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DYNANOMETER FUEL EFFICIENCY STUDY AT MINING EQUIPMENT SPARES FOR BHPB LEINSTER OPERATIONS

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C O N T E N T S

Appendix

EXECUTIVE SUMMARY

The FTC/FPC Combustion Catalysts manufactured and marketed by Fuel Technology Pty Ltd have been proven in laboratory and field trials to reduce fuel consumption under comparable load conditions along with substantially reduced greenhouse gas emissions.

Recent studies as part of "Linkage Program" between BHPBIO, Australian Research Council, University of Western Australia (UWA) and Fuel Technology (FTPL) conducted by Professor Zhang at UWA department "Centre for Energy", has scientifically proven beyond doubt the ability of this unique catalyst to improve combustion and significantly reduce fuel consumption.

Following discussions and submissions of FTC/FPC product literature to BHPB Leinster Operations NLN Energy Specialist Mr Noel Mullins, agreement was reached that once an engine from a BHPB site could be sourced, Dynamometer tests would be conducted. It was also agreed that Professor Zhang and his team from UWA would simultaneously conduct emission testing, oversee tests and validate all data.

Dynamometer equipment at Mining Equipment Supply's (MES) was identified and inspected by representatives from UWA and FTPL and with minor alteration's determined to be acceptable to accurately measure fuel efficiencies.

This study was primarily designed to compare fuel efficiencies under comparable loads but also at differing RPM's such as is experienced in the field in a working environment, with and without FTC/FPC Combustion Catalyst dosed into fuel

The average efficiency gain (reduction in fuel consumption) measured in this very controlled Dynamometer test by FTPL was ***3.9%***. Study conducted by UWA measured average fuel efficiency of **2.7%.** Significant reductions in emissions were also measured by UWA and are tabled in UWA report page 17. (UWA report to be read in conjunction with this report)

INTRODUCTION

Fuel efficiency tests were conducted on a Caterpillar C11 DI TA AAAC 353hp engine removed from a bogger operating at BHPB Leinster Nickel site. Engine had approximately 14,000 Hrs. on clock and was removed for rebuild.

Fuel Technology Pty Ltd supplied a new 700L fuel tank, fuel meters to measure fuel into and return from engine fitted with thermo couplings to measure fuel temperature and, torque measuring equipment fitted to drive shaft to measure hp. Fuel was sourced from BP truck service station Forrestfield.

Testing commenced 20th February 2012.

TEST METHODS

The Specific Fuel Consumption (SFC) test procedure employed in this efficiency study measures the absolute amount of fuel consumed at a chosen load and RPM over a given time. This test was designed to allow untreated and FPC treated fuel efficiencies to be compared at the selected RPM's and loads.

RPM's and loads selected to test at were:

1400RPM	1800RPM
25% Load	25% Load
50% Load	50% Load
75% Load	75% Load
100% Load	100% Load

Once test engine reached operating temperature, MES technicians selected required RPM's and load. Calibrated Hoffer turbine flow transducers were used to measure fuel supplied to the engine and also fuel returning from the engine from which the net volume of fuel consumed can be calculated.

The flow transducers are fitted with thermocouple probes which enable measurement of fuel temperature at each transducer. All these measurements are automatically downloaded to a data taker every 4 seconds. Each test sequence was run for 45-60 minutes.

From the fuel temperature, the density at that temperature is calculated. A sample of fuel was taken for laboratory analysis and the density determined at industry standard of 15°C. Copies of the laboratory reports are included in the *Appendix*.

Volumetric fuel flows are corrected for density and temperature and reported in mass (kg) of fuel.

Unfortunately FTPL's new drive shaft torque measurement equipment required further development so was not used as a comparison to MES dynamometer torque readings as planned.

TEST EQUIPMENT

Data Taker

Hoffer Turbine Flow Transducers

TEST RESULTS

Fuel Efficiency

A summary of the fuel efficiency results achieved in this test program are detailed in the following tables 1 and 2.

The results are represented graphically in Graphs 1 and 2.

