

# SCIENCE OLYMPIAD AT RANDOLPH MIDDLE SCHOOL

During a trip in early November, UNC Charlotte students Kurrisa Vialet, Timothy Dinsmore, Matthew Dinsmore, Neal Salas Zamudio, and Travis Carter took a trip to Randolph Middle School to share and discuss their balsa wood bridge designs. Together, these colleagues spent time with the Randolph Middle School's Science Olympiad Team to explain design configurations, run calculations, and even describe the computer modeling analysis behind their designs. The students of Randolph Middle School were extremely knowledgeable, and were inspired to think like an engineer by the UNC Charlotte students. The UNC Charlotte students had an amazing time mentoring the possible future engineers.



CEE

CIVIL AND ENVIRONMENTAL  
ENGINEERING

## IN THIS ISSUE

- |                      |                      |
|----------------------|----------------------|
| 1. CHAIR'S LETTER    | 4. RESEARCH GRANTS   |
| 2. SENIOR PROJECT    | 5. RAILWAY CHALLENGE |
| 3. COAL ASH RESEARCH | 6. SCIENCE OLYMPIAD  |

WINTER 2015

## LETTER FROM THE DEPARTMENT CHAIR

Greetings! The Civil and Environmental Engineering Department at UNC Charlotte continues to advance research, practice and policy in strategic areas. Fabulous facilities and the efforts of our talented 22 faculty, 6 staff, 400 undergraduates and 100 graduate (MS and PhD) students are the reason for our department's rise in rankings that has been among the fastest in the nation. For example, our students were selected as one of three finalist teams to compete in the Student Structural Design Competition at the ASCE Structures Congress in Portland, Oregon, in April of 2015.

In terms of research, this issue of our newsletter focuses on our timely work with coal combustion residuals (CCR), as we have more CCR expertise than any academic department in the country. However our diverse faculty are engaged in a robust array of activities across all disciplines, as

noted in our representative listing of recent research grants.

Our emeritus faculty are also receiving awards, and I hope you'll join me in a special congratulations to Professor Emeritus Johnny Graham. Prof. Graham was competitively selected to be inducted into the UNC Charlotte Alumni Hall of Fame for 2015. What a prestigious honor! Dr. Graham was in the 1st Calvary Division in Vietnam and very few of us can identify with the sacrifices he made, sacrifices which earned him the Bronze Star, Combat Infantry Badge, and two Purple Heart Medals. He was a professional engineer with many years of practice and an inspiration to students and faculty alike. I asked him for some advice, for me and all of you. He told me, "Take the profession seriously, but do not take yourself too seriously". Well



Dr. John Daniels, P.E.

said. We'd also like to hear your advice, or just an update as to what's new in your life. Drop us a line or stop by.

Dr. John L. Daniels, P.E.  
Professor and Chair



From the left are Dr. Milind Khire, Dr. Johan Enslin, Dr. Shubhashini Oza and Dr. Vincent Ogunro.

## SOUTH AFRICA WORKSHOP ON COAL RESIDUES-BRINE MANAGEMENT, ENERGY STORAGE AND RENEWABLES

This fall, Department of Civil and Environmental Engineering and EPIC, in collaboration with the Southern Company, visited South African power generating companies SASOL and ESKOM, and universities Stellenbosch and theUniversity of Western Cape. The goal of this visit was three fold: (i) to exchange ideas, experiences and technologies on coal combustion residues-steam electric power plant waste water management, (ii) to explore the feasibility of research collaboration among the participating universities and utilities, and (iii) the exchange of ideas, technologies, and students to better address issues of interest to electric power industry. The workshop took place from November 2 – 10, 2014, in South Africa, and UNC Charlotte was represented by Prof. Johan Enslin (the Director of EPIC), Prof. Milind Khire (CEE), Associate Prof. Vincent Ogunro (CEE) and Research Associate Dr. Shubhashini Oza (CEE).



# CEE LEADS COAL ASH RESEARCH AND POLICY

Concerns about power plant coal ash became issues of regional and national significance in 2014, and the expertise of UNC Charlotte's Civil and Environmental Engineering (CEE) Department was brought to bear on a number of aspects related to the issue. The CEE department has more faculty with expertise on this issue than any other engineering department in the country, with specialization in disposal, reuse and policy. Some of our equipment is unique to North America, as in the case of our Advanced Cyclic Shear Device for evaluating the effective shear strength of ash subjected to field-relevant earthquake motion.

