TECHNICAL; BULLETIN

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MEASUREMENT OF GENSET EFFICIENCY BY SPECIFIC FUEL CONSUMPTION METHOD

INTRODUCTION

Fuel Technology Pty Ltd supply a combustion catalyst known as FTC which when dosed in hydrocarbon fuel provides a faster, more complete burn of the fuel. As a result fuel efficiency gains in the order of **3%** to **5%** have been measured in power generation equipment.

Clinical laboratory tests have shown that FTC does provide significant efficiency gains in internal combustion engines. However, laboratory tests generally do not reflect the true operating conditions of most power generation equipment in the field. Variations that are often observed in daily operational data make proving the benefits of FTC difficult to quantify. Factors other than the addition of FTC can easily affect the results of trial periods on which evaluations are made. These variables include fluctuations in load, seasonal changes in ambient conditions, variations in fuel temperature and density, engine ageing and recording errors.

Using an engineering based test procedure is the only way to make a ***true*** comparison of the effect FTC has on an engine's efficiency. Employing a Specific Fuel Consumption test procedure Fuel Technology has been able to demonstrate to potential clients the benefits of FTC in their own equipment and operating environment.

The purpose of this Technical Bulletin is to detail the Specific Fuel Consumption method used by Fuel Technology on power generation equipment in the evaluation of FTC Combustion Catalysts.

METHOD

The basis of the specific fuel consumption method is to measure the absolute amount of fuel consumed against the work done by the engine over time at a constant load. From this the engine's efficiency can be calculated.

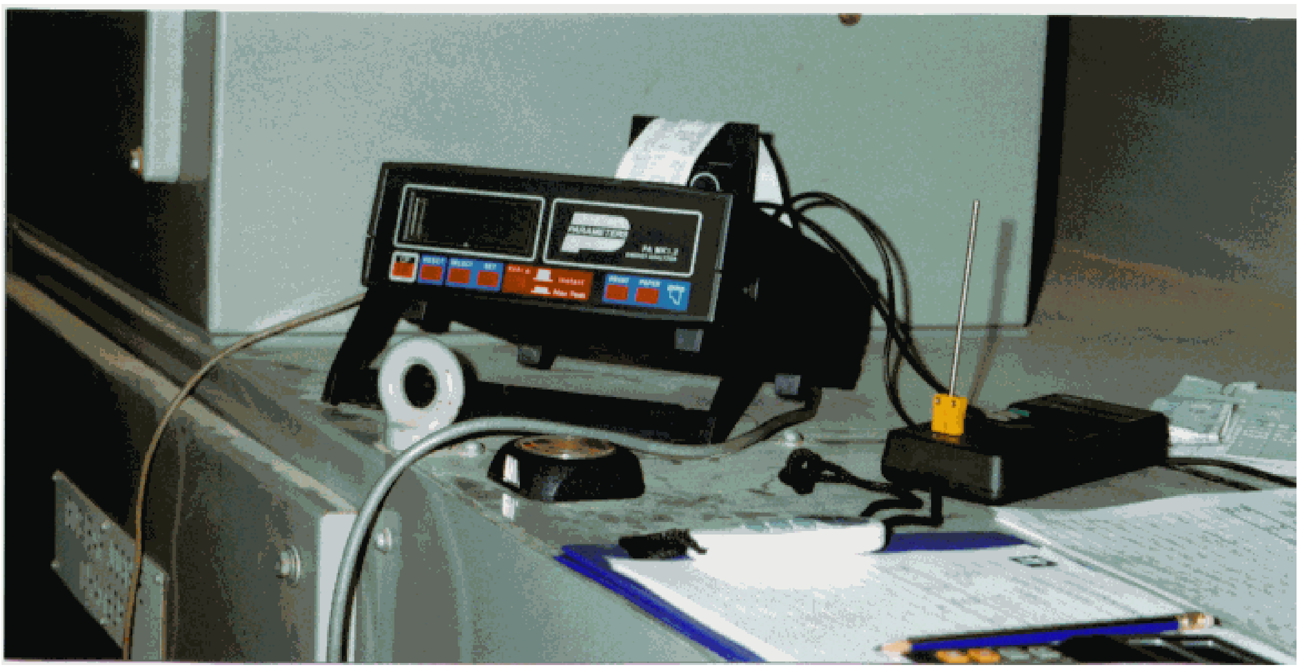
In the evaluation of FTC a series of back to back untreated (baseline) and treated tests are conducted with approximately one (1) month treatment period between to allow for engine conditioning.

