Preliminary evaluation of diesel fuel made from Australian oil shale

In 2010, QER engaged an independent, internationally respected research and development organization in the USA to undertake preliminary performance and emissions assessments on Ultra Low Sulphur Diesel (ULSD) made from oil shale from the Stuart deposit in Queensland, Australia.

Two engine platforms were selected for these assessments, namely a heavy duty truck engine and a light duty engine from a pickup truck.

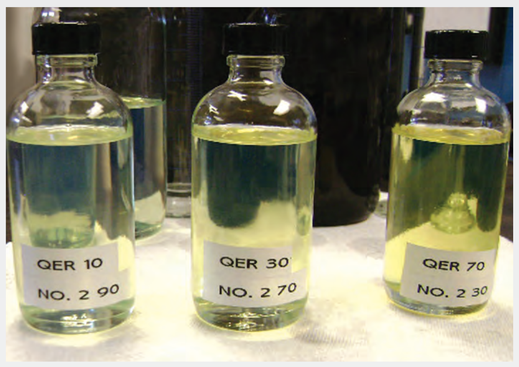
For the heavy duty tests the candidate fuels were prepared thus:

- Base fuel (100% retail ULSD complying with Australian fuel quality specifications)
- 8% Shale derived diesel 92% retail blend
- 30% Shale derived diesel/70% retail blend
- 100% Shale derived diesel ULSD.

For the light duty tests the blends were the same as for the heavy duty evaluation except there was no tests carried out on 100% shale derived ULSD. The blend proportions were selected on the basis of "low "case (i.e. it mirrors some proportions of the Australian bio fuel blends) and the "high" case (i.e. 30%), on the basis that it would represent the highest theoretical proportion that a service (gas) station would deliver to motorists via retail pumps.

The Test Engines

For the heavy duty tests a 1991 S60 series, 12.7 litre, turbocharged Detroit Diesel engine producing 268kW @ 1800rpm was used and for the light duty cycles a 1991 Dodge Ram fitted with a 5.9 litre Cummins diesel engine producing 120kW @ 542 Nm was selected. The age of the engines was selected on the basis that the research institution had already established a long history of performance and emissions data from these engines and due to their vintage, differences in performance and/or emissions that are fuel related, can be more easily detected than if newer engines were used which when fitted with sophisticated engine management systems or post combustion systems can mask fuel differences.



Examples of shale derived diesel from Queensland oil shale.

The Test Cycles

For the heavy duty tests both the European Stationary Cycle (ESC) and the World Harmonised Transient Cycle (WHTC) tests were used and for the light duty evaluation both the Australian Design Rules (ADR) 37 cycle and the New European Driving Cycle (NEDC) tests were used. These test cycles are well known and established in Australia as a basis for fuel evaluation. They simulate both highway and urban driving conditions with hot and cold starts with low and high engine loads.

Conclusion:

The report of the testing program concluded:

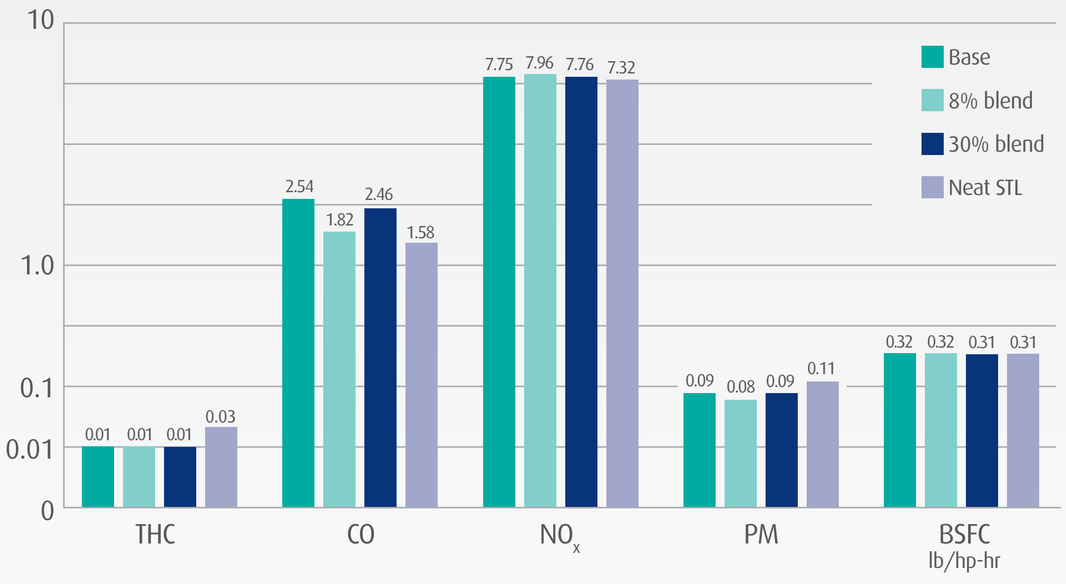
"For both the heavy duty engine and the light duty vehicle testing, there were no statistically significant differences in the regulated emissions or the fuel economy when operating on the base diesel fuel and the two STL diesel blends."

