Investigation of Fuel Effects on HC/CO Emissions for Highly Dilute Low Temperature Combustion in a Light-Duty Diesel

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Sponsors – GM R&D, DOE

Background and Project Goals

Collaborative Research project combining UW experimental work, UW computational analysis, GM testing, and Sandia National Labs optical diagnostics

- Experimental Baseline and CFD Validation
- Realize minimization of UHC/CO in LTC regime (9.5% inlet O2)
- UHC speciation using FTIR
- Investigate fuel property effects regarding UHC/CO
- Detailed investigation of biodiesel LTC effects
- Develop engine map for gasoline CI operation → potential for low NOx/PM operation @ high load

UW SCE Capabilities

- Closed loop control of engine systems through PC based virtual instrumentation
- Configurable fuel injection (1600 bar, 5 inj/cycle)
- Inlet, Coolant, and Oil Temps (< +/- 1 C)
- Exhaust Backpressure (< +/- 2 kPa)
- Inlet Boost (< +/- 1 kPa)
- Inlet O2 Control (< +/- 0.05%)

Fuel Effects in LTC

- Increasing CN reduces CO, HC, ISFC, and noise
- Lighter weight/higher volatility fuels reduce soot and HC
- Decreasing aromatic content increases magnitude of LTHR and advances its location

Additional Work:

Engine Operating Map Development for Gasoline Compression Ignition Operation

- 3-16 bar IMEPn (1500-2500 RPM)
- Iterative approach combining KIVA simulations and experiments
- Examine performance sensitivity related to variation in multiple input parameters e.g. inlet temp, injection pressure, inlet charge composition

Injection Pressure Effects @ 14 bar IMEPn

- 860 bar injection
- 1000 bar injection

- Increasing injection pressure at high load increases the operating map area
- At high load, φ → 1; gasoline reactivity is sufficient to provide stable combustion; no need for high inlet temps or improved fuel-air stratification via lower injection pressures as seen at low load

- Bio-blends showed small changes in CO & NOx
- SME blends showed lower HC and smoke
- Light & heavy HC show different trends across the timing sweep