

Center for Transportation Infrastructure and Safety
NUTC NEWS
at Missouri University of Science and Technology



NATIONAL
UNIVERSITY
TRANSPORTATION
CENTER

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A MESSAGE FROM THE DIRECTOR — JOHN J. MYERS

Missouri's first hydrogen fueling station is now open! E³ Commons opened officially in August and since has hosted guests such as the 2008 Hydrogen Road Tour (<http://hydrogenroadtouro8.dot.gov>) and Missouri Governor Matt Blunt. CTIS researchers have been recognized for leading the way in alternative fuel technologies.

We are delighted to feature Dr. Sunggyu “KB” Lee in our faculty profile section this issue, one of our key researchers in the arena of alternative fuel technologies. Read more about Dr. Lee’s research and innovations on page 6.

On the structural side, this issue’s “What Are They Doing Now?” section features Dr. Tarek Alkhrdaji of Structural Group, Inc. in Baltimore, Maryland. Catch up with former UTC student Dr. Alkhrdaji on page 5.

This issue also features Ph.D. student Ayman Faza, who was the recipient of a NUTC sponsored GRA Fellowship. He is developing reliability models for critical infrastructures systems. Learn more on page 7.

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Other features in this issue include an update on Dr. Jianmin Wang’s fly ash research for implications in road construction and an overview of the Missouri Transportation Institute, a strategic partner in CTIS outreach.

Please enjoy this season’s newsletter and feel free to pass it on to others as well!

Warm Regards,
John

UPCOMING EVENTS

Missouri’s Railroad System

November 14, 2008
Rolla, Missouri

More info at [http://
utc.mst.edu/events](http://utc.mst.edu/events)

51st Annual Asphalt Conference

December 9-10,
2008
Rolla, Missouri

More info at [http://
asphalt.mst.edu](http://asphalt.mst.edu)

The New Mississippi River Bridge

December 12, 2008
Rolla, Missouri

More info at [http://
utc.mst.edu/events](http://utc.mst.edu/events)

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MISSOURI
S&T



ENVIRONMENTAL IMPLICATIONS OF USING FLY ASH IN ROAD CONSTRUCTION

Missouri S&T student investigators, Tingzhi Su, Tian Wang, Yulin Tang and Zhaoguo Gong, under the supervision of Dr. Jianmin Wang, Ph.D., P.E. and the sponsorship of the CTIS National University Transportation Center (NUTC) and the Electric Power Research Institute (EPRI) have been researching the environmental implications of the use of fly ash in road construction.



Fly ash samples for lab testing

BACKGROUND

Fly ash is a by-product of the power industry through coal combustion. In 2006, 72 million tons of fly ash was produced. Forty-five percent of those tons were used in the cement/concrete industry. Because of its ready availability and physical consistency, the ash has a great potential to be used for road construction. However, trace elements from the ash leaching into soils and groundwater are of high environmental concern.

OBJECTIVES

This UTC-sponsored project intends to address some of the environmental concerns of fly ash use in road construction with evaluation of the leaching behavior of several different types of ash. Arsenic (As) and selenium (Se) are two of the trace elements with potential to cause the most harm when released into the environment by leaching. Therefore, the project intends to determine control mechanisms for the release as well as to establish protocols for evaluation of potential leaching factors.

APPROACH

To meet the project objectives, investigators implemented the following steps: 1) Sample identification and initial characterization; 2) Equilibrium-based assessment of samples; 3) Mass transfer-based assessment of samples; 4) Identification of intrinsic leaching parameters for As and Se; 5) Identification of impacts of other factors on As and Se release.



Tekran 2600 Series Ultra-Trace Mercury Analysis System

BENEFITS

The completed research will allow for better predictions of the environmental impacts of fly ash when used for road construction and will offer developed technologies to prevent the release of toxic elements, improving overall road quality and promoting environmental sustainability.



MISSOURI'S FIRST HYDROGEN FUELING STATION IS NOW OPEN

A ribbon-cutting ceremony for the highly anticipated E³ (E-cubed) Commons at Missouri University of Science & Technology (Missouri S&T) was held on Tuesday, August 19, 2008. E³ Commons is the home to Missouri's first Hydrogen fueling



station and was the 26th of 33 stops in 19 states (Maine to California) for the Hydrogen Road Tour.