This work confirms that under the above described controlled conditions shale derived diesel is a satisfactory drop in substitute fuel requiring no alterations to existing engines, fuel systems or post combustion systems.

To further our knowledge on the performance of shale derived diesel from QER's technology demonstration plant at Yarwun in Queensland, a long term program (i.e. at least 12 months) has been designed to assess the performance of the diesel using selected highway trucks from a commercial trucking operation.

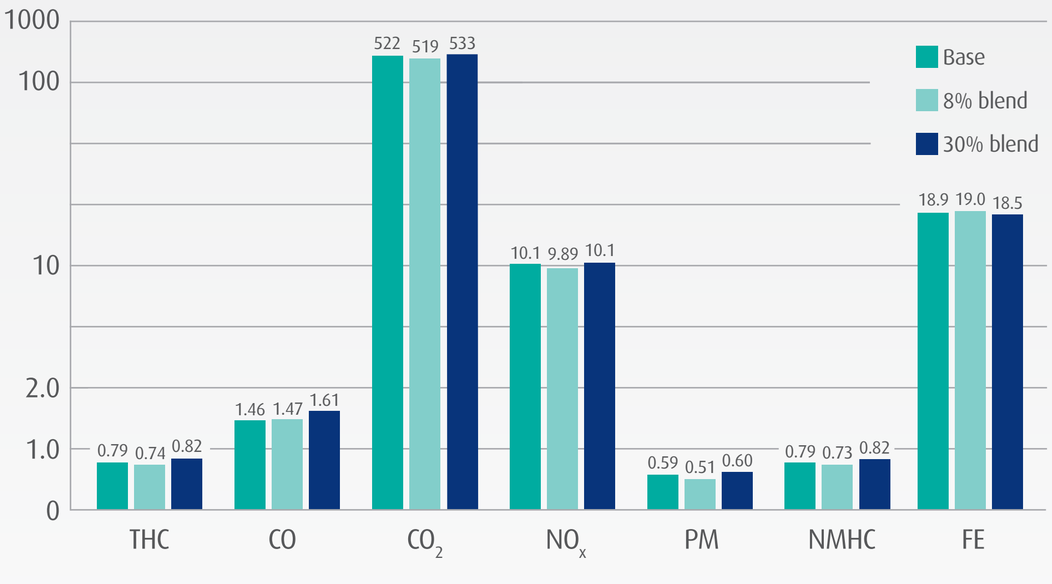
This program will monitor engine performance, fuel economy and other performance parameters under the project management of Rare Consulting, a respected consultant in the area of transport economics and the heavy duty transport sector in general.

Emissions Results g/bhp-hr European Stationary Cycle (ESC) Tests



THC = total hydrocarbon
CO = carbon monoxide
NO_x = oxides of nitrogen
PM = particulate matter
BSFC = brake specific fuel consumption lb/hp-hr

Emissions Results grams/mile for New European Driving Cycle (NEDC) Tests



THC = total hydrocarbon
CO = carbon monoxide
CO_2 = carbon dioxide
NO_x = oxides of nitrogen
PM = particulate matter
NMHC = non-methane hydrocarbons
FE = fuel economy (miles per gallon)

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