OVERVIEW

Liquid fuels from bioderivative and waste sources allow for an attractive alternative strategy, providing a cleaner, high energy density fuel stream with a very low carbon footprint. Currently, in small-scale applications, reciprocating engines are commonly used, which exhaust considerable amounts of criteria pollutants. Small scale gas turbines, which present a reliable, high efficiency and cleaner option can provide a feasible replacement for existing remote and backup power generators. The current UCI study addresses the role of fuel preparation and its impact on engine performance and emissions in a 30kW gas turbine for soy biodiesel and ethanol fuels in comparison to the engines designated fuel, low sulfur diesel.

GOALS

The UCI study's focus is to (1) determine the chemical makeup and liquid properties for the fuels of interest, (2) fundamentally understand the role of plain-jet airblast atomization and vaporization during the fuel preparation process for these fuels, and (3) explain the fuel preparation process’s impact on engine performance and exhaust emissions.

RESULTS

Sustained operation of a commercial gas turbine fueled with B99 was demonstrated. This simple switch in fuel streams produced an increase in NOx emissions, wear due to raw/cooked fuel deposited on the injection hardware and issues with an incomplete fuel purge during shutdown (due to B99’s higher viscosity). Atomization performance in the fuel injection system compared well with the airblast atomization theory proposed by Rizk and Lefebvre.

RESULTS (CONT.)

Modifying the engine to improve the atomization quality by increasing air flow at the point of injection (decreasing fuel spray drop size) resulted in a reduction of NOx and CO (Figure 2) and eliminated impingement of fuel on the hardware. An air to liquid ratio (ALR) of 0.85 was found to produce the lowest emissions (Figure 2). Overall, the NOx levels with B99 were still slightly higher than those for DF2.

PAPERS & PUBLICATIONS

EVALUATION OF PLAIN-JET AIRBLAST ATOMIZATION AND EVAPORATION OF ALTERNATIVE FUELS IN A SMALL GAS TURBINE ENGINE APPLICATION (2010). Accepted for publication in J. of Atomization and Sprays (C.D. Bolszo and V.G. McDonell)


PERSONNEL

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