UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE of ENGINEERING

Newsletter: SPRING 2018

cee.uncc.edu

CEE News
CIVIL & ENVIRONMENTAL ENGINEERING Department

LETTER FROM CEE Department Chair

Here in the Civil and Environmental Engineering Department at UNC Charlotte, we are conducting many research projects at any given time. As engineering researchers, we use terms like multi-modal transportation, microbial resistance, full-scale blast testing, and bromide sequestration with ease. This is because these terms point to some of our specialty areas -- our bread and butter.

In this installment of the CEE newsletter, we feature one of our research specialties — coal ash research. We have more faculty with coal ash (and related materials) expertise than any other department in the United States. The article, entitled The Benefits of Collaboration, stresses the importance of the human factor in the perception of coal ash as a beneficial resource. And it profiles several of our faculty and graduate students as well as two alumni.

We're also proud to announce that our ASCE student chapter did exceptionally well in the Carolinas Conference competition this year. We came in 2nd Place overall, with both our Concrete Canoe Team and Steel Bridge Team being invited to the National ASCE Student Chapter Games. This is a first for our department. I'm sure you can imagine our excitement.

I would also like to add personally that this is the last newsletter for which I will have the privilege of writing the introduction. This is because at the end of June I will be finishing my term as Interim Chair. On that day I will hand back the Chair to Dr. John Daniels, who has been 'on assignment' for the past three semesters.

In this role, though temporary, I've seen the department from an entirely new vantage point. I have sincerely appreciated the experience leading the department these past eighteen months. Especially poignant for me have been opportunities to greet nearly two hundred new department alumni, and the many other times that I have represented the department to the Charlotte community.

Our graduates work in a variety of roles. Everything from engineers to educators. They reside close by in Charlotte and in far-flung locales. They are involved in some really big projects. We are very proud of them. They represent us well.

Go Niners!

James D. Bowen
Professor and Acting CEE Department Chair

CEE @ A GLANCE

UNDERGRAD STUDENTS:	DOCTORAL STUDENTS:	MASTERS STUDENTS:	FACULTY MEMBERS:
417	63	65	25

UPDATED: MAY 2018

IN THIS Issue

ASCE STUDENT CHAPTER

RESEARCH FEATURE

RESEARCH PARTNER

AIRPORT ENGINEERING

ASCE STUDENT CHAPTER @Carolinas Conference

The ASCE Student Chapter returned from the 2018 ASCE Carolinas Conference (hosted by Duke University) with a great experience, a lot of fun, and many successful competitions! The Carolinas Conference is organized every year (UNC Charlotte hosted this event last year - with great success), and brings together ASCE Student Chapters from the Carolinas and Georgia (among others, it includes UNC Charlotte, NCSU, Duke, NCA&T, Clemson, GTech, Citadel, and USC, as well as international engineering schools). Many faculty members helped our students prepare for the competitions over the past 6-8 months. Special thanks to Dr. Erika Weber who year after year attends each event, showing support to our students!

For the first time ever, this year our students qualified to compete at the National level in both Concrete Canoe and Steel Bridge competitions, while collecting a total of 21 awards (including Conference Overall 2nd place)!

The results for the individual competitions were:

- Concrete Canoe
  - » Coed Sprint: 1st Place
  - » Women Sprint: 1st Place
  - » Men Sprint: 1st Place
  - » Design Paper: 1st Place
  - » Oral Presentation: 1st Place
  - » Product Display: 1st Place
  - » CONCRETE CANOE OVERALL: 1st PLACE (qualified for the National Competition to be hosted by UC San Diego)
- Concrete Cornhole: 3rd Place
- Environmental: 2nd Place
- Hydraulics: 1st Place
- Quiz Bowl: 2nd Place
- Surveying: 1st Place
- Transportation: 3rd Place
- Steel Bridge
  - » Display: 3rd Place
  - » Construction Speed: 2nd Place
  - » Weight: 3rd Place
  - » Stiffness: 3rd Place
  - » Economy: 2nd Place
  - » Structural Efficiency: 2nd Place
  - » STEEL BRIDGE OVERALL: 2nd PLACE (qualified for the National Competition to be hosted by University of Illinois Urbana-Champaign)
  - » OVERALL 2018 CAROLINAS CONFERENCE: 2ND PLACE

Well done, Civil and Environmental Engineering Students - your hard work paid off! ◆

Courtesy: Dr. Janos Gergely, Chapter faculty advisor

The concrete canoe team, heading for the water

Paddling to victory

The entire concrete canoe team

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Follow Us:
http://Twitter.com/UNCC_CEE

SPOTLIGHTED: Publications & Presentations

Barancheshme, Fateme, and Mariya Munir. (2017). "Strategies to Combat Antibiotic Resistance in the Wastewater Treatment Plants." Frontiers in microbiology 8: 2603.

