Department Newsletter
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Drexel to Host Major Indoor Air Quality Conference in 2018

by Dr. Michael Waring

We Americans spend about 90% of our time inside buildings. While inside, we are breathing indoor air that can be much more polluted than outdoor air, for some major types of pollutants. This pollution largely comes from indoor emissions by building materials, as well as occupant activities such as cooking and using cleaning products or pesticides. Exposure to this pollution has real impacts on Americans, and the US Environmental Protection Agency has ranked exposure to indoor air pollution as one of the top five risks to American public health.

On July 22 to 27, 2018, led by Conference President Michael Waring, Drexel will host the fifteenth iteration of the Indoor Air conference, which is the flagship conference of the International Society for Indoor Air Quality and Climate (ISIAQ). This large, international conference has been hosted all around the world, in recent locations such as Austin, Texas, Hong Kong, and Ghent. It is a week long meeting of the international indoor air community to foster networking, exchange of ideas, and discussion of the latest indoor air science.

The Indoor Air Conference reflects the breadth of ISIAQ's efforts as a society, with a scientific program that is as diverse as its members, which hail from over 100 countries. Indoor Air 2018's technical program covers all research areas related to indoor air quality and climate: from basic chemistry and physics related to the indoor environment, to source and airflow fundamentals, to epidemiology and health effects due to indoor pollutant exposure.

The conference's top quality program will include multi-disciplinary collaboration, platform talks and workshops, interactive poster sessions, short courses, and social activities, all of which will make Indoor Air 2018 an exceptional and unmissable event for the indoor air community.

Dr. Sabrina Spatari Returns from Very Active Sabbatical in Israel

by Dr. Sabrina Spatari

This past academic year, I took my first research sabbatical from my eight year tenure at Drexel. I spent the majority of my time at the Technion Israel Institute of Technology in Haifa, Israel, where I worked with faculty in the Civil and Environmental Engineering Department to study new and recycled construction materials using life cycle assessment (LCA) methods, my expertise. With Professor Kosta Kovler at the Technion, I have been examining alternative materials and methods for reducing the greenhouse gas intensity of building materials, especially cementitious materials. Along with masters student Simon Ulka, and post-doc Dr. Alex Mezhov, Kosta and I have begun a project to examine the life cycle environmental and cost trade-offs of adding industrial by-products (wastes) during cement grinding to improve the sustainability of cementitious binders, both in terms of durability (service life) and environmental performance. The project builds on ongoing experimental work that Kosta has been doing to recycle industrial residues in new building materials, and to test their durability and mechanical properties. Modifiers such as surfactants, that can be extracted from pulp mill residues, can introduce beneficial properties in cementitious binders owing to mechano-chemical activation. Therefore, their project aims to estimate the economic and life cycle environmental trade-offs of the cementitious binders, including examination of their projected service life performance. Ordinary Portland Cement (OPC) is one of the most heavily used commodities in the building industry. Approximately 3.6 billion tons of OPC are produced globally each year to supply binder for more than 50 billion tons of concrete and cementitious products[1, 2]. At the same time, OPCD is responsible for 5%-10%[3] of global anthropogenic greenhouse gas (GHG) emissions, as well as the consumption of energy resources. Thus, finding low-carbon substitutes for OPC is critical towards meeting climate change mitigation goals.

Understanding the environmental and cost trade-offs of using recycled construction materials in new construction requires systematic analysis. Life cycle assessment (LCA) is a valuable analytical tool for guiding engineering decisions, especially material design choices since they affect the performance of infrastructure and the built environment. Often it is not clear whether a design choice meant to reduce waste, such as recycling post-consumer or industrial waste, will lead to improved environmental outcomes systematically, since these materials may require additional processing energy and chemicals to improve material properties, or they still may not meet durability requirements, and thus require early replacement. Using LCA modeling software, we are building models to explain the trade-off of the additional energy, resources, cost, and capital involved in pursing this pathway. This project complements other work I am doing at Drexel with Drs. Grace Hsuan and Yaghoob Farnam, and Dr. Pieter Billen, former Drexel post-doc and now Assistant Professor at the University of Antwerp in Belgium. Our NSF-funded project investigates using coal bottom ash, a residue from coal combustion in power plants, to manufacture lightweight aggregates, where there is a trade-off in using additional energy and chemicals to process waste materials using high temperature processes to manufacture building materials that meet design life requirements.

In addition to research with the National Building Research Institute, I taught a class on life cycle assessment in the Civil and Environmental Engineering Department in the fall. Students learned different LCA frameworks, including process-based and economic input-output LCA and applied these tools to current civil engineering design and public policy decisions in Israel. Projects included alternative road construction materials, alternative fuels and propulsion systems in Israel's public transport bus fleet, and life cycle uncertainties in building retrofitting. Students learned to apply Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model, a life cycle assessment program that provides primarily life cycle inventory data for transportation fuels, but additionally for electricity, as well as thermal energy provision. As a class, we collected data to characterize Israel's electricity generation mix and parameterized GREET to reflect Israel's forecasted power supply. Using GREET and Carnegie Mellon's EIO LCA tool, students Simon Ulka and Michael Goren examined the environmental consequences of Tama 38, a policy in Israel that incentivizes builders to add floors to existing low-rise apartment buildings and add energy efficient retrofits such as insulation and improved heating ventilation and air conditioning (HVAC) systems. The students found economic benefits, in addition to energy and GHG emissions reduction when new and existing apartment units were retrofit with foam insulation and wall-mounted air conditioning units. The study demonstrated the utility of

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life cycle cost and environmental calculations, not only for guiding green design of buildings, but also as a test of policies aimed at incentivizing growth of the built environment.