TABLE 1

Fuel Consumption Test Results
1400 RPM

HP	Load	Untreated Fuel Kgs/Hr	Treated Fuel Kgs/Hr	Variation
62	25%	10.9	8.9	-18.3%
128	50%	19.4	17.4	-10.3%
183	75%	30.9	29.4	-4.9%
265	100%	41.9	40.8	-2.6%
Average		**25.8**	**24.1**	**-6.6%**

TABLE 2

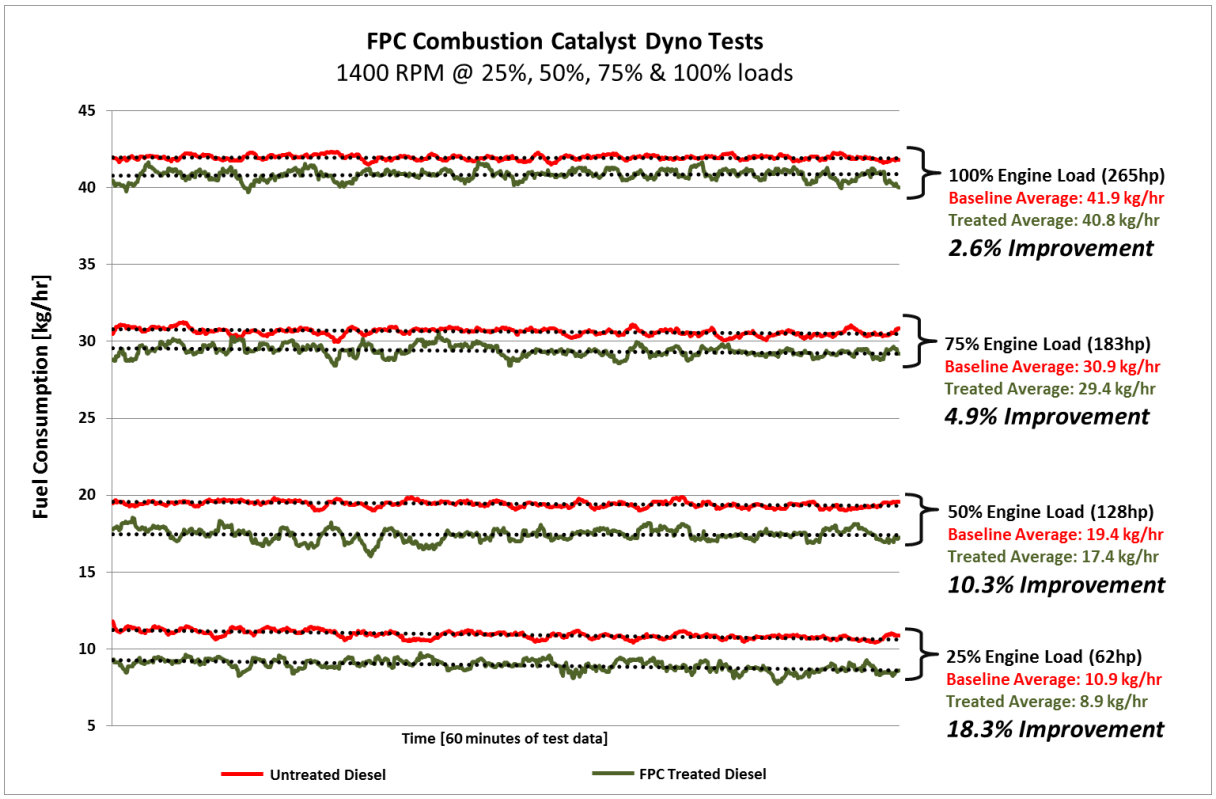
Fuel Consumption Test Results
1800 RPM

HP	Load	Untreated Fuel Kgs/Hr	Treated Fuel Kgs/Hr	Variation
87	25%	15.2	13.5	-11.2%
167	50%	27.2	25.9	-4.8%
234	75%	37.4	36.1	-3.5%
322	100%	49.0	48.4	-1.3%
Average		**32.2**	**30.1**	**-6.5%**