Koilada, Krupanidhi, Srinivas S. Pulugurtha, and Ajinkya S. Mane. (2018). Risk Factors Affecting Crash Injury Severity by Work Zone Area. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

Pulugurtha, Srinivas S., Venkata R. Duddu, and Praveena Penmetsa. (2018). Monetary Value of Travel Time Reliability and Thresholds Based on Random Participants Perceptions. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

Srirangam, Lakshmi Prasanna and Srinivas S. Pulugurtha. (2018). Modeling Pedestrian Crashes at Intersections Near Light Rail Transit Stations and Comparing Before-After Patterns. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

Teketi, Nutan, Srinivas S. Pulugurtha and Ajinkya S. Mane. (2018). Modeling Pedestrian Crashes at Midblock Locations. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

Duddu, Venkata R., Srinivas S. Pulugurtha, and Praveena Penmetsa. (2018). Illustrating the Monetary Impact of Transportation Projects / Alternatives Using the Values of Travel Time and Travel Time Reliability. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

Pulugurtha, Srinivas S. and Kanya K. Mukoko. (2018). Modeling Bicycle-Vehicle Crash Frequency on Urban Roads Using Demographic, Land Use and Network Characteristics. Transportation Research Board 97th Annual Meeting, Washington, DC, January 7-11.

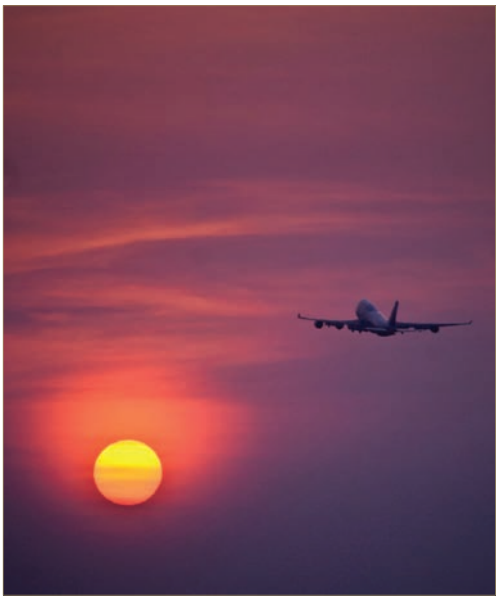
Bahrani, Babak, Faeme Barancheshme, Vivek Pulikkal, Abhisek Manikonda, Sandra Clinton and Jy S. Wu. Anaerobic Digestion of Curbside Organic Waste and Its Impact on New York City's Food-Energy-Water-Climate Nexus, UNC Conference of Nexus 2018 for Water Food, Energy and Climate, April 16-18, 2018. ◆

FALL SEMINAR: Airport Engineering

HOLD THE DATE. CEE be co-hosting an airport engineering seminar with the Charlotte Douglas International Airport October 15-16, 2018. The day-and-a-half event will take place at the Carolinas Aviation Museum at 4672 1st Flight Drive in Charlotte, NC.

This inaugural seminar is suitable for engineers, technologists and other professionals, and students of air transportation development and management. It will include training from industry experts and a tour of Charlotte Douglas International Airport.

Professional development hours (PDHs) will be available. If you would like to be added to the mailing list for updates about this event, please contact the department at cee-dept@uncc.edu. ◆



ALUMNI: Share Your News

Please send us news of your latest accomplishments, awards, or recognition.
Email your announcement to the department at cee.dept@uncc.edu.
Be sure to include your: Name, mailing address (if updated), company name, degree, major and class.

THE BENEFITS OF Collaboration

HUMAN RESOURCES

Our current and former students are important to our department. In a sense, they are our "human resources". This article shines the spotlight on several of them. Each has played a key role in the development of one of our department's internationally-recognized research areas — coal ash reuse.

