

NC STATE UNIVERSITY

Volume IX Number 2
Summer 2009

results.

Research and Graduate Studies at North Carolina State University



FRESH WATER
Research to protect the
Earth's Life Support System



Dressing Down Groundwater Contamination

Dr. Robert Borden and doctoral student Ki Young Cha use pH strips to check the success of adding buffering agents to a proprietary mix that breaks down chlorinated solvents in groundwater.

Unlike the late Paul Newman, who bottled his special-recipe salad dressing and sold it in supermarkets, Dr. Robert Borden simply mixes up his own “dressing” and pumps it into the ground.

That’s because the environmental engineering professor and his graduate students are more interested in feeding microbes to clean up contaminated groundwater than in making just another Ranch dressing. “It’s really very similar to salad dressing,” Borden says of his creamy blend of soybean oil and other ingredients. “You could eat it if you want, but I don’t think you’d want to.”

Borden’s recipe builds on the science of using microbes to cleanse soils and groundwater of toxic chemicals. To clean up leaks from buried gas tanks, for example, it’s common practice to pump oxygen into an aquifer for aerobic microbes to break down petroleum. Chlorinated solvents like metal degreasers and dry-cleaning fluid pose a different challenge. Because anaerobic microbes can break off chlorine atoms from the compounds to “breathe,” researchers simply inject food into the groundwater for the organisms to feast on as they break down the solvents.

Test columns in Borden’s lab measure how well his “dressing” travels through the soil after being injected into the ground.

Some researchers have tried sugar or molasses as food, but Borden says that’s like giving candy to children. There’s a burst of microbial activity, but as the sugar rush subsides, more food needs to be injected. That adds to the expense and trouble of cleaning sites. He decided to use soybean oil, which he says provides energy for the microbes over a longer period. But he needed something to help the oil spread out in the groundwater and not clump together near the injection site. The solution: Borden’s own salad dressing. “We made our own cream by breaking the oil into tiny droplets,” he says of his proprietary method. He also devised computer models to simulate the movement of the creamy mix through soil and even built giant sandboxes to demonstrate how it would spread through a contaminated area. His mix can feed microbes for three to five years, which he says is long enough to clean up many sites.

Injecting food into the groundwater feeds microbes as they break down chlorinated solvents.

Borden is now experimenting with mixing in buffers to keep an aquifer at neutral pH during a cleanup. As the soybean oil degrades, it produces acetic acid and lowers the groundwater’s pH level. If the pH drops too low too fast, acidic conditions could kill the microbes, he says, comparing it to the vinegar that preserves pickles. “You could pickle an aquifer if you’re not careful,” he says with a chuckle. “We think we’ve come up with a solution with a buffering agent that’s as simple as the salad dressing concept. The next step is to get it into practice.”