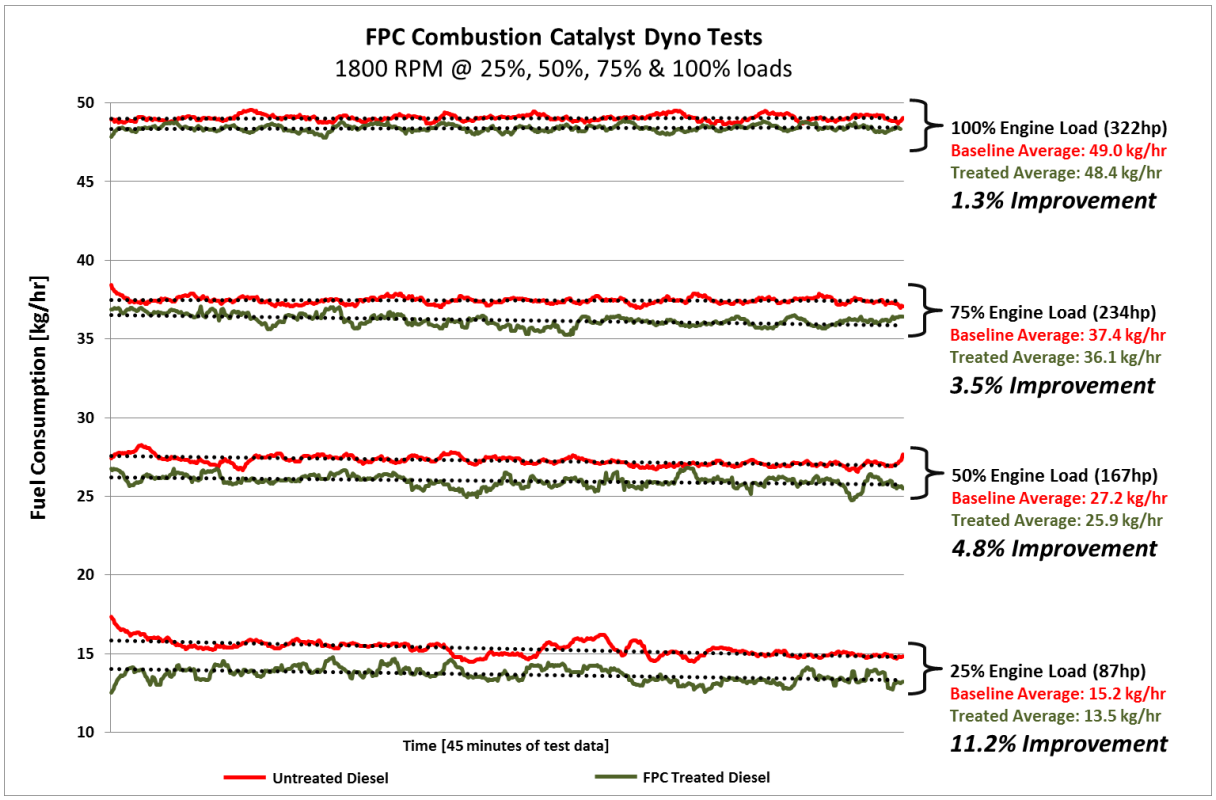
Note:

As has been proven in laboratory tests, the lower or least efficient mode engine is operating in, the higher the benefits provided by FPC. This is evident in the above results although measured fuel efficiency at 1400 rpm at 25% load appears unrealistic. If we eliminate both the 25% load data the average fuel efficiency gains are ***4.9%*** at 1400 rpm and ***2.9%*** at 1800 rpm averaging ***3.9%.*** ***(***Further investigation since conducting these tests has shown that Hoffer flow meters used, may require pulsation dampeners when subjected to low fuel flows as experienced at these low loads).

GRAPH NO. 1



GRAPH NO. 2



CONCLUSION

This carefully controlled Dynamometer test conducted on Caterpillar C11 353hp engine, confirms that FPC Combustion Catalyst will provide reduced fuel efficiencies at differing workloads as experienced in the field of between ***2%-5%.*** Further to fuel savings, Green House gas emissions will also be significantly reduced as tabled on page 17 UWA report.

The fuel efficiency gain of ***3.9%*** as measured by FTPL is slightly larger than the ***2.7%*** identified in UWA report but does correspond with the lower the engine load the greater the efficiency provided by FPC treatment of fuel.

Appendix "A"

Laboratory Report