

Technical Highlights April 2013

Fuels, Engines, and Emissions Research Center (FEERC) Staff Organize and Participate in Multiple Events during Society of Automotive Engineers (SAE) World Congress Week

FEERC staff contributed to 18 technical papers and 2 oral-only presentations at the annual SAE World Congress in Detroit, Michigan. Nine of these papers were selected for journal publication and one of the papers on the effects of air conditioner use on real-world fuel economy received special coverage in the SAE Vehicle Engineering Magazine. FEERC staff participated as organizers of multiple technical sessions and two special events that included the international SAE High Efficiency Engines Symposium and the Vehicle Data Jam which is sponsored by the White House Council on Environmental Quality, the Department of Energy (DOE), and the Department of Transportation. In addition, staff participated in meetings of the SAE leadership as members of multiple technical committees, the Powertrain Fuels and Lubricants Executive Committee and the Engineering Meetings Board. Two FEERC staff were also awarded the status of SAE Fellow.

The Oak Ridge National Laboratory (ORNL) Team Develops a Safe and Novel Means for Rapid Aging of Catalysts in Natural Gas Engines

A research team that included Mike Kass, Brian Kaul, Maggie Connatser, Sam Lewis, and Todd Toops successfully devised and evaluated a method of introducing lubricant oil to the engine exhaust of a running natural gas engine. The approach uses a commercial oil burner to combust a solution of oil and diesel fuel. A portion of the burner exhaust is introduced to the intake of a natural gas engine where it serves as a diluent during combustion. Preliminary analysis of the burner and engine exhaust gases has shown that the resulting engine exhaust chemistry is sensitive to the initial concentration of lubricant components. Standard lubricant formulations produce similar gas chemistry with or without the burner addition.

ORNL Vehicle Idling Best Practices Guide Highlighted by DOE Sustainability Performance Office

ORNL researcher Scott Curran and ORNL Fleet manager, Kathye Settles, worked with the local Clean Cities program, East Tennessee (ET) Clean Fuels, to issue a guide on best practices for idling to improve vehicle operations at ORNL. The guide dispels myths about idling that will help improve vehicle fuel economy and reduce tailpipe emissions. ORNL's Vehicle Idling Best Practices Guide was highlighted in the April DOE Sustainability Performance Office (SPO) monthly newsletter.

ORNL Researchers Visit Ford and General Motors (GM) Facilities to Provide Update on Projects of Interest

Jim Parks, Josh Pihl, and Todd Toops visited the research facilities of Ford and GM to provide updates on projects of specific interest to the research teams. This included an in-depth discussion on NH₃ storage on Cu-zeolite, NH₃ sensor development, advanced fuel effects on catalysts, and lean gasoline emissions control technologies. Scott Sluder, Jim Szybist, Brian West, and John Storey also visited Ford Research. Discussion topics included exhaust gas recirculation (EGR) cooler research and ethanol and high-octane fuel research. These onsite visits allow in-depth discussions on the topics presented such that the industrial partners can obtain a greater understanding of the findings and the ORNL researchers can understand the key challenges that are most important.

Vehicle Research Laboratory Efforts Generate Industry and Media Interest at SAE Congress.

Efforts involving the Vehicle Research Laboratory resulted in three papers being published and presented at the 2013 SAE World Congress (April 16–18). A paper on the fuel economy penalties for air

conditioner use and driving with windows down received (ref. 1) special coverage in the SAE Vehicle Engineering Magazine (url: <http://www.sae.org/mags/sve/rgstd/12027>). In addition, the paper on fuel economy degradation with increased highway cruising speed (ref. 2) was selected for journal publication and an inquiry was received from a New York Times reporter during the conference. Both of these papers generated interest from industry, with requests for further information concerning our work and capabilities.

1. S. P. Huff, B. H. West, and J. P. Thomas, "Effects of Air Conditioner Use on Real-World Fuel Economy," SAE Paper number 2013-01-0551, 2013 SAE World Congress, Detroit, Michigan, April 16–18, 2013.
2. J. F. Thomas, H-L. Hwang, B. H. West, and S. P. Huff, "Predicting Light-Duty Vehicle Fuel Economy as a Function of Highway Speed," *SAE International Journal Passenger Cars – Mech. Syst.*, **6(2)**, DOI: 10.4271/2013-01-1113, 2013.
3. J. F. Thomas, B. H. West, and S. P. Huff, "Effect of Intake Air Filter Condition on Diesel Vehicles," SAE paper 2013-01-0311, doi: 10.4271/2013-01-0311, SAE 2013 World Congress, Detroit, Michigan, April 16–28, 2013.

