Seabed microbe study leads to low-cost power, light for the poor

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A Harvard biology professor's fascination with seafloor microbes has led to the development of a revolutionary, low-cost power system consuming garbage, compost, and other waste that could provide light for the developing world.

Assistant Professor of Organismic and Evolutionary Biology Peter Girguis has developed a fuel cell run by the natural activity of anaerobic microbes. The cells can be manufactured for just a few U.S. dollars, putting them within reach of many of the world's poor who today do not have access to electricity.

Though the power output is relatively low, Girguis said it should be sufficient to run low-energy lighting or to recharge batteries for a host of devices such as cell phones, an increasingly important communications method in the developing world.

"There are 2.8 billion people on Earth without electricity who are clamoring for [power]," Girguis said. "Most people want electricity for lighting and telecommunication."

Girguis' work was recently awarded a $10,580 Lindbergh Grant by the Charles A. and Anne Morrow Lindbergh Foundation. The grant — the amount Lindbergh used to build his plane, the Spirit of St. Louis — was one of 14 awarded this year out of 150 applicants. Girguis said the money is welcome because the project falls between areas that traditionally attract research funding.

Scientists have been studying microbial fuel cells in the lab for decades, Girguis said. His aim has been to take existing knowledge and apply it in a workable, inexpensive device that can be distributed to places lacking electricity.

The crucial point in the development process came when Girguis realized that the fuel cells didn't require research-grade materials to operate properly and that they'd work adequately with less expensive materials that would significantly lower the cost.

The fuel cells operate because of a particular trait of anaerobic bacteria. As these bacteria live and metabolize food in their oxygen-free environments, they produce extra electrons, which are normally released into the material around them. By introducing an electrode, those electrons can be harvested to create a small electrical current.

Girguis' fuel cell uses an electrode, wires, and a small circuit board about the size of a pack of cards. The electricity flows from the electrode into the circuit board and out of one of two outlets on the other side. One provides juice for electrical devices such as LED lightbulbs while the other has a cell phone recharger.

Iqbal Quadir, executive director of the Massachusetts Institute of Technology's Legatum Center for Development and Entrepreneurship, is intrigued by Girguis' fuel cells. Quadir, who started a company that has brought cell phone service to millions of people in Bangladesh, has offered to let Girguis distribute the microbial fuel cells as part of a new power-generation venture Quadir is heading. The venture, Emergence Bioenergy, uses microbe-filled biodigesters to generate methane from cow manure. The methane is then burned to generate electricity.

"I like his technology, it's a paradigm shift," Quadir said. "He could put his technology inside our biodigesters and produce extra watts."

A number of steps remain before that can happen, however. Though Girguis has developed several different fuel cells, he has not yet begun producing them. The Lindbergh grant will finance continued research on the cells, to see the difference in output from different soils and sediments, and on what happens when the soil is enriched with organic matter.

Girguis is considering a public demonstration of the technology, perhaps by putting a fuel cell into a trash can with a public cell phone and charger attached. People could make calls from the phone, and, each time someone threw garbage into the receptacle, they'd be feeding the microbes that were powering the charger.

An additional benefit to the fuel cell technology is that, since it doesn't burn fossil fuels, it generates power without having an impact on the climate. Despite that feature, Girguis said the fuel cells are not a replacement for fossil fuels. The cells can be enlarged — with larger electrodes — to generate more power and supply power through wires that run into a house, but the cells are most appropriate to bring power to remote areas, not as a substitute for existing municipal power grids. A plant to power a town the size of Cambridge would cover several blocks, Girguis said.

Source: Harvard University