MT KEITH OPERATIONS

Evaluation of FTC/FPC Combustion Catalyst as a means of reducing Geenhouse Gas Emissions and diesel fuel costs in mobile mining equipment.

September, 2005

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EXECUTIVE SUMMARY

The FTC/FPC Combustion Catalysts manufactured and marketed by Fuel Technology, have proven in laboratory and field trials to significantly reduce fuel consumption under comparable load conditions and to also substantially reduce carbon emissions.

Following meetings with Mt Keith Operations Continuous Improvement team and alternately Continuous Improvement Superintendent, Mr Tim Riley, it was agreed that a fuel efficiency study should be conducted on selected haul trucks at the Mt Keith Operations employing two International Engineering test procedures namely "Specific Fuel Consumption" (SFC) and "Carbon Mass Balance" (CMB). This trial commenced on 26th July 2005 and was completed on 31st August 2005.

The net average efficiency gain (reduction in fuel consumption) measured by the SFC and CMB test methods was **4.85%** and **7.9%** respectively.

*B*ACKGROUND

The FTC/FPC Combustion Catalyst is the only fuel chemical yet proven by the world's leading testing authority, Southwest Research Institute, Texas (SwRI) 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 and more complete 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.

*I*NTRODUCTION

Equipment provided for this fuel efficiency evaluation comprised of three Caterpillar 793 series trucks, Numbers 1269, 1326 and 1581. Due to truck availability trucks 1269 and 1326 were selected for CMB testing and trucks 1269 and 1581 for SFC testing. Test truck 1326 received performance alterations between tests and was therefore deemed unsuitable for treated tests.

Fuel Technology Pty Ltd supplied, on loan, a calibrated air operated catalyst-metering system allowing fuel to be FTC/FPC treated at time of fuel transfer from bulk storage tanks to day tanks at refuelling bay.

Trucks 1269 and 1581 were selected for the SFC test, which were conducted over a surveyed circuit marked out on the "F" stage haul ramp in an area where no changes to the profile would occur over the test period. The CMB, which is a static test, was conducted adjacent to the workshop.

TEST METHODS

The 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. (*Horiba four gas analyser photograph No*. 1)

Each test truck was driven to area adjacent the workshop where CMB test probe was positioned in the exhausts independently. With the assistance of on site personnel the test truck engine was run at high idle while emissions were recorded. Exhaust smoke samples via "Bosch Smoke" testing equipment were also recorded at this time.

The Specific Fuel Consumption (SFC) test procedure requires measurement of the mass of fuel consumed related to the work performed in hauling a measured load of ore over a defined distance.

A start point was selected on a reproducible section of the ramp haul and windrow marked. A point near the Snails Ears (top of ramp) was defined as the end point of the haul route. The distance between these points was surveyed at 1.979km.

MacNaught Model M10 flow transducers complete with thermocouple probes were connected to the truck's fuel tank outlet and return fuel pipelines (*Photograph No. 2*).

These transducers, which have been calibrated to ± 0.25% by a NATA certified laboratory are connected to a KEP Minitrol Totaliser mounted in the truck cab. The thermocouple probes are connected to a dual reading digital thermometer, also mounted in the cab workstation (*Photograph No. 3*).

As the temperature of the fuel can vary relative to ambient temperature changes as well as increase significantly during a working shift, constant temperature monitoring is required to enable calculation of the mass of fuel consumed for each haul.

