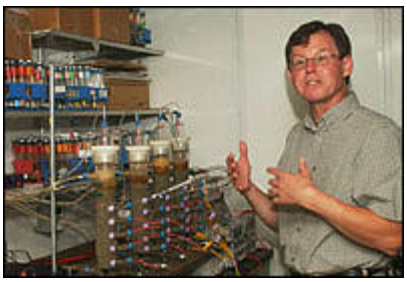
Research follows nature's way

By CHERYL B. WILSON, Staff Writer



GORDON DANIELS
Derek Lovley, a microbiology professor at UMass, was awarded a $8.9 million grant to use natural solutions to solve problems in energy production, environmental cleanup and carbon recycling. Here, microbes are consuming a glucose solution and producing electricity.

Monday, August 12, 2002 -- AMHERST - Grass clippings fueling electric lawn mowers? Microbes clearing up uranium pollution? Micro-organisms on the ocean floor powering sensors for biochemical warfare agents?

It may sound like science fiction, but it's all part of research under way in the basement laboratories of Morrill North at the University of Massachusetts, under the direction of microbiologist Derek Lovley.

He has just been awarded an $8.9 million grant over three years from the U.S. Department of Energy. Lovley's project is part of a 10-year program called Genomes to Life that plans to take advantage of solutions nature has already devised to help solve problems in energy production, environmental cleanup and carbon recycling.

Lovley's research is focused on the role microbes can play in pollution control and small-scale energy production.

Since the early 1960s, scientists have known that certain microbes have the ability to degrade petroleum by using oxygen, Lovley said. He began studying microbial action on petroleum about a decade ago while he was at the United States Geological Survey in Reston, Va. Lovley was trying to devise strategies for speeding up the degrading process.

"Our contribution was to realize not only oxygen could be used, but a lot of (the microbes) used iron," he said.

"All the micro-organisms (being studied) exist in an environment where there is no oxygen," he said. "They are below the surface of the water in mud. They use metals to get their electrodes - to breathe, essentially."

The microbes, called geobacters, are truly microscopic. "Line up 10,000 and you get an inch," Lovley explained.

In the laboratory, Lovley and his associates feed the microbes sugar or glucose. They

also add electrodes to the water to speed up the decomposition process. They force the electrodes through graphite in the experiment. "Graphite is an everyday material - it's what's in a pencil - a really cheap material. If we put a piece of graphite in the mud, we'll get a flood of electricity," Lovley said.

The microbes are using metals in the water to generate their own electricity, the process stepped up by the introduction of a small amount of electrodes.

The implications for this electricity production are enormous, but on a small scale, Lovley said.

"We don't think the electricity made from this will be plugged into the power grid. It will be more local," he said. "Remember what has happened turning corn into ethanol? Maybe you could turn it into electricity."

For example, with the help of electrodes, microbes could work on a pile of grass clippings from this week's mowing of a suburban lawn. "You could use the electricity to mow your grass next week," Lovley suggested.

That process is a long way down the road, but Lovley's grant will help make it possible.

Already, the Navy is making use of Lovley's previous research on microbial activity on iron to make prototypes to replace battery-operated underwater sensors. Small machines are being tested deep in the ocean to monitor possible biochemical warfare agents and other substances. The sensors are powered by microbes feeding on iron on the ocean floor.

"They wouldn't have to go back to change batteries and that would save a lot of money," he said.

Lovley's recent research on microbial generation of electricity was based on experiments in Boston Harbor. Other field projects stretch across the country to Idaho and Colorado.

In the early 1990s, there was a lot of publicity about uranium contamination, Lovley recalled. "I wondered, 'If (microbes) could use iron maybe we can find if they use uranium." However, he was nervous about radioactivity and uranium until a fellow USGS researcher assured him it was safe in the laboratory.

Lovley discovered microbes "like uranium just as much as they like iron."

This spring, after much laboratory research, Lovley's colleagues on the uranium project hit pay dirt in Colorado at the site of a uranium mine tailings operation.

"We just finished a field experiment in Rifle, Colo. After five weeks we had cleaned up 70 percent of uranium out of groundwater," he reported.

Much of Lovley's work is basic research, he said, not the applied variety that can

quickly lead to new lawnmower designs or pollution-control devices.

His new grant will focus on genomic sequencing. "We will be determining what the genomic sequences are, the same way they did with the human genome," he explained. "It gives you another stream of information. Sequencing is the first step. Then you have to figure out what it means. The big thing is what do these genomes do?"

A unique part of Lovley's new project is using micro-organisms collected in the environment instead of starting with laboratory-created microbes.

The grant pays salaries of more than 25 researchers at UMass and at two other research institutes in Maryland and Illinois, all under Lovley's direction. It also pays for equipment and for disposable supplies for sequencing, he said.

Lovley, 48, said he became a biologist because he wanted to work outdoors. He specialized in microbiology after deciding that micro-organisms were responsible for affecting the entire base of the environment.

Since coming to UMass in 1995, he has brought to campus nearly $21 million in grants that fund postdoctoral researchers who can work with younger graduate and undergraduate students, a benefit to the university. Lovley added.

As a research professor, he works with graduate students rather than those in introductory courses. "I mostly mentor," he said. "I teach them how to do research, how to write research papers. I feel that creative science is as valuable to students as relaying basic facts."

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