Research Highlight

Cold Climates & Vehicle Emissions: The Cold Start Air Toxics Pulse

Though very short (<120s), cold start emission rates of pollutants are thousands of times greater than engine idling or running emissions and are a strong function of ambient temperature. Engine starts during the morning rush hour produce a large pulse of air toxics emissions that get trapped under low lying temperature inversions. This produces high concentrations of pollutants and enhances human exposure to disease causing compounds. People living in colder climates may be experiencing much greater exposure to compounds that lead to cardiovascular disease and cancer.

Dr. Tom Jobson, a professor in the Department of Civil and Environmental Engineering, Washington State University, became interested in cold start emissions after realizing that while vehicle emissions had a large impact on ambient pollutants it was the cold start emissions that were the biggest source of pollution from vehicles. "In the winter
time the catalytic converter becomes very cold causing the vehicle to emit a huge plume of unburned and partially burned fuel out of the exhaust when turned on. The big fraction of the pollution we breathe in is from the first 60 seconds of when you start your car,” said Jobson. The colder it is the worse it is. Additionally, research on this matter isn’t very well documented. Attention has been focused on vehicles in warm, urban places that have air quality problems but not much attention has been focused on the small, cold towns that struggle with pollution.

Dr. Jobson and his team are using sophisticated high time resolution equipment to measure on a second by second basis what is coming out of a vehicle. The team uses an old building on campus where they have parked their mobile atmospheric chemistry lab in. They use an objector dilutor that if you flow a stream of air into creates a small vacuum and can pull a stream of air from another port. This allows the team to sample the vehicle exhaust. This past winter the team was able to sample cold emissions from five different vehicles. The biggest difference among the vehicles was the amount of time it took for the vehicle to stabilize and return to idling emission levels. Ultimately, they hope to create a more accurate assessment of how cold climates engine start emissions impact ambient concentrations of air toxics and the potential role of ethanol in gasoline in enhancing winter concentrations of formaldehyde and acetaldehyde.
Educational Outreach

Kids2College

On April 15th, 450 elementary school students from Fairbanks, Salcha, Delta and Tok area came to the University of Alaska Fairbanks (UAF) to experience a day in the life of a college student. For six weeks the students have been learning about college and careers. The goal is to have them start to prepare now for college by saving money, making a plan and getting good grades. Students were even able to attend mock college classes, receive a tour of campus, and have lunch with college students.

CESTiCC was happy to participate in Kids2College for the second year in a row. Dr. Sheng Zhao gave a presentation to show 23 students from Fort Greely School the unique engineering challenges of transportation infrastructure in cold regions such as Alaska and how to reduce environmental impacts during construction. Dr. Zhao and undergrad student Paul Eckman gave a lab tour where students were able to see equipment and testing specimens to simulate real world situations. It was a great opportunity to share with students the many positive impacts civil engineers can have in the world.
Technology Transfer

Webinar Series

In April, CESTiCC paired up with Louisiana Transportation Research Center Pavinars to present *High Content Recycled Asphalt Pavement up to 100% Recycling* by Dr. Martins Zaumanis from Latvian State Roads and Dr. Nima Roohi Sefidmazgi from Green Asphalt LLC. Asphalt is the most recycled material in the USA at a re-use rate of 99%. However, by average only about 20% of reclaimed asphalt pavement (RAP) is used in a given mix design and a large part of the RAP is degraded for use in lower value applications. The amount of RAP in asphalt mixtures can be significantly increased with the application of good RAP management practice, readily available modern production technologies and advanced knowledge of mix design. The presentation summarized the state-of-the-art technology for increasing the amount of RAP in asphalt mixtures above 40% and all the way up to 100%. A recording of the presentation can be found on the Pavinars website.

In May, CESTiCC invited Dr. Marcel Huijser from Montana State University to present in our webinar series. Dr. Huijser’s presentation on *Reliability, Effectiveness and other Considerations for Design, Implementation and Maintenance* provided a summary of considerations for the design, implementation, and maintenance of animal detection systems. The presentation was very well attended and generated numerous questions and positive feedback among the attendees. Dr. Huijser explained that while wildlife warning signs are among the most frequently used mitigation measures aimed at reducing wildlife vehicle collisions (WVC), these standard and enhanced warning signs are unlikely to be effective in reducing collisions. Their widespread use may be primarily because of engrained practices, relatively low cost, a desire to inform the public about the impact of WVC on human safety and nature conservation, and possible litigation concerns. If you would like to read more on Dr. Huijser’s work on animal detection systems you can download the presentation from the CESTiCC website.