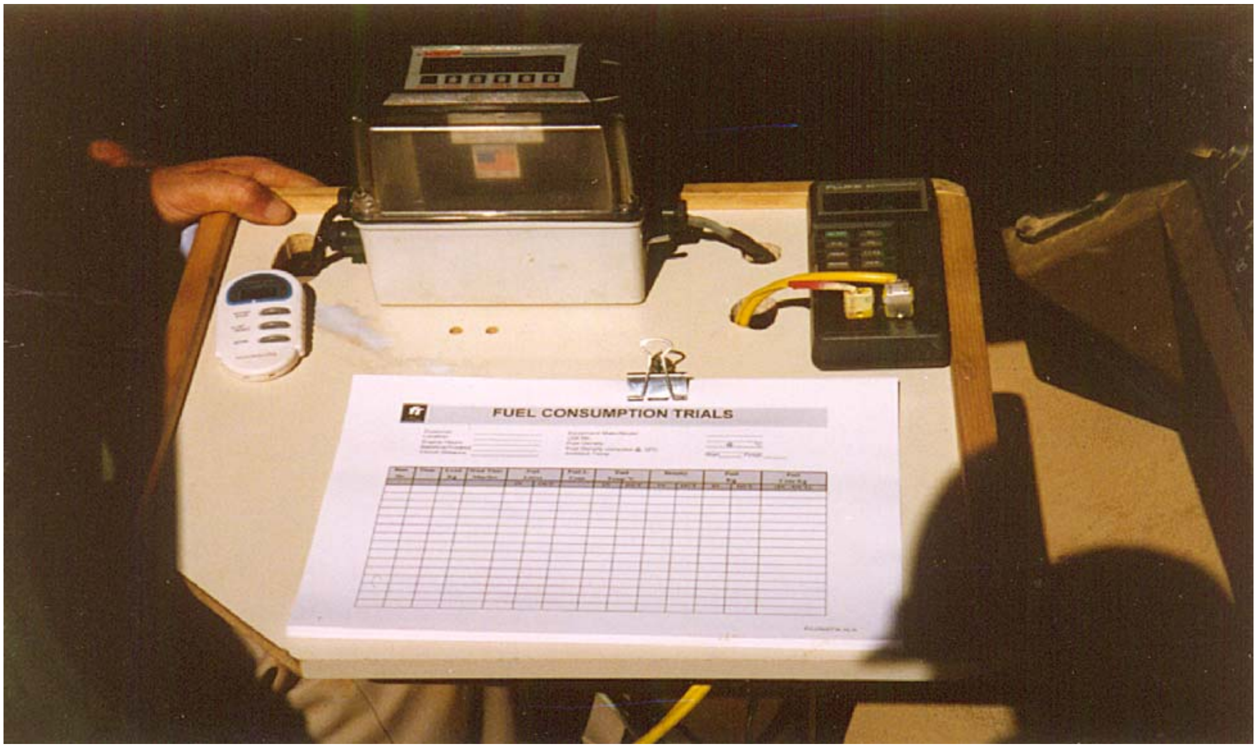
Prior to the test commencing, a fuel sample is drawn and submitted to an independent laboratory where the density is measured at the observed temperature and then corrected to industry standard of 15°C.

Following loading of the truck at each cycle, the truck was driven to the pit ramp marker and stopped. The Minitrol totaliser and stopwatch are zeroed. At the signal "*GO*" the driver accelerates and the test engineer activates the totaliser and stopwatch. The truck is driven at full throttle to avoid driver variables over the haul route. Fuel temperatures are recorded at the mid haul point. Upon arrival at the end marker the stopwatch and Minitrol totaliser readings are recorded.

TEST EQUIPMENT

Photograph No. 1

Photograph No. 2



Photograph No. 3

TEST RESULTS

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

TABLE 1

Carbon Balance Fuel Consumption Test Results

Unit No.	Untreated 26/7/05 Carbon flow g/s	Treated 29/8/05 Carbon flow g/s	Variation
1269 Top Exhaust	9.462	8.698	
1269 Bottom Exhaust	10.129	9.338	
TOTAL g/s	**19.591**	**18.036**	**-7.9%**

1326 Top Exhaust	8.886	N/A	
1326 Bottom Exhaust	9.578	N/A	
TOTAL g/s	**18.464**		

The CMB test procedure provides confirmation that addition of the Catalyst to the fuel supply of truck 1269 has resulted in a reduction in carbon flow (fuel consumption) of **7.9%**. This test is a static test conducted at high idle with no load applied to the engine and therefore used as an indicator of change following FTC/FPC treatment of fuel but not used in final analysis of tests. The computer printouts of results and raw data sheets are contained in the *Appendix*.

