

## NWRI-AMTA Fellowships in Membrane Research

*Fall 2008* - Established in 2007, the NWRI-AMTA Fellowship for Membrane Technology awards \$10,000 per year to two graduate students helping to solve water supply and quality issues through the widespread application of membrane technology. The 2007-2008 Fellowship recipients – Eva Steinle-Darling of Stanford University and Kendra Colyar of the University of Colorado – were selected for their original and outstanding research projects and their potential for advancing membrane technology.

Membranes are used to filter unwanted particles and pathogens from target water sources and are important tools in the water treatment industry. As the leading advocate of membrane processes in the United States, the American Membrane Technology Association (AMTA) is committed to promoting and advancing the understanding and application of membrane technology.

“The purpose of this Fellowship is to give back to the membrane industry,” said Steven Duranceau, who is a member of the Board of Directors for AMTA, as well as NWRI’s Research Advisory Board.

“Everyone benefits from services such as the Fellowship because the knowledge that results from research builds the clearinghouse of information for the industry.”

### **Setting Standards for Membrane Use in Water Recycling**

*Eva Steinle-Darling, Stanford University*

A lifelong competitive athlete, Eva Steinle-Darling is unfazed by mental and physical challenges. So when her advisor at Stanford University gave her the unusual assignment of advising another masters student during her own second year of graduate study, Eva grabbed the reigns and began by asking, “What are your interests? Let’s see what I can advise you on.”

Together, Eva and “her” masters student studied membrane rejection of nitrosamines, a disinfection byproduct of water treatment. Using this topic, her student wrote his master thesis and Eva returned to the field to further investigate the extent to which membranes are effective in removing other trace organic contaminants.

Eva’s research, “Rejection of Trace Organics – Nitrosamines, Perfluorochemicals, and Others – via Reverse Osmosis and Nanofiltration: Influence of Feed and Solute Characteristics,” aims to build on the field of knowledge on the mechanistic effects of size, charge, and solute-membrane affinity on the rejection of three families of contaminants that may have adverse health effects on humans and aquatic life: nitrosamines, perfluoro chemicals (PFCs), and pharmaceuticals and personal care products (PPCPs).

“There may be many chemicals in our waters that we don’t know about yet,” said Eva. “It’s important to understand the rejection mechanisms of these trace organic contaminants, such as those in PPCPs, so that future membrane technologies can be more efficiently implemented in water, wastewater, and recycled water treatment processes.”

By amassing fundamental information about compound rejection mechanisms and their treatment, Eva's research will facilitate the work of those designing treatment systems in the future. They will simply have to look to Eva's work to determine whether or not certain compounds in question would be effectively removed by membranes. Her research also aspires to provide predictive capabilities for other compounds found in water.

"One significant finding in my work is that there is a clear correlation between the rejection behavior of a compound and the amount of compound that ends up sorbed to the membrane material," explained Eva. "More generally, I hope that one of the contributions of my work in the water and wastewater field will be to help practitioners decide whether membranes are the best treatment option for their particular contaminants of concern."

Although her research with PPCPs is still ongoing, Eva's findings on membranes and PFCs has already been published in *Environmental Science and Technology*. She graduated this summer with her Ph.D. in Environmental Engineering, and plans on spending the rest of the summer traveling – first to present her research findings at the AMTA/ SEDA 2008 Joint Conference and Exposition and then to Europe to visit friends and family. This fall, she will begin work with Erler & Kalinowski, Inc. in Burlingame, California, an engineering and environmental consulting firm that provides complete engineering services with a focus on the environment, water, wastewater, and water resources.

### **Powering Towns with Plant Fuel**

*Kendra Colyar, University of Colorado at Boulder*

As an avid runner and Washington native, Kendra Colyar – a master's student at the University of Colorado at Boulder – is no stranger to the outdoors or hard work.

While studying physics and engineering as an under graduate, Kendra turned to running for peace and meditation. She was a member of the cross-country team in college, and her first marathon ran through Boulder County's countryside along side farms and cottonweed groves on rural roads. With so much time spent outdoors, it is no surprise that her research would focus on nature and the environment. What separated her research from that of her peers was her impressive use of membranes in tying both the environment and technology, which garnered her the NWRI-AMTA Fellowship Award.

Kendra's research on the "Evaluation of Nutrient Extraction and Membrane Processes to Facilitate the Reuse of Water and Macro nutrients Prior to Lignocellulosic Biomass-to-Fuel Processing in Rural Communities" involves the use of membrane separation processes to recycle water back to bio-refineries to conserve water and improve the economics of producing biofuel.

"Today, we have the capability to create cellulosic ethanol – fuel derived from plant matter – but there are many environmental and economical barriers associated within the plant-to-fuel conversion process," explained Kendra. "The purpose of this study was to address two of those current drawbacks: water consumption and nutrient depletion."

Corn stover, which consists of corn husks and stalks, is the feedstock used by process facilities to create biofuel, which can in turn be used to power cars and even power plants.

“Our research was geared towards rural communities that could benefit a great deal from having their own biorefinery,” said Kendra. “An agricultural population could save money by providing their own fuel for transportation and harvesting equipment, and they could even power the biorefinery and the community by burning byproducts produced in the conversion process.”

Conducting preliminary experiments with corn stover from Imperial, Nebraska, Kendra proposed a two-stage nutrient extraction-filtration process that would facilitate the reuse of macronutrients, and possibly increase the overall benefits gained from plant-to-fuel processing.

“There are still variables that need to be looked at,” said Kendra of her research on Imperial, Nebraska. “I would love to be a size contributor in the next step and to the overall process in the future.”

With her research in its final stages, Kendra graduated in May 2008, receiving an M.S. in Civil Engineering with an environmental emphasis. Her plans for the future include a possible relocation to San Diego, California, where she has received an offer from the United States Department of the Navy for a position in which she will acquire the skills necessary to become a project manager for future environmental remediation projects.

*For more information about the AMTA Fellowship and other NWRI Fellowships, please visit our Fellowship Program webpage at [www.nwri-usa.org/Fellowship](http://www.nwri-usa.org/Fellowship).*