Following the spill of tons of fly ash material at Duke Energy's Dan River coal plant in February 2014, North Carolina enacted legislation to cap or move 32 similar ash ponds in the state by 2029. CEE professor and department chair Dr. John Daniels is now leading a blue-ribbon panel of nationally recognized experts who will review Duke Energy's strategy and procedures for closing its ash impoundments. Another CEE professor, Dr. Rajaram Janardhanam, was appointed to serve on the NC Department of Public Safety's new Coal Ash Management Commission, which will develop risk-based rankings for closing the ash ponds.

Along with the Professional Engineers of North Carolina, UNC Charlotte hosted a North Carolina Coal Ash Forum on Dec. 4, 2014. The forum brought together more than 200 stakeholders involved in coal ash management to discuss constructive solutions that are environmentally sensitive and economically viable. Participants included legislators who wrote NC's Coal Ash Management Act, senior leadership from NC's Department of the Environment and Natural Resources, members of the Coal Ash Management Commission, utility executives responsible for ash pond closure, engineering firms, contractors, environmental advocacy groups, and the media.

CEE's research into the containment and reuse of fly ash has accounted for more than \$1 million in projects in the past two years. Projects include the physical testing of fly ash and wastewater to optimize stabilization, ground water modeling for areas around



Dr. Milind Khire, left, and Ph.D. student Bill Boivin test the water repellent capabilities of fly ash in a small-scale laboratory experiment.

ash basins, and the development, waterproofing and application of coal ash concrete.

An addition to CEE's expertise in coal ash was the hiring of Dr. Milind Khire in 2014, who brings a great wealth of expertise in landfill coverings. His current research includes optimizing landfill covers for the varying geography and climate of 180 municipal landfills across Texas. Through large-scale testing he has also developed improved filtering packages to prevent silting problems at methane gas landfill power generation sites in Texas.

At UNC Charlotte, Dr. Khire is now working with fellow CEE researchers to make fly ash more resistant to rain water penetration. The large-scale testing research involves using flue gas desulfurization wastewater that comes from coal plant scrubbers, mixing it with organo silanes and applying it as a bonding agent for fly ash surfaces.

**THE CEE DEPARTMENT  
HAS MORE FACULTY  
WITH EXPERTISE ON  
THIS ISSUE THAN ANY  
OTHER ENGINEERING  
DEPARTMENT IN THE  
COUNTRY...**



The North Carolina Coal Ash Forum on Dec. 4, 2014.

## RECENT CEE RESEARCH GRANTS

Representative research awards were made to the following Civil and Environmental Engineering faculty members during 2014.

- Matt Whelan, David Weggel, \$247,012 from the National Institute of Justice for post-blast investigation tools for structural forensics by 3D scene reconstruction and advanced simulation.
- Vincent Ogunro, John Daniels, Brett Tempest, \$156,090 from Southern Company for Stabilizing and Immobilizing FGD Waste Water and ZLD Solids: Cost-Effectiveness Indicator Study.
- Matt Whelan, David Young, \$97,935 from Duke Energy for the first phase of development of a low-cost, portable, and rapid nondestructive inspection tool for wood distribution poles.
- John Daniels, \$335,000 from Duke Energy to fund the National Ash Management Advisory Board.
- John Daniels, Vincent Ogunro, Miguel Pando, \$93,369 from the Environmental Research and Education Foundation for water repellency for ash containment and reuse.
- John Daniels, Milind Khire, William Langley, \$98,040 from the Southern Company for computational modeling: bench-scale, pilot-scale, and full-scale ash/gypsum/wastewater mixtures in support of zero liquid discharge applications.
- Rajaram Janardhanam, Miguel Pando, Shenen Chen, \$215,605 from the North Carolina Department of Transportation for guidelines for roadway utility excavation practices in NC regions.
- Shenen Chen, Miguel Pando, Rajaram Janardhanam, \$229,299 from NCDOT for improvement of material criteria for highway embankment construction.
- Milind Khire, \$145,000 from the Solid Waste Association of North America for geoclimatic design of alternative final covers for municipal solid waste landfills in Texas.
- Milind Khire, \$70,000 from Waste Management, Inc. for field-scale testing of hydrology of water balance covers.
- Srinivas Pulugurtha and John Chesser - \$99,366 from NCDOT for cost of independent bicycle and pedestrian facilities.
- Vincent Ogunro, Milind Khire, \$229,150 from Duke Energy for meso-scale testing of solidification/stabilization of flue gas desulfurization waste water.
- Miguel Pando, Youngjin Park, \$27,000 from the Rural Research Institute of the Republic of Korea for research on the seismic analyses of earth dams.
- David Young, \$34,004 from the Electric Power Research Institute for development of testing procedures for experimental evaluation of mechanical behavior of composite line post insulators.