The Hydrogen Road Tour, sponsored by the U.S. Department of Transportation (U.S. DOT), the California Fuel Cell Partnership and the National Hydrogen Association, stopped at the Missouri S&T campus to refuel and to allow ceremony guests a chance to either ride in or test drive one of the hydrogen vehicles on tour.

Paul Brubaker, Administrator of the U.S. DOT's Research and Innovative Technology Administration (RITA) was in Rolla for the ceremony. "Please go home and email 10 people about what you saw here today," he said, "We are taking the research out of the labs, and bringing it to the streets for the American people."

Missouri S&T's leadership in raising public awareness of Hydrogen as a viable transition-state fuel and in the development of needed infrastructure has been recognized on national, state and local levels.

In a proclamation issued by Missouri Governor Matt Blunt declaring October 2008 as Energy Month, Missouri S&T was named "a leader in the research and development of alternative fuel for vehicles, helping to increase the energy independence of the United States." Governor Blunt further encouraged his support with a stop at E³ Commons on October 1, 2008.

E³ Commons is the name given for the site of several planned renewable energy, environmental and educational initiatives sponsored by Missouri S&T in collaboration with many governmental and industry partners. The university uses the equation "E³ = C" as shorthand for the slogan "energy, environment and education equals civilization."

In addition to being a Hydrogen Fueling station, E³ Commons is also the future home of the Renewable Energy Transit Depot, a new "green-building" fabricated from four recycled shipping



Photos, top down: RITA Administrator Paul Brubaker; H₂ vehicles; Gov. Blunt with Missouri S&T students



containers, the EcoCAR student design team, architectural wind turbines and a solar photovoltaic canopy.

Visit <http://ecocarchallenge.mst.edu> to learn more about E³ Commons activities.



6TH NATIONAL SEISMIC CONFERENCE ON BRIDGES AND HIGHWAYS

Over 300 bridge engineers and transportation professionals from 21 countries and 35 states gathered together July 27-30, 2008 in Charleston, South Carolina for the 6th National Seismic Conference on Bridges and Highways (6NSC), themed “Seismic Technologies for Extreme Loads.”

6NSC provided a forum for engineers and professionals to inform one another and encourage collaborative solutions to infrastructure vulnerabilities around the world. In sharing the latest codes and guidelines in geo-seismic engineering and examining specific examples of



past infrastructure damage, engineers can continue to research and work on bridge construction, retrofitting and designing for multiple hazards with new evidence and historical context in mind.

The 6NSC technical program featured over 75 presentations and keynote speakers from around the world on topics such as: Emerging Seismic Design and Retrofit Technologies; Lessons Learned from Recent Earthquakes and Other Extreme Events; Soil-Structure Interaction & Foundations; Effect of Near-Field Earthquakes on Bridges; and Risk Assessment of Highway Networks.

There were also two “best paper” awards presented. The conference included a student



design competition, a poster session, an awards luncheon and an optional boat tour of Charleston harbor and the recently completed Arthur Ravenal Jr. (Cooper River) Bridge. A technical exhibition was held, where engineers and managers were able to learn about the latest technology, products and services from company representatives in the field.

The conference was organized by the Federal Highway Administration (FHWA), the Transportation Research Board (TRB) and MCEER, University of Buffalo. South Carolina Department of Transportation (SCDOT) hosted the event at the historic Francis Marion Hotel.

Conference proceedings of nearly 100 papers are available from MCEER at www.mceer.buffalo.edu/meetings/6NSC.





CATCHING UP WITH FORMER UTC STUDENT TAREK ALKHRDAJI

As Engineering Manager of the Strengthening Division at Structural Group, Inc. in Baltimore, MD, Dr. Tarek Alkhrdaji assumes many responsibilities, including design of structural repairs; developing repair and strengthening strategies; field investigation and load test evaluation; project management and coordination; and material development and evaluation. He was directly involved in the structural upgrade of many structures nationwide, including several that received prestigious awards such as Frank Lloyd Wright's Fallingwater in Mill Run, PA and the Guggenheim Museum in New York, NY.

