'Hidden-Hero' Microbes In Soil, Water May Help Naturally Clean Toxic Sites

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Buried under 243 acres in an East Tennessee valley adjacent to the Oak Ridge National Laboratory's Y-12 National Security Complex, toxic waste from weapons manufacturing at the facility between 1951 and 1983 leaches into groundwater that extends in radioactive plumes for miles from the contaminated site.

But soon, Florida State University Associate Professor Joel Kostka and his FSU oceanography department team will help clean up the mess.

During the course of a forthcoming five-year study funded by the U.S. Department of Energy, FSU researchers will be testing a natural method called bioremediation -- the stimulation of naturally occurring microbes that Kostka calls "hidden heroes" -- to promote bacterial growth in the soil subsurface that scrub it of potentially deadly radioactive metal.

If bioremediation proves successful on the uranium, technetium, nitrate and other potentially lethal leftovers at the Oak Ridge site, the process should work to mitigate contamination at more than 7,000 other sites nationwide -- and do so more economically and effectively than most conventional methods.

"The stakes are high and the impact potentially huge," Kostka said. Together, those 7,000 U.S. sites encompass an estimated 1.7 trillion gallons of contaminated water -- that's about four times the nation's daily water consumption -- and about 40 million cubic meters of contaminated soil.

Kostka has a five-year, $1 million share of the total $15 million in U.S. DOE funding for the project, which includes research teams from FSU and multiple universities and national laboratories across the country.

Together, the partners will develop models to help predict the rate at which contamination levels drop when using natural methods such as bioremediation and artificial techniques such as chemical additions and pH adjustments. Subsurface changes are monitored using geophysical methods that send acoustic, electric and other signals into the ground.

Kostka's research team from FSU's nationally top 10-ranked oceanography department will lead the "subsurface microbiology" portion of the project.

"Radioactive metal contamination such as that found at the Oak Ridge Field Research Center (ORFRC) where we will be working is a huge global issue," Kostka said. "It affects not only the U.S. but in particular, also Eastern Europe, Canada and South America, and the costs of cleanup are projected in the billions if not trillions of dollars in the U.S. alone.

"As it now stands, bioremediation, which is potentially much cheaper than current technologies, has not been used much at all, but it should be," he said. "Subsurface aquifers, where most of the radioactive contamination resides, are primary sources of groundwater used for drinking, and contaminated aquifers tend to be extreme environments where microorganisms dominate. These microbes are the 'hidden heroes' that do the work of bioremediation. Our new project will provide the basic science necessary to deploy bioremediation technologies at the scales necessary for them to be effective at U.S. DOE sites."

In addition, the ORFRC has funded Kostka's FSU lab to develop and maintain a genetic database of genes of organisms that are present in the

Oak Ridge site's subsurface.

"With the genetic database and associated cutting-edge genomics techniques, my lab will determine and predict the functioning or metabolism of subsurface microbial groups that catalyze key chemical reactions for contaminant removal from groundwater," he said.

"In fact, my FSU group recently isolated a new 'wonderbug,' a metal-reducing bacteria we named Geobacter FRC-32," Kostka added. "The genome of this organism now has been sequenced, and we will use that genome sequence and those of other 'bugs' at Oak Ridge in developing our new bioremediation strategies for DOE sites."

To learn more about Kostka's bioremediation research and its significance, visit www.joelkostka.net/biorem.cfm or www.joelkostka.net/funding.cfm .

Source: Florida State University