BOSCH SMOKE MEASUREMENTS

A Bosch smoke test was 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.	Untreated 26/7/05	Treated 29/8/05	Variation
1269 Top Exhaust	1.3	1.1	
1269 Bottom Exhaust	1.4	0.9	
AVERAGE	**1.35**	**1.0**	**- 26%**
1326 Top Exhaust	0.9	N/A	
1326 Bottom Exhaust	0.8	N/A	
AVERAGE	**0.85**		

The Bosch Scale reads from 0.1 (very clean) to 9.9 (very dirty).

SPECIFIC FUEL CONSUMPTION

Specific Fuel Consumption tests conducted on trucks 1269 and 1581 in a working environment provided fuel efficiency gains of **5.7%** and **4%** respectively averaging **4.85%** when SAE recommended formula of tonne/km per kg of fuel is applied. Computer printouts follow in tables 3 and 4. Graphical representation is graphs 1 and 2. Work sheets in *Appendix*.

Test Truck 1269-Table 3

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer:	MT KEITH		Engine Hrs	42328.5
Date:	28/07/2005		Amb; Temp; Start deg; C	
Truck No;	1269		Amb; Temp; Finish deg; C	
Make/Model	CAT 793C		Circuit Distance kms	1.978
Tare Weight T	167			

Fuel Sample	Density	Temp Deg C
	0.8234	25
Corrected	0.830	15

UNTREATED

Run No	Time	Load Tonne	Haul Time		Haul Time	Fuel (Lt)		Fuel (Lt)	Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km
			Mins	Secs	Mins	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel
1	11.10	225.9	8	54	8.90	127.40	68.20	59.20	25.5	53.1	0.823	0.804	104.85	54.80	50.05	0.1274	15.527
2	11.40	223.1	8	54	8.90	127.50	68.60	58.90	27.8	55.7	0.821	0.802	104.73	55.00	49.73	0.1275	15.516
3	12.15	247	9	00	9.00	130.50	69.20	61.30	31.0	57.0	0.819	0.801	106.91	55.42	51.49	0.1244	15.904
4	1.45	216.9	8	41	8.68	125.40	67.80	57.60	34.3	58.8	0.817	0.800	102.43	54.21	48.22	0.1256	15.747
5	2.15	231.9	8	57	8.95	128.00	68.60	59.40	36.6	59.8	0.815	0.799	104.35	54.80	49.55	0.1242	15.924
6	2.45	221.5	8	44	8.73	126.10	68.00	58.10	38.5	61.6	0.814	0.798	102.62	54.23	48.39	0.1246	15.880
7	3.15	221.3	8	47	8.78	126.00	67.60	58.40	40.9	62.6	0.812	0.797	102.32	53.86	48.46	0.1248	15.849
8	3.45	218.4	8	41	8.68	126.30	67.50	58.80	42.5	63.5	0.811	0.796	102.43	53.74	48.69	0.1263	15.658
9	4.10	224	8	55	8.92	127.10	67.40	59.70	43.9	64.6	0.810	0.795	102.95	53.61	49.34	0.1262	15.675
10	4.25	235.5	9	08	9.13	129.30	68.50	60.80	45.7	64.9	0.809	0.795	104.58	54.47	50.11	0.1245	15.889
11	5.00	224.5	8	59	8.98	127.60	67.60	60.00	47.5	65.8	0.808	0.795	103.04	53.71	49.33	0.1260	15.698
Mean		226			8.88			59.29							49.396	0.126	15.752

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No:	1269		Engine Hrs	42781
Date:	30/08/2005		Amb; Temp; Start deg; C	
			Amb; Temp; Finish deg; C	
			Hrs Between Tests	452.5

