DEVELOPMENT OF TRUCK ENGINE TECHNOLOGIES FOR USE WITH FISCHER-TROPSCH DIESEL FUELS

Michael May
Ricardo

Keith Vertin
National Renewable Energy Laboratory

There has recently been an emergence of "gas-to-liquids" (GTL) projects worldwide, in many cases to make use of remote natural gas resources, to monetize associated gas, to avoid wasteful gas flaring or reinjection, and to synthesize value-added chemicals. GTL processes enable the conversion of natural gas to a liquid phase that can be transported to market more cost effectively than by natural gas pipelines or by LNG tankers.

GTL products are currently being used as transportation fuels in select markets. Fischer-Tropsch synthetic diesel fuel is used as a neat transportation fuel in regions of South Africa today. Fischer-Tropsch diesel has also been used as a blend stock for upgrading crude-derived fuels to meet California on-highway diesel fuel quality standards.

Tests have shown that Fischer-Tropsch diesel fuels can be used in unmodified engines and vehicles. Engines fueled with neat Fischer-Tropsch fuels emit about 10 percent lower NO_x and 20 percent lower particulate matter (PM) compared to conventional diesel fuels, while maintaining the same fuel consumption on an energy equivalent basis.

Whereas exhaust emissions reductions from these previous studies have been impressive, far greater exhaust emissions reductions can be achieved if the diesel engine is optimized to exploit the properties of the Fischer-Tropsch fuels. Fischer-Tropsch synthetic diesel has properties conducive to low emissions, including a cetane number greater than 74, less than 1 percent vol. aromatics, and virtually no sulfur content.

A Power Stroke 7.3-liter engine has been modified and optimized to exploit the properties of Fischer-Tropsch diesel. The combustion system was revised; an active $DeNO_x$ catalyst system was employed, and designs of experiment techniques were used to explore possible strategies to reduce NO_x and PM emissions, while maintaining diesel-like thermal efficiency.

Fuel properties, baseline engine test data, and optimized engine test data are presented. Ninety percent NO_x reductions were achieved. This research highlights possible pathways for meeting Federal Tier 2 and 2007 heavy-duty on-highway emissions standards.