Measurement Of Work Done

Using a Microvip MkII Energy Analyser connected into an individual genset's control panel, measurements of the following parameters can be constantly monitored and printed out on demand.

KWatt KVArh LmA

Ampere	kWh	MVAr
Volt	Hours	PF Med
Hz		



Photograph 1 shows the Microvip connected to the switchboard of a genset during a test.

Fig 1 shows a sample of the Microvip print out.

Micro VIP	
Kwatt	255
CosO PF	+0.77
Ampere	446
Volt	432
KVArh	01178.377
KWh	01228.747
Hours	0012.18
LmA	000
MVAr Δ i	> 258
P.F.Med.	> 0.72
Hz	50.0

Measurement Of Fuel Consumed.

Fuel Technology have two methods of measuring the volume of fuel consumed depending on the fuel system configuration of the test engine.

1) Where the engine is fitted with either one inlet line supplying a belly tank or a closed circuit system (ie: return circulation fuel is fed back into the inlet line) an Oval Flowpet positive displacement flow meter is used. The flow meter is connected into the fuel inlet line of the engine and a volumetric reading of fuel being consumed is measured.

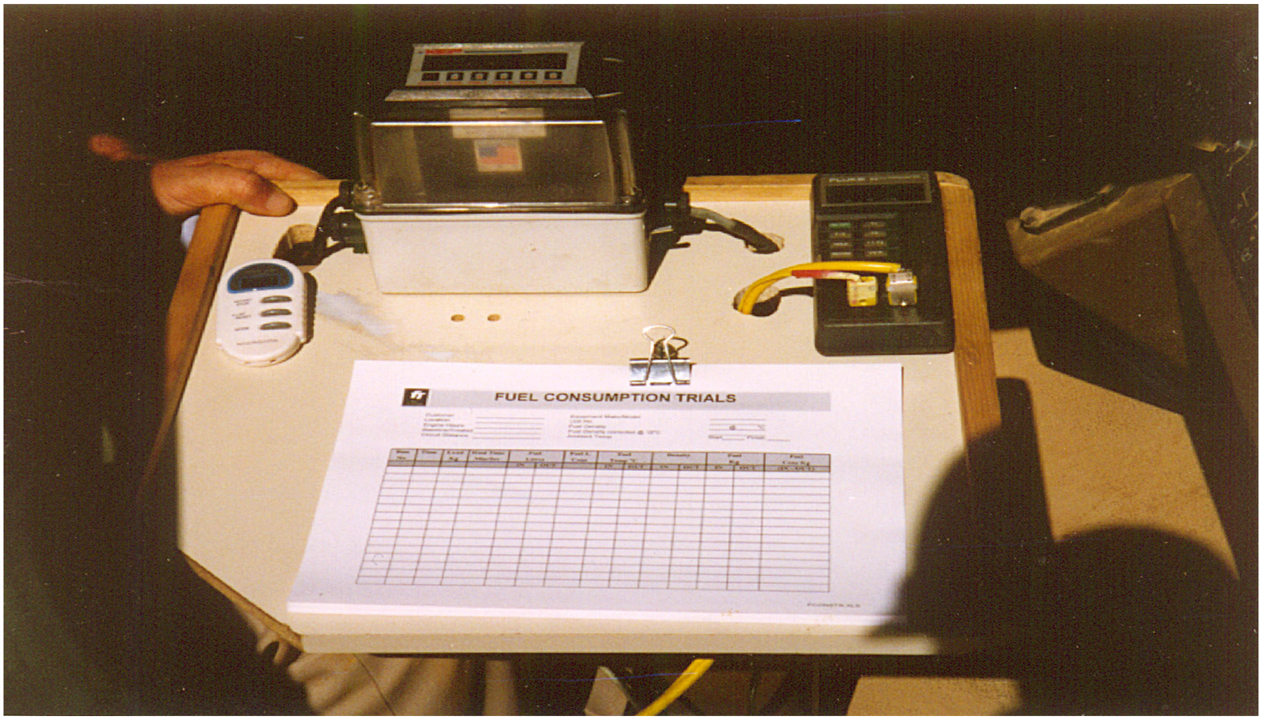
Photograph 2 shows the Oval Flowpet Flow Meter connected to the inlet fuel line to the belly tank of a Cummins KTA 38 genset.