Over this year, I visited many other research institutions in the holy land, as well as Europe, to learn about work on renewable energy, energy and buildings, and the circular economy as it pertains to building materials. In July, I visited Ben Gurion University in the Negev to meet with Professors Shabtai Isaac, Almah Peled, and Erez Gal in the Department of Structural Engineering to learn about their work on emerging building materials, such as hemp-crete and zero net energy buildings. In January, along with Professor Mira Olson of CAEE and undergraduate student Bryce Peckman, I visited the Arava Institute to learn about Dr. Olson's collaborations in Peace Engineering. In December, I visited Tel Aviv University's Porter School of Environmental Studies and Mechanical Engineering to speak about my research on LCA of low carbon transportation fuels.

Finally, in July, I spent a week at the Technical University of Vienna and was hosted by Professor Helmut Rechberger, the director of Institute for Water Quality, Resource and Waste Management (http://iwr.tuwien.ac.at.en/home/). I gave a lecture at the institute on my research on biomass, bioenergy, and bio- and recycled materials.

My stay at the Technion and in Israel and TU Vienna was most hospitable. Over the academic year, I visited archaeological sites, hiked in the Golan Heights, visited the desert and Dead Sea, and experienced the rich cultural and intellectual life offered in Haifa, Tel Aviv, and Vienna.

1 U.S. Geological Survey (2016); https://minerals.usgs.gov/minerals/pubs/commodity/cement/mcs-2016-cemen.pdf, accessed on April 23, 2017.

2 Marceau, L, M Nisbet, M VanGeem (2006) Life Cycle Inventory of Portland Cement Concrete, Portland Cement Association

3 See also; Worrell, E, L Price, N Martin, C Hendriks, L O Meida (2001) Carbon Dioxide Emissions from the Global Cement IndustryAnnual Review of Energy and the Environment 2001. 26: p. 203.

Boesch, M E, S Hellweg (2010) Identifying Improvement Potentials in Cement Production with Life Cycle AssessmentEnvironmental Science & Technology. 44(23): p. 9143-9149.

Marceau, L, M Nisbet, M VanGeem (2006) Life Cycle Inventory of Portland Cement Manufacture, Portland Cement Association.

CAEE Student Awards

Bahar Riazi (pictured right), an Environmental Engineering Ph.D. student, has been selected as recipient of the 2017 Claudio Elia Memorial Fellowship for $5,000. This fellowship was established in memory of Claudio Elia, an international business leader in environmental science and environmental engineering.

Bahar Riazi

Yetunde Sorunmu (pictured below), an Environmental Engineering Ph.D. student, received the Wesley O. Pipes Student Award this year for $1,000. Professor Pipes was a long time faculty member of the department and this award was established in his honor after his death. Yetunde also received the Association of Environmental Engineering and Science Professors (AEESP) conference student travel award sponsored by Carollo.

Walter Yerk (pictured right), an Environmental Engineering Ph.D. student, was the recipient of the Student Poster Presentation Award of the 2016/2017 academic year by the Philadelphia Metropolitan Area Section of the American Water Resources Association (AWRA-PMAS). Walter received this award because the AWRA-PMAS Scholarship Committee was very impressed with his research activities.

Walter Yerk

Dr. Kerry Hamilton (pictured below), a recent graduate of the Ph.D. program in Environmental Engineering and a current post-doc in the CAEE Department, received the College of Engineering Award and the Drexel University Graduate College Award for Outstanding Dissertation.

Frank-Nelson Musemate (pictured below), a Senior in Civil Engineering, was awarded the American Concrete Institute (ACI) Baker Student Fellowship. This fellowship provides $7,000 toward tuition costs for the 2017-2018 school year.

Finally, **Professor James Mitchell** and his Senior Design Group consisting of **Matthew Cimino, Ajani Curwen, Patrick Gillen, Kerry May,** and **Mary Nelson** (pictured below) received 3rd Place in the "Best of Senior Design" for their design of the "Drexel Sprout Center."

Dr. Kerry Hamilton with Dr. Haas

Yetunde Sorunmu

Frank-Nelson Musemate

Interim Dean Palmese with students and Professor Mitchell

Department Promotions

Dr. Peter DeCarlo

On September 1, 2017, Peter DeCarlo, Ph.D. (pictured left), will be promoted to Associate Professor of Environmental Engineering. Dr. DeCarlo's research focuses on outdoor air quality, particulate matter size and composition instrumentation and measurements, source appointment of ambient particulate matter, and climate impacts of particulate matter.

On September 1, 2017, Robert Brehm, Ph.D. (pictured right), will be promoted to Teaching Professor of Civil and Architectural Engineering. Dr. Brehm's interests include international infrastructure delivery, response to natural catastrophes, risk assessment and mitigation strategies, and project management techniques.

Dr. Robert Brehm