Structural Group, Inc. is a specialty-contracting firm that delivers services, systems and technologies that repair, protect, strengthen and reinforce concrete, steel, and masonry structures. The Strengthening Division includes several engineers with experience in structural repair, rehabilitation and strengthening of structures and supports more than 20 Structural Group offices throughout the United States.

Alkhrdaji earned a Ph.D. in Civil Engineering from the University of Missouri – Rolla (UMR, now Missouri S&T) in 2001 and a M.S. in Civil Engineering from UMR in 1998. He received a B.S. in Civil Engineering in 1992 from the University of Baghdad. Opportunities to gain knowledge and experience in new technologies and systems utilized in the restoration and renewal of existing infrastructures prompted Alkhrdaji to get involved with the UTC.

As a graduate student working with the UTC, Alkhrdaji was involved in the development of new structural repair and strengthening techniques using advanced fiber-reinforced polymer (FRP),

including theoretical studies, laboratory testing and full-scale application to bridges in Missouri. "I was able to participate in many bridge rehabilitation projects and gained a great deal of experience, not only in engineering design and construction, but also in project coordination and management," says Alkhrdaji. "I gained practical knowledge and leadership skills that have helped me pursue a successful career and allowed me to impact my profession."



Tarek Alkhrdaji, Ph.D., (left) is presented an Award of Merit.

Alkhrdaji also worked with UTC faculty to develop national design standards that are currently utilized by design professionals in the U.S. and several other countries worldwide. With encouragement from the UTC faculty, Alkhrdaji became actively engaged in professional organizations such as the American Concrete Institute (ACI), American Society of Civil Engineers (ASCE) and the International Concrete Repair Institute (ICRI).

As his career progresses, Alkhrdaji plans to grow his commitment to and leadership within the industry with field-proven techniques and technology-driven solutions. Understanding the importance of global stewardship, Alkhrdaji has a new focus on developing repair and strengthening products that reduce the carbon footprint and have a positive environmental impact. Further, he would like to advance sustainable construction practices.

Alkhrdaji lives in Baltimore, MD with his family; wife Dr. Houda Jadi, P.E. (also a UMR graduate) and their two sons, whom he enjoys playing with in the evenings. To current students, Dr. Alkhrdaji gives the following advice: "Turn your profession into a hobby. Always try to be a bit of an inventor. Participate and make noise."



SUNGGYU “KB” LEE, PH.D.
PROFESSOR OF CHEMICAL ENGINEERING

Dr. Sunggyu “KB” Lee is a Professor of Chemical & Biological Engineering at the Missouri University of Science and Technology (formerly the University of Missouri – Rolla). He joined the faculty at Missouri S&T full-time in 2006 and established the state-of-the-art Laboratory of Fuels and Polymer Processing.

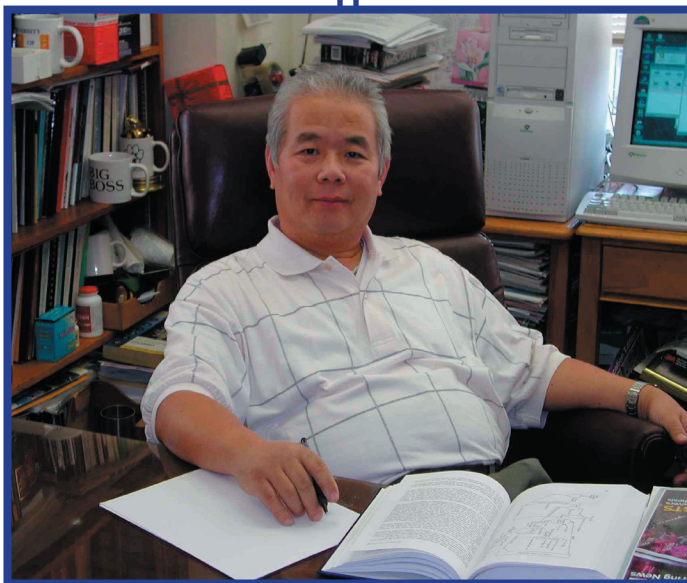
His research specialties are in the areas of transportation fuels, chemical process engineering, polymer synthesis and processing. Transportation area expertise includes coal science and technology, fuel reformation, hydrogen technology, biofuels processing, oil shale technology and methanol/DME synthesis, among others.

