

## UPDATE FACT SHEET



# Bioremediation of Groundwater Plume Shows Promise At WAG 1

## WASTE AREA GROUP

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Bioremediation of trichloroethene (TCE), one of five alternative treatments identified for a groundwater contaminant plume at TAN, shows promising results eight months into a one-year test. TCE, an organic degreaser that was widely used in the past, is the most common groundwater contaminant in the United States. The TAN bioremediation test is the largest of its kind in the United States, and the first in the world to attempt this type of bioremediation of groundwater in a deep fractured-rock aquifer.

At TAN, where TCE-contaminated sludge was formerly injected below ground, environmental engineers are using the same well to pump 300 gallons of sodium lactate per week into the TCE-contaminated groundwater plume. Sodium lactate, a common food-grade preservative, is an electron donor in a complex series of biochemical reactions that ultimately break down the TCE into harmless constituents. Naturally occurring bacteria in the groundwater beneath the INEEL, are doing the dirty work. The bacteria are known as chloro-respirators, in effect "breathing" chlorine compounds to get energy for life processes.

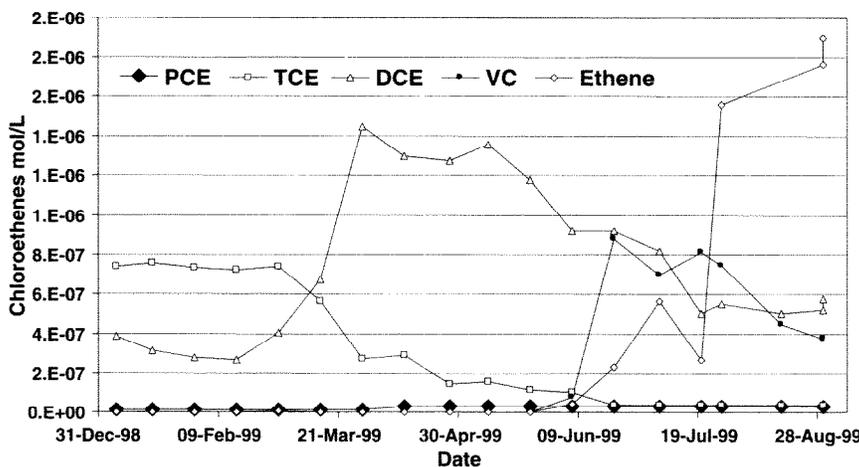
The addition of sodium lactate is one of five alternative treatments other than the pump-and-treat method, identified for remediating the plume. Of the five, two have been evaluated and rejected. Laboratory studies indicate that the remaining three all hold some promise, but the sodium lactate treatment results are the most encouraging thus far.

BBWI Senior Engineer Kent Sorenson believes the bacterial processes will break down the TCE all the way into the harmless constituents ethene and ethane. Bacteria ferment the sodium lactate into propionate and acetate, which can be further degraded, donating electrons which provide energy to the bacteria. The ultimate breakdown products are bicarbonate, carbon dioxide, and water.

Sampling of the plume has shown TCE reduction in one case from 3800 micrograms per liter down to 10 micrograms per liter. The TCE first is reduced to one or more phases of dichloroethene (DCE), then further reduced to vinyl chloride.

Vinyl chloride is the last step before the harmless by-products of ethene and ethane are produced. Continuing monitoring of the contamination plume from a number of sampling wells around the disposal well, has shown a decrease in TCE, an increase in DCE, and most recently, low concentrations of vinyl chloride and ethene near the injection well. The observation of ethene is important because it demonstrates that the bacteria are degrading TCE completely to harmless by-products.

Reductive Dechlorination Indicators in TAN-31



The graphic above tracks the levels of five substances in the groundwater beneath TAN, during an eight-month period. As TCE levels drop from roughly 100 ppb to less than 10 ppb (below detection levels), the level of cis-dichloroethene, a breakdown product, first shoots upward to more than 120 ppb, then falls lower and lower. As cis-DCE breaks down, levels of vinyl chloride and ethene are rising, with ethene becoming most prevalent. Ethene is a harmless final breakdown product of TCE.



The test will last for the remainder of 1999. Researchers hope two further goals can be achieved. One is to demonstrate that all of the TCE can be reduced into harmless constituents. The second is to show that anaerobic reductive dechlorination can be used to break down the TCE remaining in the disposed sludge, not just the TCE plume in the groundwater.

Test Area North is in the north-central portion of the INEEL. From 1954 to 1961, the area was used to support the Aircraft Nuclear Propulsion Program, whose mission was to test the concept of a nuclear-powered airplane. From 1962 through the 1970s, the area was principally devoted to the Loss-of-Fluid Test (LOFT) Facility, which was used to perform reactor safety testing and behavior studies. Beginning in 1980, the area was used to conduct work with material from the 1979 Three Mile Island reactor accident. Current activities include the manufacture of armor for military vehicles at the Specific Manufacturing Capability (SMC) Facility and nuclear inspection and storage operations at the Initial Engine Test (IET) Facility, the Technical Support Facility (TSF), and the Water Reactor Research Test Facility (WRRTF).

The main sources of contamination at Test Area North include discharges to an injection well, releases during transfers to and from underground storage tanks, windblown contaminants from another release site, releases in disposal (burn) pits, releases to surface ponds, a mercury spill, and a fuel leak.

# INEEL

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