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WORSLEY ALUMINA
Boddington Operations

Evaluation of FTC Combustion Catalyst as a means of reducing diesel fuel costs in mobile mining equipment

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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 proven in laboratory and field trials to significantly reduce fuel consumption under comparable load conditions and to also substantially reduce carbon emissions.

Following Fuel Efficiency tests conducted for Worsley Alumina at their Boddington operations in 1989 an automated dosing system was installed and all fuel treated with FTC-3 for the following fourteen years. Due to the long elapsed period since these tests were conducted and the fact that new mining equipment had been purchased, Worsley Alumina management requested an updated evaluation be conducted. This trial commenced on 23rd July 2003 and was completed on 3rd March 2004. .

The net average efficiency loss following withdrawal of catalyst treatment of fuel was **4.7%**. when measured by Australian Standards 2077 Carbon Mass Balance (CMB) test method.

BACKGROUND

The FTC Combustion Catalyst is the only fuel chemical yet proven by the world's leading testing authority, Southwest Research Institute, San Antonio, Texas, to improve fuel efficiency in an as new 2500HP diesel engine operating at its most efficient state. SwRI also determined that FTC does not alter the physical or chemical properties of diesel fuel.

SwRI also determined, using the Caterpillar 1G2 Test (ASTM 509A) that there are no detrimental effects that could cause increased wear or deposit problems following catalyst treatment of fuel.

These findings have been verified by countless field studies in diverse applications which have confirmed efficiency benefits for mine mobile equipment. Maintenance benefits documented include reduced wear metal profiles in lubricating oil and reduced soot. Combustion and exhaust spaces become essentially free of any hard carbon with continuous catalyst use.

FTC's action in producing fuel efficiency gains is to promote a faster fuel burn which releases the fuel's energy more efficiently. That is, a larger portion of the fuel burn occurs when the piston is closer to top dead centre.

INTRODUCTION

Equipment provided for this fuel efficiency evaluation comprised of five Komatsu 985 haul trucks.

As fuel at Worsley Alumina Boddington operations has been FTC treated for the past fourteen years fuel efficiency tests were conducted in reverse. That is, FTC treated tests were conducted and then FTC metering system was turned off. Allowing time for treated fuel to be extinguished and engine deconditioning to apply, untreated tests were then conducted as per treated tests.

TEST METHOD

Carbon Mass Balance (CMB) is a procedure whereby the mass of carbon in the exhaust is calculated as a measure of the fuel being burned. The elements measured in this test include the exhaust gas composition, (HC,CO,CO_2 and O_2) temperature and the gas flow rate calculated from the differential pressure and exhaust stack cross sectional area. This is an Engineering Standard Test (AS2077-1982) and has been used by the US EPA since 1974 as the "Standard Federal Test Procedure" for fuel economy and emission testing.

Each test truck was driven to the workshop where CMB test probe was positioned in the exhausts independently. With the assistance of operators the test truck engine was run at high idle and CMB and Bosch smoke tests conducted.

TEST RESULTS

A summary of the CMB fuel efficiency results achieved in this test program is provided in the following table.

TABLE 1
Carbon Balance Fuel Consumption Test Results

Unit No.	Treated 23/7/03 Carbon flow g/s	Untreated 3/3/04 Carbon flow g/s	Variation
211 Top Exhaust	3.128	1.772	-76.5%
211 Bottom Exhaust	3.822	3.979	3.9%
215 Top Exhaust	3.594	N/A	
215 Bottom Exhaust	2.650	2.875	7.8%
216 Top Exhaust	6.068	N/A	
216 Bottom Exhaust	7.147	7.300	6.0%
217 Single Exhaust	10.831	11.452	5.4%
218 Single Exhaust	10.801	N/A	
Ave Excluding 211 top, 215 top, 216 top, 218	**6.1125**	**6.4025**	**4.7%**

The CMB test procedure provides confirmation that removal of the Catalyst from the fuel supply has resulted in an increase in carbon flow (fuel consumption) of **4.7%,** excluding truck 211 top exhaust, which for unknown reasons is an outlier. Tests conducted on this truck's top exhaust indicate a very low carbon flow during CMB treated test which have resulted in unrealistic data recorded. Trucks 215 and 216 top exhausts and 218 (single exhaust) all had excessive damage to exhaust systems and could not be tested during untreated tests. The computer printouts of results and raw data sheets are contained in the *Appendix*.

Following is photograph showing CMB measurement in process.

BOSCH SMOKE MEASUREMENTS

A Bosch smoke test is also undertaken during conduct of the CMB test and the results are shown in the following table. Smoke patches in *Appendix*.

TABLE 2
Bosch Smoke Results

Unit No.	Treated 23/7/03	Untreated 3/3/04	Variation
211 Top	0.4	0.3	-33%
211 Bottom	0.3	0.3	0%
215 Top	0.6	N/A	
215 Bottom	0.6	0.7	16%
216 Top	0.6	N/A	
216 Bottom	0.6	0.8	33%
217	0.6	0.9	50%
218	0.5	N/A	
Average Excluding # 215 & 216 Top & 218	**0.5**	**0.6**	**20 %**

GREENHOUSE GAS REDUCTION

A gross reduction of **4.7%** of the current estimated annual fuel consumption of 8,000 kL translates to a **1012 tonnes per annum** reduction in CO_2 emissions, based on the formula outlined in Worksheet 3 of the "Electricity Supply Business Greenhouse Change Workbook". Our estimate is based on the following calculations:-

(8,000 kL x 38.6 x 69.7) ÷ 1000 = 21,523 tonnes CO_2 per annum

- 4.7% (7,624 kL x 38.6 x 69.7) ÷ 1000 = 20,512 tonnes CO_2 per annum

CO_2 reduction by application FPC Catalyst
21,523 – 20,512 = 1,012 tonnes

CONCLUSION

These carefully controlled engineering standard test procedures conducted on a selection of Worsley Alumina Boddington operations fleet provide clear evidence of average increased fuel consumption of **4.7%**. following removal of FTC Combustion Catalyst from fuel supply.

A fuel efficiency gain of **4.7%** produced by FTC and as measured by the Australian Standards (AS2077) CMB test method, if applied to the total fuel currently consumed by your Boddington operation, will result in a **net** saving of in excess of **$126,000 per annum.**

Additional to the fuel economy benefits measured, is a reduction in greenhouse gas emissions of 1,012 tonnes per annum due to more complete combustion of the fuel. Further, the more complete combustion will translate to significant reduction over time in engine maintenance costs. FTC/FPC also acts as an effective biocide.

Appendix "B"

Carbon Balance Printouts