CEE Alumnus (1976) and Duke engineer Tony Mathis

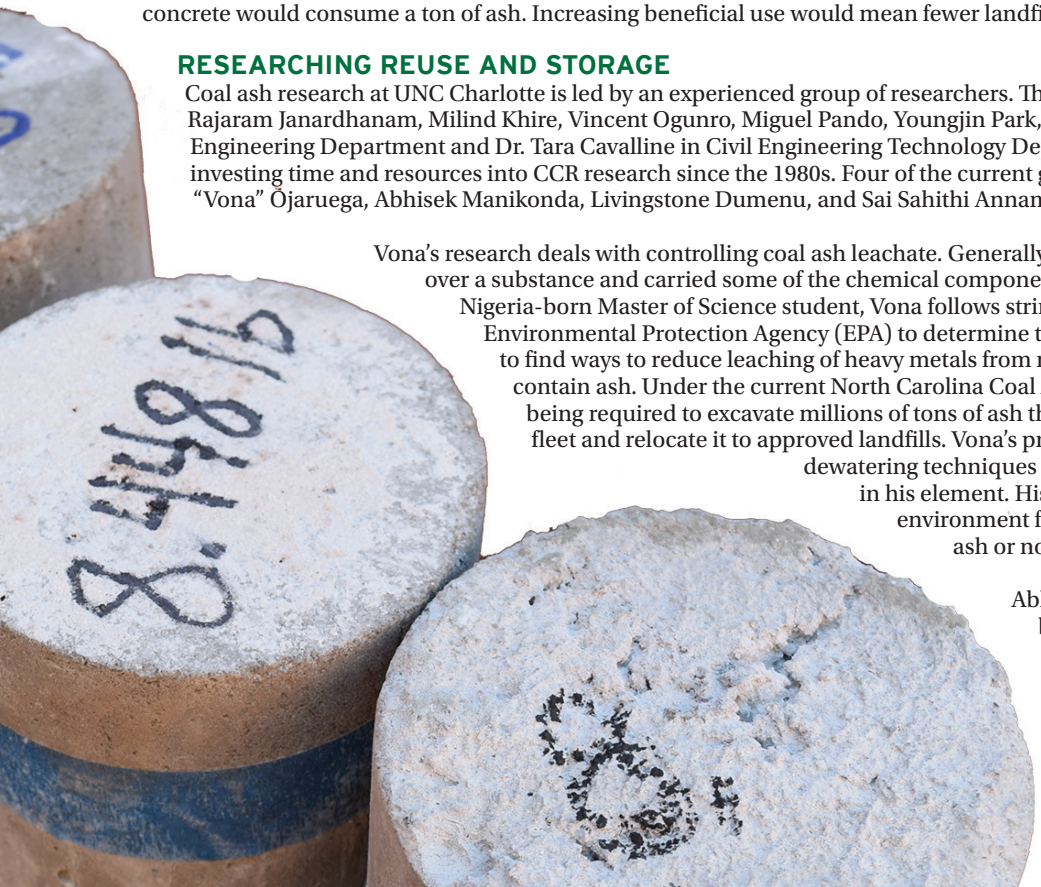
The first graduate highlighted in this article is Charlotte native **Tony Mathis**. Tony graduated from UNC Charlotte in 1976 with a BS Degree in Urban and Environmental Engineering (UEE). Tony's degree in UEE, now known as Civil Engineering, opened doors of employment with Duke Power Company (now Duke Energy). For nearly five years, Tony performed structural design on nuclear power plants for Duke. He then moved into a staff engineering position which led to a role in the Engineering Modifications Section. In this position, he focused on a variety of civil and environmental engineering projects for nuclear, fossil, and hydropower stations. In fact, he has worked on nearly every station in the Duke fleet.

One project he found especially rewarding involved using dry fly ash, a byproduct of burning coal for fuel, in ready-mix concrete formulations. The process of recycling ash is called beneficial use. In all, Tony has worked in Duke's beneficial use group for more than 12 years. He now works as a Manager of the Coal Combustion Products (CCPs) Beneficial Reuse Team.

UP IN ASHES

Coal ash reuse has environmental, economic, and materials benefits. Using fly ash as a substitute for Portland cement in concrete is common in the construction industry. This practice is known as encapsulated beneficial use, which immobilizes the chemical components of the ash, decreasing impacts to the environment. Approximately 60 million short tons of coal combustion residuals (CCR), which include fly ash, bottom ash (the heavier counterpart), and a gypsum, was beneficially used in 2016 according to the American Coal Ash Association (ACAA). Encapsulated CCR can be found in concrete, cinder blocks, wallboard, roofing materials, bricks, concrete pavers and pipes, and grout, primarily. It is an integral part of residential and commercial buildings. ACAA estimates that about 107 million tons of ash were generated in the U.S. in 2016. Research by UNC Charlotte engineering researchers like Drs. Brett Tempest and Tara Cavalline have shown that coal ash increases the strength, durability, and workability of materials in which it's used.

