

April 2015 Highlights

ORNL Fuels, Engines, and Emissions Research Center

TECHNICAL HIGHLIGHTS

Seven Oak Ridge National Laboratory (ORNL) Researchers Recognized at the Society of Automotive Engineers (SAE) Awards Ceremony

At the SAE 2015 World Congress in Detroit this month, seven ORNL/ETSD researchers (including six from the Fuels, Engines, and Emissions Research Center (FEERC)) received awards. Scott Sluder received his Fellow pin at the annual Fellows dinner and was again recognized for Fellow election as well as for the Lloyd Withrow Distinguished Speaker Award at the Awards Ceremony. Jim Szybist and Brian West received the Harry L. Horning Memorial Award for best paper on the mutual adaptation of fuels and engines for their 2013 paper on knock limits of ethanol/hydrocarbon (HC) blends. Derek Splitter and Martin Wissink received The Myers Award for outstanding student paper for their work at the University of Wisconsin on Reactivity-Controlled Compression Ignition (RCCI). Derek Splitter is a FEERC staff member and Martin Wissink is a new postdoctoral research fellow on the FEERC team. Derek Splitter, Scott Curran, and Sujit Das received the Forest R. McFarland Award for outstanding contributions in service to the SAE Engineering Meetings Board.

FEERC Hosts Researchers from Filter Sensing Technologies Inc. (FST) to Investigate Radio Frequency Soot Sensor in Diesel Exhaust

Researchers from FST visited ORNL to study the performance of their radio frequency diesel particulate sensor on light-duty (LD) diesel engine. The RF sensor technology developed by FST is a low-cost, robust sensor that, unlike conventional exhaust sensors, provides a direct measure of the soot loading in a diesel particulate filter (DPF). During this study the RF sensor performance was benchmarked against advanced analytical instruments available at ORNL including Tapered Element Oscillating Microbalance (TEOM) and AVL Micro Soot Sensor (MSS). The RF sensor showed high sensitivity to small changes in engine out particulate matter (PM) emissions and could quantitatively track PM emissions measured by TEOM and AVL MSS. The RF sensor's direct measure capability of the catalyst loading state has the potential to enable optimized control of the engine and emissions aftertreatment system to reduce engine fuel consumption while meeting future emissions regulations.

FEERC Director attends Department of Energy (DOE) Big Ideas Summit

Robert Wagner attended the 2nd DOE Big Ideas Summit in Arlington, Virginia. He has a leadership role in developing a DOE Big Idea around the co-development of engine and fuel technologies for significant reductions in greenhouse gas emissions. Jim Szybist leads a sub-team on fuel properties. Other FEERC participants supporting the plan development include Scott Curran, Todd Toops, Brian West, and Tim Theiss. The summit was attended by leadership from DOE as well as most of the national laboratories.

FEERC Director Organizes SAE High Efficiency Engine Symposium

Robert Wagner and co-organizers from Southwest Research Institute (SwRI), Clemson University, and Lund University organized the 5th SAE International Symposium on High Efficiency Internal Combustion Engines. The symposium had record attendance of more than 180 participants. Robert also presented the opening keynote address on "Future

Contact

Robert M. Wagner, Ph.D.
Director, FEERC
Oak Ridge National Laboratory
865.946.1239
wagnerm@ornl.gov

feerc.ornl.gov

ORNL is managed by
UT-Battelle for the
US Department of Energy

Engines – Incremental Advances Driving Disruptive Opportunities” and chaired the opening session.

FEERC Director Participates on SAE Technical Expert Panel Discussion

Robert Wagner participated on an SAE International panel on “Emissions and Efficiency Solutions 5-10 Years Out; Regulations, Solutions, Obstacles, Most-Likely Surprises, etc.” He was introduced as the “futurist” perspective of the panel. The panel focused on challenges of the internal combustion engine going forward including regulatory challenges to reduce emissions another 80–90% and fuel consumption by 10–30% (heavy duty (HD), LD) by 2025. The panel discussion also included open Q&A with the audience. Other panel members included leaders from the Environmental Protection Agency (EPA), Umicore Autocat, Delphi Corporation, SwRI, and Johnson Matthey.

FEERC Researchers Organize Expert Panel at SAE 2015 World Congress

FEERC researchers Scott Curran and John Storey along with Will Northrop of the University of Minnesota organized an Expert Panel titled “Current Understanding of Particulate Matter from Low Temperature Combustion Modes” at the 2015 SAE World Congress on April 21, 2015. The panel included Matti Maricq of Ford, Andre Boehman of the University of Michigan, as well as Storey and Northrop. Presentations covered each researcher’s experience with the measurement and characterization of PM with low or no solid component. Attendance exceeded expectations with many people standing inside and outside the room during the panel.

