



Biosystems Engineering Program Joins EEES Department



In July, the Biosystems Engineering undergraduate and graduate programs joined the EEES department. Biosystems Engineering (BE) is a dynamic engineering field that incorporates fundamental principles of biology with engineering analysis and design. The BE program emphasizes two main areas - bioprocess engineering, with its basis in microbiology, and ecological engineering, with its basis in ecology. Bioprocess engineering focuses on the sustainable production of biorefinery compounds (ie biofuels, bioactive molecules, and biomaterials) using metabolic pathways found in nature and 'green' processing technologies. The ecological engineering area encompasses the design of sustainable communities utilizing low-impact development strategies (bioretention

basins, rainwater harvesting, bioswales) for stormwater retention, control and treatment, and water conservation in food and energy-crop production. Biosystems engineers apply engineering design and analysis to biological systems and incorporate fundamental biological principles to engineering designs to achieve ecological balance.

Four BE faculty - **Drs. Caye Drapcho, Tom Owino, Charles Privette and Terry Walker** – and approximately 100 students (80 undergraduate and 20 graduate) joined the department. The ABET-accredited undergraduate curriculum includes courses in engineering sciences (statics, dynamics, thermodynamics, mechanics of materials, fluids and circuits), biological sciences (biology, microbiology, ecology) and core BE courses such as Biological Kinetics/Reactor Modeling, Bioprocess Engineering, and Small Watershed Hydrology.



Faculty research programs focus on biofuels production - i.e., biodiesel from algal oils, biohydrogen from fermentation of waste organic materials - and nonpoint source pollution assessment, control and treatment - such as impact of road construction on water quality/quantity and evaluation and modeling of vegetative filter strips.

Dr. Drapcho's research focuses on the development of sustainable bioprocesses for the production of hydrogen gas and valuable co-products from waste agricultural feedstocks. **Dr. Owino's** research interests are in the areas of water quality, irrigation and drainage, horticultural engineering. **Dr. Privette's** current research interests are in the areas of hydrology, stormwater, run-off and erosion control best management practices, low impact development. **Dr. Walker's** research group focuses on conversion of lignocellulosics, vegetable-based oils and glycerine by-products to algal and fungal oils, enzymes and alcohols used primarily in biofuels production.

Faculty Profile



Dr. Ron Falta, Professor, joined the departments of Earth Sciences and Environmental Systems Engineering at Clemson in 1992. Prior to coming to Clemson, he had received his BS and MS degrees in

Civil Engineering from Auburn University, and his Ph.D. in Mineral Engineering from the University of California, Berkeley, and he had worked as a Post Doctoral Researcher at the Lawrence Berkeley National Laboratory. At Berkeley, he was a developer of the T2VOC multiphase flow code for simulating thermal remediation of contaminated soils and aquifers. Dr. Falta's early research and teaching at Clemson focused largely on mathematical simulations of subsurface contaminant transport and remediation. His research focus shifted towards field testing of in-situ remediation methods in the mid to late 1990's, when he directed two field projects of cosolvent flooding. During the past decade his research has continued look at in-situ remediation, and also at quantifying the benefit of groundwater contaminant source and plume remediation. Work in this latter area lead to the development of the EPA REMChlor model used for evaluating source and plume remediation efforts. Most recently, Dr. Falta has gotten involved in research in greenhouse gas control and alternative energy. He is currently directing an EPA project related to geologic sequestration of carbon dioxide, and a DoD project related to subsurface thermal energy storage for heating and cooling buildings.

Chair's Corner

Dear EEES alumni and friends:

I would like take this opportunity to wish you a happy and safe Holiday Season and a prosperous New Year. I am very pleased to report that the state of the Department is strong despite the economic challenges around the country and in our state. EEES faculty, staff and students have shown amazing and exemplary professionalism, productivity, and citizenship throughout the past year. We currently have 152 undergraduate and 134 graduate students. The new research awards, several of which are from keen national competitions, reached \$3.3M in the past year, while the research expenditures totaled \$2.7M. This is a testament to the hard work and impressive productivity of our talented faculty, students and staff.



Two new faculty, Drs. Shuller-Nickles and Nammouz, joined the department at the beginning of the Fall semester. In addition, the Biosystems Engineering undergraduate and graduate programs joined EEES after the reorganization in the College of Agriculture, Forestry, and Life Sciences. Four Biosystems faculty with their research and teaching on biofuels, bioprocessing, storm-water runoff, erosion control, irrigation and water quality will compliment and further strengthen the Department. On the cover, you will find our feature article about Biosystems Engineering Program.

We are also very proud of the accomplishments of our students; several of them have received impressive national awards and recognitions, as listed on the next page. Several of our faculty have continued to serve on editorial boards of journals and national assignments. Our new undergraduate degree in Environmental Engineering continues to grow. We have about 50 majors after the first two years. This is the only program degree of its kind in South Carolina.

