(1) An Overview of the Center for Alternative Fuels, Engines, and Emissions (CAFEE) Research at West Virginia University

(2) Investigation of Oxygenated Fuel for Soot-Free Combustion in an Optical Direct-Injection Diesel Engine

1. West Virginia University's Center for Alternative Fuels, Engines, and Emissions (CAFEE) is a non-profit research center with a rich history in providing focused engineering solutions for emissions research, including advanced engine technologies, post-combustion technologies, after-treatment development and evaluation, and fuel technologies. Due to the close proximity to the Marcellus Shale reservoir, CAFEE research focuses on increasing shale-gas utilization in transportation (i.e., passenger cars, light-duty trucks, and heavy-duty transport vehicles), off-road applications (e.g., agricultural, construction and mining equipment), natural gas compressor stations, and power generation (e.g., back-up power generation). The goal is to increase the understanding of fundamental combustion processes in internal combustion (IC) engine applications, such as the interaction between the engine platform, the combustion strategy, and the composition and property of the fuel.

2. An optically accessible heavy-duty diesel engine was used to investigate the impact of oxygenated fuels on combustion and emissions. The fuels investigated were neat methyl decanoate (MD) and a 50/50 blend by volume of tripropylene-glycol monomethyl ether (TPGME) and ultra-low sulfur #2 diesel certification fuel (CF). Specific goals of the study were to produce experimental data for validating engine combustion models, as well as to determine if oxygenated fuel could enable soot-free leaner-lifted flame combustion (LLFC), a mode of mixing-controlled combustion associated with equivalence ratios below approximately 2. In addition to conventional pressure-based and engine-out emissions measurements, exhaust laser-induced incandescence, in-cylinder natural luminosity, and in-cylinder chemiluminescence diagnostics were used to provide detailed insight into combustion processes. Results indicate that oxygenated fuel effectively eliminated engine-out smoke emissions by curtailing soot production and/or increasing soot oxidation during and after the end of fuel injection. Oxygenated fuel greatly reduced soot luminosity when compared with neat CF, but didn't enable LLFC because the equivalence ratios at the lift-off length, $\phi(H)$, never reached the non-sooting limit. Concerning other engine-out emissions, injection pressure influenced the effects of oxygenated fuel on NO_x emissions.