Invited Talks and Presentations

ORNL's FEERC has Strong Representation at the 2013 SAE World Congress

A total of 16 ORNL staff members from FEERC contributed to 18 technical papers and two oral-only presentations at the annual SAE meeting in Detroit, Michigan. Lead author on 14 of the 18 papers were FEERC staff; lead authors on 4 papers were colleagues from other national labs or universities. The work presented at SAE reflects the breadth of the research done within FEERC, with the diverse range of topics including combustion, fuel effects, aftertreatment, and vehicle systems modeling. Much of the presented work was done as part of a collaboration with industry or academia, with co-authors from Delphi, Ford, MECA, National Renewable Energy Laboratory, Pacific Northwest National Laboratory (PNNL), University of Tennessee, Texas A&M University, University of Wisconsin, and Michigan Technical University. Nine of these technical papers were selected to be included in one of the SAE International Journals. Additionally, FEERC staff organized multiple technical sessions and hold leadership positions on several SAE committees.

FEERC Staff Co-Organize SAE Symposium on High Efficiency Engines

Robert Wagner was an organizer for the 2013 SAE High Efficiency Internal Combustion Engines Symposium. This meeting included leading international experts from industry, academia, and government laboratories discussing advanced combustion concepts for near-term and long-term applications as well as technologies important to enabling the next generation of high efficiency engines. Attendance far exceeded projections and led to very active dialog during networking breaks. Jim Szybist and Robert Wagner moderated the session on enabling technologies.

ORNL Invited Presentation on In-Cylinder Reforming Presented at the 2013 SAE High Efficiency Engine Symposium

Jim Szybist from ORNL delivered an invited presentation at the 2013 SAE High Efficiency Engine Symposium entitled "An Investigation of Non-Catalytic In-Cylinder Fuel Reforming." Recent results on in-cylinder reforming were presented, as were implications on a new combustion scheme for a multi-cylinder engine. The presentation highlighted a path to increased knock resistance in vehicles that reduces the performance demand on the fuel rather than increasing it, as most high efficiency concepts require. The presentation was well-received and generated a significant amount of discussion.

ORNL Presents Broad Range of Research Topics and Collaborations at the 2013 Cross-Cut Lean Exhaust Emissions Reduction Simulations (CLEERS) Workshop

A total of eight ORNL researchers from FEERC attended the annual CLEERS workshop in Dearborn, Michigan, and contributed to four oral presentations and three poster presentations. A broad range of topics were addressed including speciation of emissions from RCCI, low-temperature catalysis, sensor development, advanced fuel effects on catalysts, and lean gasoline emissions control technologies. Additionally, ORNL collaborative efforts were included in another six oral presentations and two posters given by industry or academia, with co-authors from PNNL, Penn State University, University of Kentucky, University of South Carolina, University of Tennessee, Texas A&M University, and GM.

ORNL Staff Co-organize and Participate in Vehicle Data Jam

The White House Council on Environmental Quality, U.S. DOE, and U.S. Department of Transportation – in partnership with SAE International – sponsored a Vehicle Data Jam in Detroit, Michigan, during the week of the SAE World Congress. The Vehicle Data Jam is part of a series of other Energy Data Jams, started last year as a part of the Obama Administration's Energy Data Initiative, which provide a forum for entrepreneurs, innovators, policy experts, and data gurus to collaboratively brainstorm and commit to building prototypes of products and services that leverage "open data", including data made available by the private sector directly to individual consumers. ORNL participants included Ron Graves, Wade McNair, Stacy Prowell, David Smith, and Robert Wagner with expertise spanning advanced engines, advanced vehicle systems, big data, and data security.

Awards

FEERC Researcher Receives 2013 ORNL Earth Day Community Sustainability Award

FEERC researcher, Scott Curran, received the 2013 ORNL Earth Day Community Sustainability Award because of his personal commitment and valuable contributions to ensuring the promotion of efficient technologies and biofuel use in the community, at home, and in his research. The award cited support of the education of students of all ages, spanning primary school through college, on the benefits of alternative fuels and hybrid vehicle technology.

Outreach

FEERC Researchers Participate in Knoxville Area Earth Day Activities

Researchers from FEERC showcased sustainable transportation science and research during Earth Month. FEERC partnered with the local Department of Energy (DOE) Clean Cities designee (ET Clean Fuels) to provide showcase vehicles and researchers for multiple ET Earth Day events which help to educate the public on alternative fuels, advanced vehicle technologies, and the fuel economy effects of driving behavior. Earth Day activities target both consumers and K-12 to educate and excite the public about energy efficiency, emissions reductions and renewable energy in transportation.

ORNL Participates in L&N Science Technology Engineering and Mathematics (STEM) Academy 1st Transportation Summit

ORNL was represented by FEERC researcher Scott Curran at the 1st L&N STEM Academy transportation summit to address the needs of pre-college programs to get students interested in pursuing careers in transportation science. A roundtable discussion with attendees from TDOT, KAT, UTK, and others provided guidance on the following discussion topics: What are the current and future trends for STEM Careers in Transportation? What are the Transportation based challenges facing ET in the next 1, 5, and

10 years? Discussion: What can the L&N STEM Academy do to be at the forefront in developing a STEM in Transportation Workforce? The goal of the summit was to provide the foundation on how the aforementioned topics can be addressed in the curriculum and class projects at L&N to gear promising students towards careers in transportation science.