FEERC Researchers Participate in Off-Site Experiment

Melanie DeBusk, John Storey, and Bart Smith traveled to Delphi in Auburn Hills, Michigan, recently for an emissions sampling campaign. Delphi and ORNL are teaming on a funding opportunity announcement (FOA) project titled, “Ultra Efficient Light Duty Powertrain with Gasoline Low Temperature Combustion.” ORNL is providing emissions sampling and analysis expertise. The successful four-day campaign resulted in the collection of large amounts of data which continues to be analyzed. Samples included light HCs, aldehydes/ketones, PM, and semi-volatile organic compounds.

FEERC Researcher Selected to Serve on Underwriters Laboratories (UL) Renewable Energy Council

Mike Kass, from ORNL/FEERC was selected by UL to serve on their Renewable Energy Council. UL is highly selective towards membership, which is international in scope. These positions are awarded based leadership, expertise, and contributions to UL’s mission of safety to the community. Mike Kass joins Tim Theiss as the only ORNL committee members (there are only four DOE national laboratory representatives in total). The renewable energy council participates in the annual UL meeting to provide guidance to future UL directives.

ORNL FEERC Hosts Cross-Cut Lean Exhaust Emissions Reduction Simulations (CLEERS) Workshop

On April 27–29, 2015, a team from ORNL FEERC hosted the 18th installment of the DOE-CLEERS Workshop at the University of Michigan-Dearborn. The Workshop generated a high level of interest across industry, academia, and national laboratories; requests for both registrations and contributed presentations exceeded the available slots. The technical program included 5 invited presentations, 29 contributed presentations (3 from ORNL), and 15 posters (6 from ORNL) covering a wide range of emissions control topics including: low temperature oxidation catalysts; sulfur poisoning of oxidation catalysts; three-way catalyst (TWC)/selective catalytic reduction (SCR) and lean nitrogen oxide (NOx) trap (LNT)/SCR systems; strategies for model development; particulate measurement, characterization, and modeling; multifunctional filters; system level modeling for optimization and control applications; natural gas engine emissions control; detailed models for predicting the performance and aging behavior of copper zeolite urea SCR catalysts; and novel urea SCR formulations. There was also an industry panel discussion on “Needs and Opportunities for Passive Adsorber Devices (traps) for Advanced Engine Emission Controls.” The depth and breadth of the technical program, combined with the wide range of expertise of the Workshop participants, have made the CLEERS Workshops, in the words of a participant, “one of the best interaction opportunities in the [aftertreatment] development circles.”

Robert Wagner of FEERC Quoted in *Green Car Congress*

Robert Wagner was quoted in a recent *Green Car Congress* article on “DOE Developing Optima Initiative: Co-Optimization of Fuels and Engines for Extreme Boost in System Fuel Efficiency above Current Policy Targets.” The article describes the recent push by DOE and the national laboratories to develop a new initiative around the co-development of fuel and engine

technologies. Robert serves on the steering committee of the fuels and engines initiative and presented a brief overview of the topic at the SAE High Efficiency Engines Symposium. <http://www.greencarcongress.com/2015/04/20150421-optima.html>.

Robert Wagner Serves as Editor for Special Journal Issue on Cyclic Dispersion in Internal Combustion Engines

Robert Wagner of ORNL and Todd Fansler of the University of Wisconsin served as editors on a special issue of the *Journal of Engine Research* on the topic of cyclic dispersion in internal combustion engines. Cyclic dispersion has become of increasing importance in recent years as more stringent regulations push research and development toward high efficiency combustion pathways which are strongly affected by this phenomenon. The special issue includes an opening article by Fansler and Wagner as well as 13 articles that exemplify the state-of-the-art research on cyclic dispersion in engine combustion. The special issue also included an invited review paper led by Charles Finney of FEERC. The article is titled “A Review of Deterministic Effects in Cyclic Variability of Internal Combustion Engines” and included additional FEERC authors Brian Kaul, Stuart Daw, Robert Wagner, Dean Edwards, and Johnny Green. FEERC staff are internationally recognized leaders in the area of cyclic dispersion with pioneering research spanning more than 25 years.

HIGH-LEVEL OR NOTEWORTHY VISITS

Bosch Visits ORNL to Discuss Collaboration on a Variable Compression Ratio (VCR) Engine for Engine Control Development and Testing

Jeff Sterniak and Shyam Jade of Bosch visited FEERC on April 1, and met with Norberto Domingo, Jim Parks, and Derek Splitter to discuss collaboration on the use of FEERC’s gasoline direct-injection (GDI)-VCR engine for engine control development and performance testing. Discussions are ongoing.