According to Tony Mathis, "over the last 15 years, much has changed with the coal industry and as a result, coal combustion products (CCPs) are seeing many impacts with [environmental] regulation changes." He also cites changes in energy production and public perception of coal as game changers but he is still hopeful despite the obstacles. "The challenge assigned to me and my team," says Tony, "is to utilize these CCPs into beneficial reuse instead of sending it to the landfills." One anecdotal estimate from the concrete industry is that ten cubic yards of concrete would consume a ton of ash. Increasing beneficial use would mean fewer landfills.



RESEARCHING REUSE AND STORAGE

Coal ash research at UNC Charlotte is led by an experienced group of researchers. These include Drs. Shenen Chen, John Daniels, Rajaram Janardhanam, Milind Khire, Vincent Ogunro, Miguel Pando, Youngjin Park, and Brett Tempest in Civil and Environmental Engineering Department and Dr. Tara Cavalline in Civil Engineering Technology Department. The CEE department has been investing time and resources into CCR research since the 1980s. Four of the current graduate research students include Akpovona "Vona" Ojaruega, Abhisek Manikonda, Livingstone Dumenu, and Sai Sahithi Annamraju.

Vona's research deals with controlling coal ash leachate. Generally speaking, leachate is water that has washed over a substance and carried some of the chemical components of the substance away with it. In the lab, Nigeria-born Master of Science student, Vona follows stringent research test methods outlined by the Environmental Protection Agency (EPA) to determine the composition of the leachate. He is trying to find ways to reduce leaching of heavy metals from municipal solid waste (MSW) landfills that contain ash. Under the current North Carolina Coal Ash Management Act (CAMA) law, Duke is being required to excavate millions of tons of ash that have been stored near stations in their fleet and relocate it to approved landfills. Vona's previous research included MSW landfill dewatering techniques and alternate disposal methods of CCR so he's in his element. His findings will help municipalities protect the environment from impacts from landfills whether they contain ash or not.

Abhisek, also a doctoral student, is researching brine sequestration which is a way to combine

two streams, namely ash and brine wastewater, into one single leachate-resistant matrix. Previous researchers have mixed ash with various products, but Abhisek is among the few to research how to stabilize highly concentrated brine wastewater. His research can help prevent the leaching of trace metals and halides into water supplies.

Livingstone's research holds much promise as a solution to bromide control. His latest project involves applying powerful silicon-based compounds called organosilanes to coal ash in the transition zone between wet and dry impounded coal ash. This research builds on previous projects conducted by Dr. John Daniels. Dr. Daniels compares organosilanes to Rain-X® because, once coated, coal ash particles repel water like a car's windshield in a rainstorm. Livingstone, CEE Ph.D. student who has worked on mine tailing dams and water infrastructure projects in Ghana, also possesses experience with groundwater water computer modeling and with shear strength design of reinforced concrete beams. In his opinion, "If the *right* resources are put into place to better [manage CCR], it would be a *good* resource."

Sahithi, who is pursuing her masters in civil engineering with a focus on environmental engineering has worked on a research project to use moisture-absorbing polymers to stabilize excess moisture in coal ash ponds. Sahithi got her motivation to pursue research in environmental aspects of CCR from her dad, who works as a mining engineer in India. This project builds on the research her advisor Dr. Milind Khire related to moisture control on MSW landfills. Moisture absorbing polymers can provide an alternative to dewatering or filter press when time is very short. Her research also evaluated if these polymers can reduce leaching of heavy metals from coal fly ash. According to Professor Khire, managing excessive moisture and leachate from CCR and other waste materials is key for innovation and research to shape the sustainability of our fragile environment.