On a sad note, Dr. Linvil Gene Rich, the founder of EEES and one of the pioneers and icons in the Environmental Engineering profession passed away on Sept. 29, 2011. Dr. Rich will be greatly missed at EEES and will always be remembered with fondness and pride by the Department and Clemson University.

Alumni support cannot be more meaningful at such challenging times. We greatly appreciate your contributions during these tough economic times, and we are thankful for your continued and most generous support. THANK YOU!

Tanju Karanfil, Ph.D., P.E., BCEE
Professor and Chair

Faculty Research Highlights

Dr. Ron Falta, together with Gerald Blount and Alvin Siddall from the Savannah River Site, have received a U.S. Patent for a new method of capturing carbon dioxide during the manufacturing of cement. The patent, titled "Carbon Dioxide Capture from a Cement Manufacturing Process", involves the use of a two-stage calcining unit, with a low temperature (900° C) unit and a high temperature (1400° C) unit. The low temperature calciner converts limestone and dolomite into calcium and magnesium oxides, and produces pure carbon dioxide as a waste product. This carbon dioxide can be sold, or stored in deep geologic formations. Some of the resulting calcium oxide from the process can then be used in a continuous open loop to react with carbon dioxide in the calciner flue gas to form calcium carbonate, which is recycled in the low temperature unit. The cement components leaving the low temperature unit are combined in a high temperature (1400° C) calciner to form the cement clinker, which is then milled into cement. This new design differs from the conventional cement making process, where all the feed minerals are heated together in a single high temperature calciner, and the carbon dioxide produced from the calcining process is mixed with the flue gases and discharged to the atmosphere. World cement production is nearly 3 billion tons per year, releasing approximately 2.7 billion tons of carbon dioxide to the atmosphere. This is almost 10% of the annual worldwide total emission of carbon dioxide.

Dr. Brian Powell and Dr. Mark Schlautman have been selected to lead a 3-year \$1.2M project funded by the DOE Nuclear Energy University Partnership. Dr. Linfeng Rao of Lawrence Berkeley National Laboratory and Dr. Heino Nitsche of University of California-Berkeley will collaborate on the project. The project is titled "Quantification of cation sorption to engineered barrier materials under extreme conditions" and will focus on quantifying interactions of risk driving radionuclides with engineered barrier materials under high temperature and high ionic strength conditions expected within radioactive waste repositories. A separate \$170k instrumentation award was also granted by DOE NEUP to purchase an isothermal titration calorimeter to support this and other projects. It will be the first instrument of this type at Clemson University.

Student News and Accomplishments



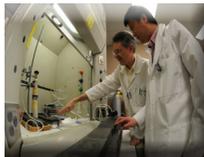
In May a group of Clemson engineering students led by EEES graduate students **Christina Anderson** (MS, EE&S, 2011) and **Catherine Ruprecht** (PhD, EE&S) traveled to Liberia, West Africa to implement sustainable engineering projects which the students had worked on in their Creative Inquiry class. The Clemson group worked alongside a group from University of Michigan and a group from University of Liberia. The five undergraduate students built a solar powered dehydrator, a biogas producing latrine, two basketball hoops, a playground and an electricity generating merry-go-round.

David Hisz (PhD, EE&S) won an Outstanding Student Paper Award for his presentation at the 2010 Fall AGU Meeting in San Francisco, California. According to the AGU citation, **Dave's** "presentation was recognized as among the best of a strong group of student presenters, which sets an example for his fellow students and the entire AGU membership." His award-winning paper was entitled: "Characterization of Fractured Rock during Well Tests using Tilt-X, a Portable Tiltmeter and Extensometer for Multi-Component Deformation measurements," and it is part of the NSF-funded research he is doing for his PhD dissertation. **Dave's** advisor is **Dr. Larry Murdoch**.

Salmatta Ibrahim (MS, Hydrogeology) recently received an award from the Margaret McNamara Memorial Fund (MMMFM) administered by the United Nations World Bank. This was a competitive application process, and she was one of only 13 people to receive a MMMFM award. Salmatta was presented with a check that she will use towards expenses while studying at Clemson. **Salmatta's** advisor is **Dr. Mark Schlautman**.

This summer **Lee Hering** (MS, EE&S) worked with ESG Operations at the Warner Robins Water and Wastewater Plants in Warner Robins, GA, where as an intern he worked closely with several engineers in the early stages of a multi-million dollar upgrade to the plants. His advisor is **Dr. Cindy Lee**.

Peng Luo (PhD, EE&S) received a 2010-11 Roy G. Post Foundation Graduate Student Scholarship in the amount of \$5,000. **Peng's** advisor is **Dr. Timothy Devol**.



