Penn State Student Awarded the First Ronald B. Linsky Fellowship

Winter 2008 – Douglas Call, an M.S./Ph.D. candidate in Environmental Engineering at Pennsylvania State University, received the inaugural NWRI Ronald B. Linsky Fellowship for Outstanding Water Research in 2007 for his research on breakthrough technology for generating energy and treating biodegradable organic matter in wastewater.

The Fellowship, which provides $20,000 a year for 2 years, was established in honor of Ron Linsky, who served as NWRI's Executive Director for 15 years. Under Ron's leadership, NWRI grew from an idea among local Southern California utilities supporting and promoting water research to becoming a nationally recognized water research organization.

"Doug Call is an outstanding choice for the Ronald B. Linsky Fellowship, based on his multi-disciplinary background and on his research addressing both water quality and the need to develop clean and renewable energy sources," said Jeff Mosher, NWRI's Executive Director.

Originally from Virginia, Doug grew up with the Chesapeake Bay as his backyard. An Eagle Scout and avid outdoorsman (he spent his honeymoon in Zion National Park in Utah), Doug has always been actively involved with the environment. Volunteering as a water quality monitor for the Chesapeake Bay Alliance in high school paved the way for him to tackle environmental issues and, after graduation, he majored in Environmental Science at the University of Virginia.

A few years later, with his B.S. in hand and a cache of environmental knowledge, he searched for a way to make a meaningful difference toward the environment. It was not until he read Cradle to Cradle: Remaking the Way We Make Things by William McDonough and Michael Braungart that he discovered how he could make the impact he desired.

"I realized that the design and engineering of technology contributes to many of our environmental problems," he said. "The way to solve these issues is to go back to the table where decisions are made to stop them before they start."

Inspired to better impact human and environmental health, Doug became an intern at McDonough Braungart Design Chemistry. While there, he noticed that the engineers and designers working for clients such as Nike and Ford were charged with the task of making changes to improve the environmental impact of their products. He realized that to effectively make similar changes, he would need a strong foundation in engineering.

Returning to school, Doug earned a B.S. in Civil and Environmental Engineering at Virginia Tech, and graduated summa cum laude in December of 2005. The following year, he began his graduate studies at Penn State with a focus in Environmental Engineering. Because of early research he conducted the summer prior, he was able to

contribute to a paper published in the journal Environmental Science & Technology regarding a new cathode structure in microbial fuel cells.

"In the 20-plus years I have been advising graduate students, I believe Doug is the first to publish work during the first semester of graduate study," noted Dr. Bruce Logan, Doug's advisor and Director of the Engineering Environmental Institute at Penn State.

In microbial fuel cells, electrons are produced by a process involving the breakdown of organic matter by bacteria. This process is relevant to wastewater treatment because one of the main steps in treating wastewater involves the removal of organic human waste, also referred to as biodegradable matter.

The electrons are transferred by the bacteria to an electrical circuit and end their journey at the cathode, where they combine with oxygen to produce water. The more efficient the cathode, the more energy – or electricity – that can be harnessed to power external resistance, such as a light bulb. A combination of the right materials has the potential to provide enough electricity to power an entire treatment plant. However, models tested thus far have been limited to the laboratory scale.

With the help of the Fellowship, Doug's initial investigation on cathode materials for full-scale use in wastewater treatment plants has expanded to include research into a new type of reactor called a microbial electrolysis reactor, which produces hydrogen as an energy source (rather than electricity).

"This technology is a great step towards producing hydrogen in a sustainable manner, while at the same time helping engineers treat wastewater," said Doug.

Microbial electrolysis reactors are similar to microbial fuel cells. Like microbial fuel cells, microbial electrolysis reactors can remove a significant portion of biodegradable matter in wastewater, but microbial electrolysis reactors have a sealed cathode that excludes oxygen, and also have an additional voltage added to the circuit.

The reactors use the same concept as the electrolysis of water (where current is passed through water, breaking it down into hydrogen and oxygen), but with the help of bacteria, a microbial electrolysis reactor requires only one-tenth the electricity to produce hydrogen. The hydrogen, in turn, can be used as an environmentally friendly fuel source to power anything from cars to entire communities.

Doug will be presenting the progress of his research alongside other NWRI Fellowship recipients at NWRI's Second Annual Graduate Fellowship Research Conference on April 4, 2008, in Washington, D.C. He expects to graduate with his Ph.D. within the next 4 years and hopes to continue finding ways to make wastewater a valuable renewable resource as an alternate source for energy production.

This article, written by Angie Im, first appeared in the Winter 2008 edition of the NWRI newsletter, *Briefings* (Vol. 17, No. 1).