CEE Graduate students: (L-to-R) Akpovona "Vona" Ojaruega, Abhisek Manikonda, Livingstone Dumenu, and Sai Sahithi Annamraju

BENEFICIAL CHANGES

Is coal ash a good resource? This next generation of engineers and researchers will continue to add to the body of knowledge about coal ash storage and beneficial use. Engineers like Tony Mathis believe CCR is good. And that reusing it is a good idea, particularly in a booming economy currently in the U.S. that encourages more construction projects. The demand for concrete is high and since using fly ash is cheaper than Portland cement, using ash just makes good sense where it is economic to do so. "You still see many of the [ancient] Roman buildings still standing that were produced using ash," he adds, pointing out one of the key benefits of using coal ash. Coal ash has been shown to be an ideal strengthening agent. The key is to use ash with just the right carbon content. Dr. Brett Tempest has conducted research on ash's strengthening qualities for Duke and NC Department of Transportation (NCDOT). Dr. Tempest is concerned that ash will be landfilled, instead of beneficially used because of public misconceptions.

Businesses and corporations like Duke will continue to partner with UNC Charlotte to the benefit of the general public. Duke's goal is to beneficially reuse more than that which is produced annually. With lessons learned from research, they are hoping to achieve this milestone within the next few years. This has been Tony Mathis' goal for many years. His responsibility is to identify and implement technologies that support increased reuse of production ash (that which is currently being produced) as well as ash that is stored in ash basins. How has he reached these beneficial use goals?

UNC Charlotte College of Engineering researchers: Drs. Tara Cavalline, John Daniels, Milind Khire, Vincent Ogunro, Miguel Pando, and Brett Tempest

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STUDENT SPOTLIGHTS

Seth Whitley

Seth, a Levine Scholar, was accepted into NC State's nuclear engineering program but after seeing the state-of-the-art high bay in the EPIC building, he chose to enroll in UNC Charlotte's civil and environmental engineering program. Both his parents are UNC Charlotte graduates.

The Marshville, NC native grew up on a 600-acre farm and is accustomed to multi-tasking. In addition to being active in the university's Venture Outdoor Leadership program, Seth is active in ASCE, and completes his Levine scholar civil engagement obligations. This summer he will be doing AIDS research in South Africa as part of the study abroad program.

Seth is a rising junior. In addition to earning a degree in Civil and Environmental Engineering, he plans to minor in Outdoor Adventure Leadership. ◆

Seth smiling at the Carolinas Conference concrete canoe race

Darvin Wilson, Class of 2018

Darvin initially came to UNC Charlotte in 2010 as a Mechanical Engineering student. The New Orleans native changed his mind about school and opted to join the Air Force Reserve instead. Darvin returned to the university in 2015 but this time, he decided to pursue Civil and Environmental Engineering, following his strong passion for "doing better" for the environment.

While at UNC Charlotte, Darvin was very active in the ASCE Student Chapter. He served as chapter president in 2017, the year that we hosted the Carolinas Conference. Darvin graduated with a BS in Civil Engineering this May. He will be working with Cardno, a land development agency in Charlotte.

Darvin is grateful for the support he received from CEE, particularly Drs. Weber, Saunders, and Gergely. We wish you well, Darvin. ◆


Darvin (left) discussing his design project at Senior Design Expo

Senior Design Success

The Spring 2018 Expo was held in May. More than 460 students participated. There were 61 completed projects that were showcased, 45 of which were completed with industry supporters. In addition, 24 posters were displayed for projects that will be completed in December 2018, 14 of them with industry supporters.

Of the completed projects that were presented at the Spring Expo, 12 were picked as finalists for Best Project. CEE's project, Matthews Land Development Project Division 2, finished in 9th place. The project supporter was Urban Design Partners (urbandesignpartners.com) out of Charlotte, NC. **Mr. David Naylor** and **Dr. Bill Saunders** were department mentors.

If you would like to support a senior design project, please contact David Naylor at 704-687-1229; dnaylor@uncc.edu. ◆

Using Concrete to Build Connections with Area High Schools

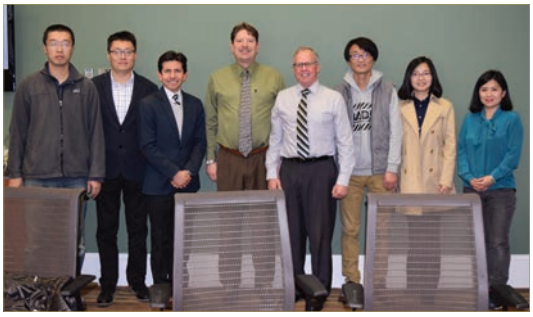
Chi Epsilon, a Civil Engineering honor society, hosted a unique event this spring. Dubbed MC² (short for "mini civil conference"), it was fashioned after the ASCE Carolinas Conference. High school students came from STEM (science, technology, engineering and math) programs in the greater Mecklenburg County area. The one-day event included contests in structural, geotechnical, transportation, and environmental engineering design. ◆