INVITED TALKS AND PRESENTATIONS

FEERC Research Featured in 13 Presentations at 2015 SAE World Congress

FEERC researchers made substantial contributions to the technical program at the 2015 SAE World Congress held in Detroit, Michigan, from April 21–23. FEERC researchers authored 6 technical papers, were co-authors on 3 additional papers, FEERC research was the focus in 13 presentations, and featured in many others as illustrating slides or references. This research spanned emissions controls, novel diagnostics, historical trends in fuel economy, advanced combustion, alternative fuel compatibility, and well-to-wheels analysis. The listing of the technical publications and presentations follows:

- V. Y. Prikhodko, J. A. Pihl, T. J. Toops, J. F. Thomas, J. E. Parks, and B. H. West, “Selective Catalytic Reduction of Oxides of Nitrogen with Ethanol/Gasoline Blends over a Silver/Alumina Catalyst in Lean Gasoline Engine Exhaust,” 2015-01-1008.
- D. A. Splitter, Barry Burrows (University of Alabama), and S. A. Lewis Sr., “Direct Measurement and Chemical Speciation of Top Ring Zone Liquid during Engine Operation,” 2015-01-0741.
- A. B. Dempsey, S. Curran, and R. D. Reitz (University of Wisconsin), “Characterization of Reactivity Controlled Compression Ignition (RCCI) using Premixed Gasoline and Direct-Injected Gasoline with a Cetane Improver on a Multi- Cylinder Engine,” 2015-01-0855.
- M. D. Kass, C. J. Janke, T. J. Theiss; J. Baustian, L. Wolf (Butamax Advanced Biofuels LLC); and W. Koch (Technology Resources International), “Compatibility Assessment of Plastic Infrastructure Materials with Test Fuels Representing E10 and iBu16,” 2015-01-0894.
- M. D. Kass, C. J. Janke, R. M. Connatser, S. A. Lewis Sr., J. Keiser, and T. J. Theiss, “Compatibility Assessment of Plastic Infrastructure Materials with Off-Highway Diesel and a Diesel Blend Containing 20 Percent Fast Pyrolysis Bio-Oil,” 2015-01-0893.
- M. D. Kass, C. J. Janke, R. M.) Connatser, S. A. Lewis Sr., J. R. Keiser, and T. J. Theiss, “Compatibility Assessment of Elastomeric Infrastructure Materials with Neat Diesel and a Diesel Blend Containing 20 Percent Fast Pyrolysis Bio-Oil,” 2015-01-0888.
- R. Hanson, S. Spannbauer, C. Gross, R. D. Reitz (University of Wisconsin); S. Curran, J. M. Storey, and S. P. Huff, “Highway Fuel Economy Testing of an RCCI Series Hybrid Vehicle,” 2015-01-0837.
- A. Pawlowski and D. A. Splitter, “SI Engine Trends: A Historical Analysis with Future Projections,” 2015-01-0972.

- M. Bergin, C. Rutland, R. Reitz (Wisconsin Engine Research Consultants); A. B. Dempsey, and S. Curran, “Load Limit Extension in Pre-Mixed Compression Ignition Using a 2-Zone Combustion System,” 2015-01-0860.
- T. J. Toops and C. E. A. Finney, and C. Kamp, “Effect of Regeneration Strategy on the Ash Distribution and Packing Density Measured with Neutron and X-Ray Radiography,” oral only.
- J. F. Thomas, “Drive Cycle Powertrain Efficiencies and Trends Derived from EPA Vehicle Dynamometer Results,” oral only.
- M. D. Kass, B. C. Kaul, C. S. Daw, A. A. Temerev, and K. Nguyen (University of Tennessee), “Extending the Dilution Limit of Spark-ignited Combustion Through Local Oxygen Enrichment of the Flame Kernel,” oral only.
- S. Curran, “Well-to-Wheel Analysis of Direct and Indirect Use of Natural Gas in Passenger Vehicles ,”oral only.

ORNL Researcher Invited to Present Bio-Fuel Work at 2015 Emerging Issues Forum

Derek Splitter was invited to present work from ORNL on intermediate ethanol-gasoline blends at the 2015 Emerging Issues Forum in Omaha, Nebraska. The presentation highlighted the ability to increase octane number with ethanol and the potential impact that intermediate ethanol-gasoline blends could offer for downsizing and downspeeding future high efficiency engines. The forum was well attended by key industry and government members including the governor and senate members of Nebraska, senior members of the EPA, and fuel and ethanol industry leaders.

AWARDS

OUTREACH