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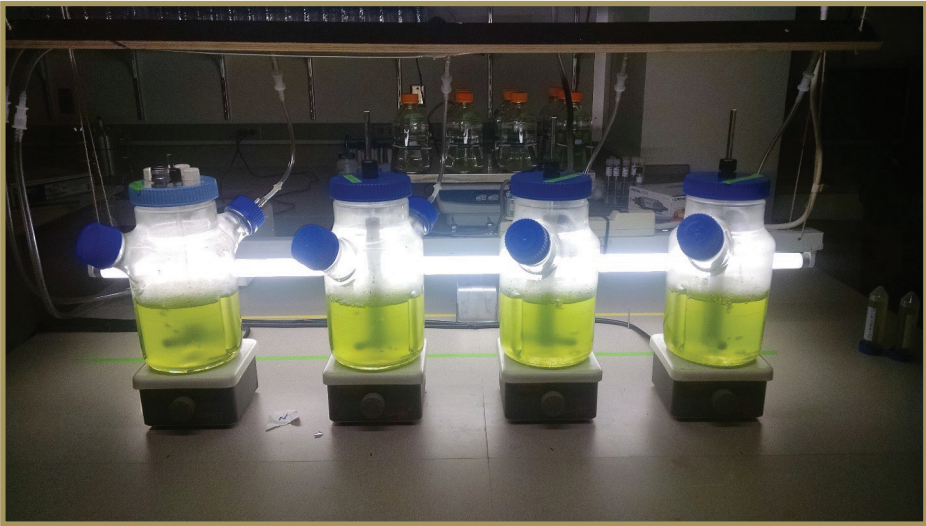


EPIC FUNDED SENIOR PROJECT INVESTIGATES  
GROWING ALGAE IN  
MUNICIPAL WASTEWATER

“Algae Bio-Reactors for Biofuel Production: Energy Production and Conservation” was a senior design project funded by EPIC for the year 2014 (Jan-Dec). The project team consisted of two students, Matt Estby and Thomas Simpson, working under the guidance of faculty mentors, Drs. Olya Keen and Shubhashini Oza and industry technical representative Dr. George Selembo.

The objective of this senior design project was to investigate the feasibility of growing algae in anaerobically treated municipal wastewater effluent and harvesting the algae for biofuel production. Anaerobically treated wastewater contains nutrients (nitrogen and phosphorus) that need to be removed before discharging the effluent to surface waters; algae need these nutrients to grow. The specific purpose of this study was to understand the nutrient removal efficiency of nine different algae, along with the production of high lipid content algae for the producing biofuels. The process was run at room temperature, as opposed to the higher temperature range typical for anaerobic treatment processes, which was another energy conserving feature.

The initial screening assisted in choosing two algae species that could meet the objectives. The selected species were evaluated in a scaled-up reactor.



SWE 2014 NATIONAL CONFERENCE

By Laura Braunfeld

The SWE National Conference was held in Los Angeles, CA, this year. UNC Charlotte sponsored three SWE members to attend. As a first-time attendee, I wasn’t sure what to expect. My plan was to observe and participate in a few events here and there, but when I arrived I stayed busy from sun up to sun down. From workshops, networking, hospitality suites, and a huge job fair, there was no shortage of things to do. The SWE conference had around 8,000 attendees this year and there is no other event like it! Being surrounded by so many women in engineering is an empowering experience and I look forward to next year’s conference in Nashville, TN! Date of Event Date: October 22nd-25th

Find UNC Charlotte SWE on Facebook: Stay up to date on news and announcements! Check out photos and more. Like us on Facebook: <https://www.facebook.com/SWEUNCC>.