Dr. Lee holds 27 U.S. patents on a number of innovative novel process technologies in the fields of alternative fuels and reactive and functional polymers. He has made significant contributions to both industry and research with the development of a highly efficient process for synthetic gasoline/diesel manufacturing; work on the development of the liquid-phase methanol process for commercialization; and a number of novel applications of supercritical fluid technology, to name only a few. He has received close to 100 research grants and contracts totaling over \$12 million as Principal Investigator and \$6 million more as Co-PI. He has also designed and helped to design twenty-one pilot plants and eight commercial and demonstration plants.

Governmental agencies and industry partners in Dr. Lee’s research include the U.S. Army, U.S. DOEnergy, U. S. DOEducation, U.S. DOT, Electric

Power Research Institute (EPRI), EPA, Ohio Coal Development Office (OCDO), Kimberly-Clark, B.F. Goodrich, Goodyear Tire & Rubber and Dow Chemical.

Dr. Lee is a member of the American Institute of Chemical Engineers (AIChE), the American Chemical Society (ACS) and the National Academy of Engineering in Korea (NAEK). He has authored seven books, with two more books in progress and under contract, nine major research monographs, over 131 refereed research publications and over 300 proceedings and conference articles.



Dr. Lee is the recipient of numerous awards, including the Outstanding Teacher Award in 1987, the Outstanding Researcher Award in 1993, and the first recipient of the Louis A. Hill Award for outstanding professional achievement in 1987. He is the only professor in the University of Akron history who has received both teaching and research awards on the university level from the University

Alumni Association. He received a Distinguished Alumni Award from the College of Engineering, Seoul National University in 1994.

In 1980, Dr. Lee was awarded a Ph.D. in chemical Engineering from Case Western Reserve University. He holds a master’s degree and bachelor’s degree in chemical engineering from Seoul National University in Korea.

Visit <http://web.mst.edu/~leesu/> for more information.



NUTC STUDENT SOLUTIONS: AYMAN FAZA

Ayman Faza's research at the Missouri University of Science & Technology focuses on developing reliability models for critical infrastructures. The magnitude and complexity of major physical infrastructure systems, such as the ground transportation system, the air traffic control system and the power grid, makes their management a very challenging task. Even small faults in the system have the potential to lead to catastrophe.

In order to reduce the vulnerability of critical infrastructure systems, control schemes and monitoring devices are often implemented. While these methods normally increase the overall reliability of a system, the complexity of an already complex system is magnified and creates additional potential points of failure.

Faza's research, which can basically be applied to any critical infrastructure system, develops mathematical models to quantify the reliability of infrastructure systems and estimate the effects of adding control and monitoring devices to the system.

The complex interactions between different components in the system being studied

caught Faza's interest. "The problem is a very challenging one," he says, "Evaluating the reliability of critical infrastructures will help to ensure a more resilient infrastructure." A more resilient infrastructure would certainly have social and economic impacts, as well as improve quality of life for many.

The high caliber of research and a welcoming international community lead Faza to pursue his doctoral studies at Missouri S&T, saying "Missouri S&T is an excellent University that meets my educational needs." After receiving his Ph.D. in Computer Engineering, Faza plans to pursue a career in research and development in either industry or academia. "My hopes are that this work will have a positive impact on future research," says Faza.



Faza comes from Amman, the capital of Jordan. He completed a Bachelor of Science in Electrical Engineering at the University of Jordan in 2003. With a 2-year Fulbright Scholarship, Faza earned a Master of Science in Computer Engineering from Missouri University of Science & Technology in 2007.



MISSOURI TRANSPORTATION INSTITUTE: PAST, PRESENT AND FUTURE

The Missouri Transportation Institute (MTI) was started on November 10, 2004 by the Curators of the University of Missouri and the Missouri Highways and Transportation Commission with the intent of establishing a nationally recognized transportation research center to develop and execute multi-modal transportation related education, public policy and research projects in Missouri. MTI was administratively located at and managed by the University of Missouri – Rolla (now Missouri University of Science & Technology) with a commitment from the Missouri Department of Transportation (MoDOT) to support half of the administrative operational costs.

Originally, ten public and private Missouri universities and the MoDOT formed MTI's Consortium. The Consortium included each branch of the University of Missouri as well as Lincoln University, Midwest Research Institute, Missouri State University, St. Louis University, University of Central Missouri and Washington University in St. Louis.