MC² attendees from Mecklenburg County area students

RESEARCH PARTNERSHIP:

Chinese University of Mining & Technology

The Department's relationship with the Chinese University of Mining and Technology (CUMT) began 20 years ago with a conference hosted by then Professor Zengfu Bian. Over the years, CEE and CUMT have partnered in mining and coal ash research. In 2017, CUMT ranked in the top 1% in the world among environmental science and engineering universities. This past spring, several Chinese scholars visited. Many of them are pictured below with Dean Bob Johnson (right of center). ◆



POSTER PRESENTATION:

Environmental Engineering Research

CEE student, **Savannah Green** presented a poster at the 2018 UNC Charlotte Undergraduate Research Conference. Her poster, entitled, Removal of Nutrient Pollution Using Biochar as a Sustainable Media. Her project invested the ability of biochar, a charcoal-like soil additive, to reduce algal blooms in rivers, lakes, and streams. Algal blooms, which consume oxygen that fish need, can result from high levels of nitrates and phosphates from water that runs off of streets, parking lots, and lawns. Dr. Mariya Munir is Savannah's advisor. The rising senior plans to pursue an MS in Civil Engineering through our Early Entry program. ◆

TRANSPORTATION CENTER UPDATE

The Center for the Advanced Multimodal Mobility Solutions and Education (CAMMSE) had a productive spring semester. Activities included attendance at the 97th Transportation Research Board (TRB) Annual Meeting in January 2018, involvement with the ITS Carolinas annual meeting, and planning efforts for the second transportation camp this summer. Five Ph.D. students of CAMMSE (Miao Yu, Zhen Chen, Pengfei Liu, Zijing Lin and Yang Li) served as a volunteer and helped organize the first annual Mini Civil Conference (MC^2) organized by CEE.

A student sponsored by CAMMSE at UNC Charlotte has graduated with a Ph.D. degree in Infrastructure and Environmental Systems (INES). Three new students (Mr. Yang Li, Ms. Zijing Lin and Mr. Pengfei Liu) from China joined the INES Ph.D. program in August 2017 and since then, they have been working as CAMMSE research assistants. Ms. Abigail Preston, though not financially supported by CAMMSE, has also been an advisee of CAMMSE Director Dr. Fan. Two graduate students have also graduated who are affiliated with CAMMSE -- Dr. Linfeng Gong with an INES Ph.D. under the supervision of Dr. Wei Fan and Ms. Ashley Hemming Graduated with a M.S. under CAMMSE supervision of Dr. Martin Kane. ◆

BENEFITS OF COLLABORATION

Livingstone (front) and Abhisek in the lab

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"[UNC Charlotte researchers] have been very instrumental and supportive in our company's direction for managing the CCPs," Tony explains, "and in researching new applications for the poorer quality products that are currently harder to beneficially reuse. We appreciate their expertise and the university's facilities to support our goal to strive for 100% beneficial reuse of all of our CCPs produced, past and present." ◆

SOURCES:
https://www.epa.gov/coalash/coal-ash-reuse;
https://www.epa.gov/coalash/coal-ash-basics;
http://www.charlotteobserver.com/news/local/article9134060.html

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HYDROGEN-POWERED TRAIN

The Summer 2018 Institution of Mechanical Engineers (IMechE) Railway Challenge in Burmingham, England will feature a sleek new train design. The 'baby' locomotive will bear the UNC Charlotte logo alongside the Birmingham University logo.

For the past several years, CEE has partnered with researchers at the Birmingham Centre for Railway Research and Education (BCRRE) at Birmingham University in a multi-year technology transfer initiative. If you would like to know more about joining this effort, contact **Dr. Shen-en Chen** at 704-687-1218; schen12@uncc.edu ◆

Mockup of 'Hydrogen Hero' train, featuring UNC Charlotte logo

GRADUATE STUDIES: in Civil & Environmental Engineering

The Department offers graduate studies leading to a master's degree (MSCE or MSE) in five areas of concentrations including environmental and water resources, structural, and transportation. Doctoral studies leading to the Ph.D. in Infrastructure and Environmental Systems (INES) are available in an interdisciplinary, inter-college program. Contact Ms. Carmalita Govan, Graduate Advisor, 704-687-1347, cgovan@uncc.edu for more information.