The CEE department held a strategic planning meeting at the North Harbor Club in Davidson. In addition to faculty, advisory board members who participated included Kord Wissman, president of Geopier, and Hilary Davidson, sustainability director from Duke Energy.

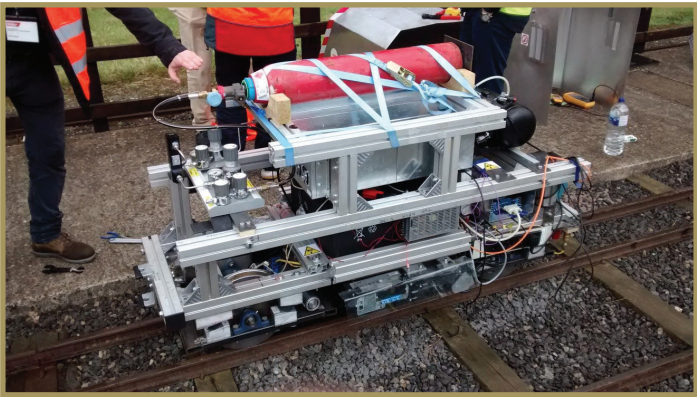
STUDENT EXPERIENCES FROM UK RAILWAY CHALLENGE

Perspectives from two CEE students who went abroad in 2014:

By Edward Washing

This past summer, I spent twelve days at the University of Birmingham (UK) as a member of the Railway Challenge Team that competed in the 2014 Institution of Mechanical Engineers (IMechE) Railway Challenge. The purpose of the competition was to promote hands-on learning for burgeoning railway professionals and to allow for experiences that test the ingenuity (and especially the patience) of the team in overcoming challenges associated with building a locomotive. The competition scored teams in seven categories (traction power, noise, ride comfort, energy storage, reliability, design, and marketability) in order to determine the winner. In previous years, the University of Birmingham team had built a hydrogen-hybrid locomotive for the competition, and this year was no different. The motivation for using hydrogen as an energy carrier is the potential for zero greenhouse gas emissions. The locomotive performed well, albeit some mechanical setbacks, but still placed first in the noise and reliability challenges.

The purpose of my involvement in the team and the product of my experience was my master’s thesis, which studied the performance of hydrogen as an energy carrier for light rail operation. While at the University of Birmingham, I had the opportunity to learn about railway engineering, hydrogen power, and the university’s in-house railway simulation software. With the software, I was able to simulate an electric, hydrogen, and hydrogen-hybrid train on the Blue Line Extension in Charlotte. My research included the energy demand and emission performance of hydrogen as an alternative energy carrier for a light rail scheme. My experience as a member of the Railway Challenge Team and master’s research helped me to grow as a researcher and student. I saw first hand the challenges associated with building a locomotive and applying advanced technologies. Then, I was able to use those experiences to complete my research and evaluate hydrogen-powered technologies in the laboratory.



Locomotive with hydrogen tank, fuel cell, and battery stack.

By Ben Gorman

Due to several key components arriving late and a busy schedule, the team had fallen behind in construction. When Gorman arrived five weeks before the competition, he started working on the motor controller. He made a script in micro basic (programming language) that collected information from sensors and controllers which in turn, controlled the power output to the two motors. He also created testing rigs for the sensors, participated in fabrication of the chassis and frame, and helped solve many problems ranging from mechanical, electrical component failures, and theoretical design issues.

Gorman’s experience with BCRRE was beneficial to multiple parties like UoB, UNC Charlotte, and their correspondents. “The amount of knowledge I had about locomotives and how they are built was only scratching the surface. I am thankful for the opportunity to work with the railway team, giving me hands-on experiences with all the subsystems that are present in current locomotives. I hope that, soon, UNC Charlotte College of Engineering can be participating in a similar railway challenge.”



Ben Gorman working on the hydrogen-powered miniature locomotive.