MEPDG Peer Exchange Meeting

On April 14-15, 2015, pavement professionals from Northwest states including Alaska, Nebraska, South Dakota, North Dakota, California, Idaho, Montana and Washington were invited to share state experiences with the Mechanistic Empirical Pavement Design Guide (MEPDG) at the FHWA’s MEPDG Peer Exchange meeting in Portland, Oregon. Attendees presented varied topics on AASHTOWare Pavement ME Design, materials, design, climate, traffic, performance prediction and validations, implementation and local calibrations. Associated lessons learned and challenges were discussed as well. On behalf of the state of Alaska, Dr. Steve Saboundjian, Statewide Pavement Engineer at AKDOT&PF and Dr. Jenny Liu, Director of CESTiCC, presented findings in *Characterization of Alaska Transportation Materials* (hot mix
asphalt, granular base, and asphalt treated base course materials) for ME Pavement Design through several AKDOT&PF funded research projects.

CESTiCC Research in USDOT April Newsletter

CESTiCC's research on bio-based renewable additives for sustainable roadway snow and ice control operations was recently featured in the USDOT's University Transportation Center Spotlight Newsletter. Each month a new University Transportation Center is showcased to share what research is being done. In the April edition, the USDOT wrote an extensive article that highlighted Dr. Xianming Shi's innovative research on environmentally friendly available anti-icing formulations for snow and ice control on highways and CESTiCC's accomplishments as a UTC.

ASCE Books in Press

CESTiCC is hosting the International Symposium on Systematic Approaches to Environmental Sustainability in Transportation (ISSAEST) on August 2-5, 2015, at UAF. Based on a rigorous peer review process, 59 technical papers were selected and included in the symposium proceedings (ASCE special publications) by ASCE Construction Institute (CI). The symposium proceedings were categorized into two e-books according to two areas: 1) Innovative Materials and Design for Sustainable Transportation Infrastructure, including 37 papers in three sections, 'Context Sensitive Solutions in Pavement Materials', 'Geo-Materials, Soil Stabilization and Ground Improvement', and 'Sustainable Design in Underground Space, Tunneling and Railway Engineering'; 2) Environmental Sustainability in Operating, Preserving, Managing, and Assessing Transportation Infrastructure, involving 22 papers in three sections, 'Managing Stormwater Runoff through Improved Monitoring, Advanced Technology, and Pervious Concrete', 'Reducing Environmental Impacts during Construction, Operations, and Preservation', and 'Life Cycle Costing and Assessment, Energy Consumption, and Environmental Assessment'. The two e-books were submitted to the Publications Division of ASCE in April 2015, and to date, are in press.

Dr. Xiong Zhang Presents in China

In May, Dr. Xiong Zhang was invited to visit several institutions in China including
Wuhan Polytechnic University; Institute of Rock and Soil Mechanics, Chinese Academy of Sciences; Beijing Jiaotong University; Chinese Academy of Railway Sciences; Beihang University; and National Center for Materials Service Safety. Dr. Zhang shared his extensive research experience on advanced testing techniques for soils, constitutive modeling of unsaturated soils, numerical simulation of climate-soil-structure interaction, and mitigation of frost-heave and thaw-weakening with Chinese peers through presentations and discussions. Some of the presentation topics were *Use of Wicking Fabric to Dehydrate Road Embankment under Unsaturated Conditions*, *Modeling Residential Buildings on Expansive Soils in Response to Climatic Conditions*, and *Limitations of Suction-Controlled Triaxial Tests in the Characterization of Unsaturated Soils*. Dr. Zhang also toured research facilities at these institutes. Researchers all showed great interest in broad collaborations in research, education, and dissemination in the future.

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**Our Students**

![Paul Eckman](image)

Paul Eckman recently graduated from UAF with his bachelor’s degree in civil engineering. Paul originally became interested in transportation engineering through Dr. Jenny Liu’s Introduction to Transportation class. “It’s something that is always going to be needed. We will always need airports and roads,” Eckman said. “The logistics behind transportation is massive so there are many avenues you can take in the field. I decided to be an engineer because I wanted to help people and also benefit the community. The roads I build will help thousands of people go from point A to B or thousands of people can sit in a stadium and safely watch a game. What I will be doing is super important and necessary, which is what I want to do with my life.”