The **Lee** research group deployed a distributed sensor system (DTS) along Town Creek near the Sangamo Weston Superfund site. Over a kilometer of fiber optic cable will be placed in the stream and used to measure temperature changes. The system will identify groundwater flux and possibly fractures within the stream bed. **David Hahn** (MS, Hydrogeology) tested the system before taking it on site along Town Creek.



April Gillens (PhD, EE&S) was awarded the 2011 Department of Homeland Security Nuclear Forensics Fellow. She is currently characterizing organic solvents associated with nuclear reprocessing via stable isotopes. This work will provide signatures of organic reprocessing solvents and their degradation products. "The goal of study is to determine whether organic solvents found in the environment have been used in nuclear reprocessing and to understand the steps of reprocessing the solvents experienced. As a graduate student I will identify methods to retrieve nuclear material from environmental samples and I will also distinguish solvents used in nuclear reprocessing from industrial solvent use" says **April**. Her advisor is **Dr. Brian Powell**.



Kay Millerick (PhD, Illinois) and **Francisco Barajas** (PhD, EE&S) attended the US-EC Course in Environmental Biotechnology, Lausanne, Switzerland. **Drs. Kevin Finneran** and **David Freedman** are their advisors, respectively

Glenn Skawski (MS, Hydrogeology) studied in Japan this summer as part of a prestigious 2011 National Science Foundation (NSF) Summer Travel Fellowship. He worked with Tomo Tokunaga at the University of Tokyo, a leading investigator in geomechanics and instrumentation. **Glenn** learned about innovative applications of fiber optic sensors to measure deformation, which have been developed by Prof. Tokunaga and his colleagues while sharing information about extensometers and downhole instrumentation developed at Clemson. The NSF Fellowship encourages recipients to travel in their host country and become immersed in its culture in addition to pursuing their studies. His advisor is **Dr. Larry Murdoch**.

Alumni News



Dr. Tom J. Temples (MS Geology, 1976 and Adjunct Associate Professor) assumed the position of President-Elect of the American Association of Petroleum Geologists (AAPG) Division of Environmental Geosciences (DEG) on July 1, 2011. In July Of 2012 he will assume the position of President for a 1 year term. **Dr. Temples** has been a member of the AAPG since 1978 and is charter member of DEG when the division was formed in 1992.

Recent graduate **John Kroon** (MS, Hydrogeology, 2011) began employment as Associate Geologist with Chesapeake Energy Corporation in Oklahoma City. **John** presented research results from his thesis, "Biomarkers in the Lower Huron Shale (Upper Devonian) as Indicators of Organic Matter Source, Depositional Environment, and Thermal Maturity," at the American Association of Petroleum Geologists (AAPG) Meeting in Washington, DC in late September. **John** received an award last year from AAPG in support of his thesis research.

Hem Joshi (PhD, BE, 2011) was recognized as Clemson Outstanding Graduate Researcher. Hem, a PhD graduate student in biosystems engineering, was selected by the Graduate Fellowship Committee as a Clemson University Outstanding Graduate Researcher. Outstanding Graduate Researchers receive a \$1,000 award. Hem's research interests include the optimization and characterization of biodiesel production from various feed-stock's and authored 7 peer-reviewed articles since 2008. He is a former recipient of the Wade Stackhouse Fellowship. **Hem** received both MS and PhD degrees in biosystems engineering from Clemson University.

The loss of a respected leader and friend



The Department of Environmental Engineering and Earth Sciences lost an inspired leader and dear friend with the passing of Dr. Linvil "Gene" Rich on Thursday, September 29th. The department was

blessed to celebrate Dr. Rich's 90th birthday in March, 2011.

Named dean of engineering in 1961, Rich was instrumental in creating Clemson's first environmental systems engineering program, a graduate degree in the civil engineering department. He elevated the program to become its own department in 1968, making Clemson among the first universities to do so.

When he left the dean's office, Dr. Rich joined the faculty of environmental systems engineering (now environmental engineering and earth sciences, or EEES).



Born in Pana, Ill., in 1921, Dr. Rich served in Europe in World War II in Gen. Patton's Third Army. After the war, he earned undergraduate and master's degrees in engineering and a doctorate in biochemistry from Virginia Polytechnic Institute and State University. He

worked at Virginia Polytechnic and the Illinois Institute of Technology before coming to Clemson in 1960 as head of civil engineering.

His 1961 text, "Unit Operations of Sanitary Engineering," was a pioneering work in the field. Providing a basis for the design of physical and chemical process in environmental engineering, it was one of five books and more than 50 technical papers he published in his career.

Dr. Rich retired from Clemson in 1986, but remained active and in touch with the Department. The L. G. Rich Environmental Research Laboratory was dedicated Sept. 20, 1991, and a Linvil G. Rich Fellowship Fund has



been established at Clemson by the South Carolina Water Environment Association and the South Carolina Section of the American Water Works Association. This past spring, Rich received the Order of the Palmetto, which is awarded to persons who make contributions of statewide significance.

