



ME Department Seminar

Development of Sustainable Fuels for High-Efficiency Spark-Ignition and Mixing-Controlled Compression-Ignition Engines: Storage Stability and Effects of Fuel Properties on Engine Performance and Emissions



Robert L. McCormick

*National Renewable Energy Laboratory
Golden, Co USA*

Tuesday, January 15, 2019

Time 4:00 - 5:00 PM

2540 GG Brown

Abstract

Sustainable fuels with advantageous properties can reduce net carbon emissions while enabling the design of more efficient engines and engine operational strategies. For SI engines, it is possible to significantly improve efficiency given fuels with improved autoignition, evaporative cooling, and particle emission properties. For diesel (or MCCI) engines, fuels can reduce engine out PM and NO_x consequently reducing cost and efficiency penalty for emission control. At the same time, a vast range of different fuel chemistries are accessible from biomass – leading to questions about how fuel chemistries outside the range available from petroleum and ethanol can impact engine operation. Our work examines the relationship between molecular structure and fuel properties, and how fuel properties outside the “normal” range impact how engines perform. For both SI and MCCI a screening process based on fuel properties was applied to a large set of proposed biomass-derived blendstocks, and the properties of the best blendstocks were evaluated. Some of these fuels exhibit poor stability towards oxidation in the liquid phase, and storage stability chemistry studies for alkyl furans, cyclopentanone and others will be presented in brief. The importance of fuel heat of vaporization for direct injection SI engines, along with new research on measurement of this parameter, will be described. Fuel effects on fine particle emissions and how our understanding breaks down for oxygenates will be discussed.

Bio

Dr. Robert L. McCormick is Senior Research Fellow in the Fuels and Combustion Science group at the National Renewable Energy Laboratory. This group’s research is focused on biofuels properties and fuel-engine interactions including biofuel quality and quality specifications, compatibility with modern engines, combustion, pollutant emissions effects, and leveraging fuel properties for design of more efficient engines. Bob is a chemical engineer with a BS from Oklahoma State University, MS from Iowa State University, and PhD from the University of Wyoming. Before joining the staff of the National Renewable Energy Laboratory in 2001 he was a research professor at the Colorado School of Mines and did research on coal conversion for a Fortune 500 company. He has coauthored over 100 peer reviewed technical articles and is a Fellow of SAE International.