A sample of fuel is drawn during the trial and fuel density at the observed temperature is recorded. This is corrected to the industry standard of 15 ^{O}C. The actual fuel temperature at the meter is measured and the density of the fuel at the operating fuel temperature is calculated from the Institute of Petroleum, Density Correction Tables, Table 53B. The corrected fuel density is used to convert the volumetric (litres) amount of fuel consumed to a mass (kilograms) amount of fuel consumed.

2) In some fuel system configurations a common line to plumb in the Oval flow meter is not available. In these instances two flow transducers may be installed, one in the inlet fuel line to the engine and one in the return fuel line. Each transducer, during operation, sends a pulse signal to a Minitrol Totaliser which is scaled to read in litres.

A fuel sample is taken as described in (1) to measure fuel temperature and density calculated to the industry standard of 15 ^{O}C. Because fuel temperature may vary between inlet and return fuel, temperature probes are fitted to each transducer to record fuel temperature at the meter. The actual fuel temperature recorded at each meter is used to calculate the actual fuel density at the observed temperature. Volumetric (Litre) measurements are converted to mass (kilograms) of fuel consumed for each reading from each flow transducer before efficiency calculations are made. Once temperature and density corrections are made the return fuel mass is subtracted from the inlet fuel mass to calculate the mass of fuel consumed during the test interval.

Photograph 3&4 show two flow transducers connected into an engine's fuel lines and the Minitrol Totaliser in operation.



General Test Procedure

Before the commencement of a genset test the Microvip Energy Analyser is connected to the control panel of the test unit and confirmed to be recording correctly. At the same time the flow meter or transducers are plumbed into the fuel lines and verified to be operating correctly.

Where possible the genset is set at a load that will be reproducible when the treated tests are conducted approximately one month later and the load will remain steady during the test.

NOTE: Steady and reproducible genset load is of critical importance to ensure that the test engine efficiency is not influenced by changes in engine load during and between tests.

Each test is run for approximately One (1) hour on each engine with readings of the Microvip and fuel meters being taken at regular intervals (usually 10 or 15 minutes). Two stop watches are synchronised at the start of each unit test to ensure readings are taken at the same time and at the nominated interval.

Readings are entered onto data sheets (copies attached) and average load, kilowatt hours produced, fuel consumed and engine efficiency (L/kWh or kg/kWh) are calculated for that interval. At the end of the unit test the mean is calculated for comparative purposes.

During the test, additional parameters such as ambient air temperature and, where possible, exhaust temperature, air inlet temperature and cooling water temperature are monitored to ensure the unit is running in a similar mode during untreated and treated tests.

REPORTING

On completion of the test series a full analysis is carried out on the data to compare the results of each test. The difference in untreated and treated means is calculated and expressed as a percentage of the baseline. To prove the statistical significance of the difference in means the standard deviation is calculated and a Student *t*-test performed. Any other factors that may influence engine efficiency (ie: significant changes in engine load and ambient air temperature) are analysed for any causal affect.

The results of the analysis is compiled and submitted to the client as a full report including copies of all raw data.

CONCLUSION

Although field tests cannot be controlled as tightly as laboratory tests, by using a recognised engineering test method and controlling as many of the variables that also affect genset performance Fuel Technology have been able to prove conclusively to clients the benefits in the use of FTC Combustion Catalysts, as a means of energy conservation, and ultimately, following extended service, the maintenance potential of the more complete and thus cleaner combustion of the fuel.