In June 2007, at the recommendation of MoDOT Chief Engineer Kevin Keith, a task force formed with the objective of developing a new operating plan for MTI. The task force was comprised of K. Krishnamurthy, Missouri S&T; Chair, Sam Kiger, University of Missouri – Columbia (UMC); Charles Nemmers, UMC; Mark Virkler, UMC; Genda Chen, Missouri S&T; John Myers, Missouri S&T; Angie Rolufs, MTI; and Mara Campbell, MoDOT.

The task force presented a proposal for a two-year, scaled-back operating structure for MTI which would narrow both size and scope in order to develop a stronger foundation of successful transportation research. Recommendations included: 1) reduce the size of the MTI consortium to the University of Missouri system schools and MoDOT only, 2) reduce the scope of the research to Structures and Geotech – two areas in which participants had the strength to develop a national transportation

research reputation for the state of Missouri; and 3) create a two-year program of research in the Geotech and Structures areas to allow for longer-term research that would provide the atmosphere for successful collaboration between MoDOT and the participating universities.

Long-term structural research projects include the following: Structural Steel Coatings for Corrosion Mitigation; Spalling Solutions for Pre-Stressed Pre-Cast Bridge Deck Panels; Reliability-Based Evaluation of Bridge Components; Coated Steel Rebar for Enhanced Bond Strength and Corrosion Resistance; and Alternative and Cost-Effective Bridge Approach Slabs.

The long-term geotechnical research program will focus on various tasks that are necessary to quantify and appropriately account for risk in the design of foundations and earth slopes, leading to the development of revised Load and Resistance Factor Design (LRFD) specifications.

The research conducted with MTI will address the needs of MoDOT while creating a foundation for future national-level collaborative research opportunities. Research programs will receive financial support from MoDOT's State Planning and Research Fund; the NUTC at Missouri S&T; and UMC's Department of Civil Engineering.

During the two-year implementation of MTI's new operating structure, Angela Rolufs will continue as MTI's Director, assisting Missouri S&T faculty with coordination of transportation research and identification of proposal opportunities. She will provide outreach for the Missouri S&T NUTC and is also committed to a research project for the Federal Transit Administration which explores alternative sources of energy to power transit vehicles; and a grant from the Federal Highway Administration for a Transportation Education Development Pilot Program. Charlie Nemmers will

Continues on the next page...



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continue to assist UMC faculty with coordination of transportation research and identification of proposal opportunities, and the two will work together in coordinating the collaborative research efforts of the two campuses.

New agreements to reflect the commitment between MoDOT and the Curators of the University of Missouri have been developed and signed. One will help to make execution of research agreements within the Consortium more efficient and the other will solidify the commitment of the state organizations involved to collaborate on the development of a national transportation research reputation for the state of Missouri.

The new MTI structure will allow the University of Missouri campuses to collaborate on building a foundation of successful transportation research at the state and national level. Following the two-year timeframe, and the creation of a successful collaborative research entity, MTI will propose a formal operating and funding structure. It is anticipated that MoDOT will continue as a partner in this new structure, but will be just one of multiple funding sources for the future MTI.

Contributed by Angela Rolufs, MTI Director

BROADCAST: HYDROGEN RESEARCH AT MISSOURI S&T

On September 19, 2008, CTIS Researcher and Associate Professor of Engineering Management & Systems Engineering at Missouri S&T, Dr. Scott Grasman and Ph.D. student of Engineering Management & Systems Engineering at Missouri S&T Kevin Martin, were guests on TechnoFiles, a monthly program on public radio KMST.

Dr. Grasman and Mr. Martin talked about current hydrogen research and activities at Missouri S&T and in the world. Many aspects of developing a hydrogen economy were discussed, including: hydrogen infrastructure modeling and its future; public perceptions around safety and reliability; and current technologies in transportation and energy, including fuel cell technologies.

Listen to the full broadcast at: <http://podcast.mst.edu/technofiles.rss>

TechnoFiles airs the 3rd Friday of each month and highlights research at Missouri S&T. The program is hosted by Dr. Wayne Heubner, Department Chair of Materials Science & Engineering at Missouri S&T.

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