzene and produced carbon dioxide, which is not harmful to the environment," says Lovley. "To our knowledge, this is the first successful field demonstration in which the anaerobic degradation of benzene has been accelerated at the site of contamination. This process might not work in all w

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sulfate-reducing microbes present in the environment."

Now Lovley and Finneran are transferring the benzene-removal technology to sites contaminated with MTBE. That gasoline additive tends to migrate quickly when it reaches underground pools of water and is difficult to remove at low concentrations through conventional treatment, says Lovley.

The two researchers have collected sediments from a variety of MTBE-contaminated sites from around the U.S. By simulating an anaerobic process similar to what Lovley and Anderson used to extract benzene, they have reduced the amount of MTBE in the soil samples by about 3 percent a week. At this rate, they expect to remove all of the MTBE from the soil in less than a year.

"One of the major advantages of using an anaerobic technique is it lets you remove MTBE at the source, before it has a chance to spread," says Lovley. Field tests following procedures similar to the benzene test will begin in California this fall.

Every day, almost 200,000 gas stations across the country pump about a half-million gallons of gasoline into America's motor vehicles, according to The Journal of Petroleum Marketing. Invariably, some gasoline escapes into the environment by dripping onto the pavement at the pump, spilling in the course of motor vehicle accidents, or seeping into the ground from a rupture in an underground tank or pipe. Accidental spills can contaminate residential or agricultural soil or

techniques his team has developed could be used to clean up some of those spills.