Paul has worked in Dr. Liu’s group on a variety of research projects. He studied asphalt pavement such as preservation and rehabilitation and also participated in the crack seal survey project, which analyzed the utility of sealing cracks. Paul was also in charge of specimen preparation and testing for the projects he worked on such as characterizing Alaskan hot mix asphalt with reclaimed asphalt pavement and using paving interlayers in asphalt concrete. Paul noted that his work with CESTiCC has allowed him to network with people in the field, especially DOT employees. This has
given him a realistic picture of what it is like to be a transportation engineer. Paul has actively participated in CESTiCC’s numerous outreach initiatives, particularly with K-12 students. “I’ve had fun getting to participate in the lab demonstrations and outreach initiatives with the community, especially the kids. I enjoy communicating with non-engineering minded people.”

Upon graduation, Paul received a job offer from AKDOT's aviation and highway design team to begin his career as an engineering assistant I in Anchorage. When he isn't studying or working Paul enjoys spending time with his wife Cara, son Jared and the newest addition to their family, daughter Olivia.

Tony Mullin was recognized in April as an influential person in a first or second year student’s academic career at the University of Alaska Anchorage. Tony worked for 25 years in the private industry where he earned a Master’s degree while working full time. Currently, he is pursuing a Ph.D at the UAF with Dr. Jenny Liu as his advisor. While pursuing a Ph.D in civil engineering he has worked on research projects, collecting and analyzing data, writing literature reviews, co-authored and authored papers pertaining to pavement preservation in Alaska, crack sealing of thermal cracks in asphalt roads in Alaska, and a proposal of using the Micro-Deval aggregate test for aggregates used in Alaska instead of the current method. Currently, Tony is also an adjunct faculty teaching at the University of Alaska Anchorage.

Lin Li passed his Ph.D dissertation defense on March 26, 2015. The topic of the dissertation was Evaluate Unsaturated Soil Behavior Using Constant Water Context Triaxial Tests.
Lin Li received his bachelor's degree from Chang'an University, China in 2004. After working at the Institute of Harbor Survey and Design in Anhui Province as a technician for highway design (field survey, pavement structure, and highway alignment) for one year, he returned to Chang'an University in 2005 for his first master's degree and graduated in July of 2008. The research topic was Structure Design for Highway Underlying with Over-Wetted Soil. He came to the United States at the end of August 2008 and started to work on his second master's degree on Impact of Fines Content on Resilient Modulus Reduction of Base Courses during Thawing under the supervision of Drs. Xiong Zhang and Jenny Liu. He received the second master's degree in 2010 and then continued on with his Ph.D. study under the supervision of Dr. Xiong Zhang.

During his master's and Ph.D studies at UAF, he has published 10 journal papers, 10 conference papers, and five project reports. He has also presented his research at professional meetings such as Transportation Research Board (TRB) Annual Meetings in 2011 and 2015, the 10th International Symposium on Cold Regions Development in Anchorage, Alaska, 2013, and the International Symposium of Climate Effects on Pavement and Geotechnical Infrastructure in Fairbanks, Alaska, 2013.

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**View Upcoming Events**

- **Summer Transportation Institute.** June 8 - 12, 2015: CESTiCC will be co-hosting the Summer Transportation Institute with Alaska Local Technical Assistance Program Center and the Alaska Tribal Technical Assistance Program Center. This 5-day training workshop will engage participants in lectures, lab tours, and field trips with various topics on transportation infrastructure in a rural and cold environment. This program will provide training certificates and professional development hours to participants. For more information, please view the [STI website](http://us9.campaign-archive2.com/?u=221e632be6c0bf884e9fc077b&id=b078ccb54f).

- **CESTiCC Project Update Meeting.** June 16 - 25, 2015: In the interest of keeping track of project progress and ensuring timely delivery of project results, CESTiCC and its partner agencies will be holding project progress update meetings for all Year 1 projects in June.

- **International Symposium on Systematic Approaches to Environmental Sustainability in Transportation.** August 2 - 5, 2015: The symposium aims to provide a forum for professionals to discuss environmental challenges associated with design, construction, and maintenance of multimode transportation systems. It will also serve as a showcase of recent development, practices, and advances to maximize environmental sustainability. The symposium will include workshops, keynote speeches, technical sessions and field trips. A **tentative program** and **sponsorship opportunities** are now available. [Online registration is open!](http://us9.campaign-archive2.com/?u=221e632be6c0bf884e9fc077b&id=b078ccb54f)
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