Fuel Sample	Density	Temp Deg C
	0.8244	25
Corrected	0.831	15

TREATED

Run No	Time	Load Tonne	Haul Time		Haul Time	Fuel (Lt)		Fuel (Lt)	Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km
			Mins	Secs	Mins	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel
1	7.45	199	8	34	8.57	123.60	69.90	53.70	22.3	50.1	0.826	0.807	102.13	56.38	45.75	0.1250	15.824
2	8.10	219	8	57	8.95	127.10	70.80	56.30	24.7	51.6	0.825	0.806	104.81	57.04	47.77	0.1238	15.983
3	8.40	210	8	37	8.62	124.00	70.10	53.90	26.9	53.1	0.823	0.805	102.06	56.40	45.67	0.1211	16.329
4	9.35	215	8	42	8.70	125.00	71.30	53.70	30.8	55.7	0.820	0.803	102.54	57.23	45.30	0.1186	16.678
5	10.20	196	8	23	8.38	121.50	70.80	50.70	32.9	56.7	0.819	0.802	99.48	56.78	42.70	0.1176	16.814
6	10.45	205	8	32	8.53	123.30	71.00	52.30	34.6	58.1	0.818	0.801	100.81	56.87	43.94	0.1181	16.746
7	10.25	223	8	39	8.65	124.60	70.90	53.70	35.7	57.6	0.817	0.801	101.77	56.81	44.96	0.1153	17.157
8	12.00	217	8	44	8.73	125.30	71.10	54.20	37.5	58.4	0.816	0.801	102.19	56.94	45.26	0.1179	16.783
9	12.30	205	8	40	8.67	124.90	71.40	53.50	38.9	60.3	0.815	0.799	101.74	57.08	44.67	0.1201	16.474
10	1.00	220	8	46	8.77	125.80	71.40	54.40	40.6	61.3	0.813	0.799	102.33	57.03	45.30	0.1171	16.899
11	2.45	224	8	44	8.73	125.40	72.30	53.10	41.8	61.2	0.813	0.799	101.89	57.75	44.13	0.1129	17.524
Mean		212			8.66			53.59							45.041	0.1189	16.6555

% CHANGE: Treated-Baseline	Load kg			Haul Time Mins		Fuel (Lt) Consumed		Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Baseline	-6.31%			-2.42%		-9.61%		-8.82%	**-5.4%**	**5.7%**

Test Truck 1581-Table 4

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer:	MT KEITH	Engine Hrs	1559.9
Date:	27/07/2005	Amb; Temp; Start deg; C	
Truck No;	1581	Amb; Temp; Finish deg; C	
Make/Model	CAT 793	Circuit Distance kms	1.978
Tare Weight T	167		

Fuel Sample	Density	Temp Deg C
	0.8234	25
Corrected	0.830	15

UNTREATED

Run No	Time	Load Tonne	Haul Time		Haul Time	Fuel (Lt)		Fuel (Lt)	Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km
			Mins	Secs	Mins	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel
1	11.40	187	8	31	8.52	124.20	69.90	54.30	39.2	57.6	0.813	0.800	101.02	55.94	45.08	0.1274	15.532
2	12.10	197	8	33	8.55	123.30	65.20	58.10	40.8	58.4	0.812	0.800	100.14	52.15	48.00	0.1319	15.001
3	12.40	229	8	44	8.73	124.60	66.30	58.30	42.5	59.4	0.811	0.799	101.05	52.98	48.07	0.1214	16.295
4	1.10	200	8	20	8.33	121.10	66.50	54.60	43.3	59.8	0.811	0.799	98.15	53.12	45.03	0.1227	16.120
5	2.25	218	8	26	8.43	121.90	65.80	56.10	44.0	59.8	0.810	0.799	98.74	52.56	46.18	0.1199	16.491
6	2.50	222	8	35	8.58	122.30	65.80	56.50	44.8	61.1	0.809	0.798	98.99	52.50	46.49	0.1195	16.551
7	3.25	211	8	34	8.57	123.00	65.90	57.10	45.6	60.8	0.809	0.798	99.48	52.59	46.89	0.1240	15.946
8	3.55	220	8	21	8.35	120.20	65.00	55.20	46.8	61.5	0.808	0.798	97.12	51.84	45.28	0.1170	16.907
9	4.20	236	8	31	8.52	121.70	64.70	57.00	47.5	61.6	0.808	0.798	98.27	51.60	46.67	0.1158	17.079
10	5.00	230	8	25	8.42	121.40	65.10	56.30	48.1	61.9	0.807	0.797	97.98	51.90	46.08	0.1161	17.042
Mean		215			8.50			56.35							46.377	0.122	16.296

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No:	1581	Engine Hrs	2160
Date:	31/08/2005	Amb; Temp; Start deg; C	
		Amb; Temp; Finish deg; C	
		Hrs Between Tests	600.1

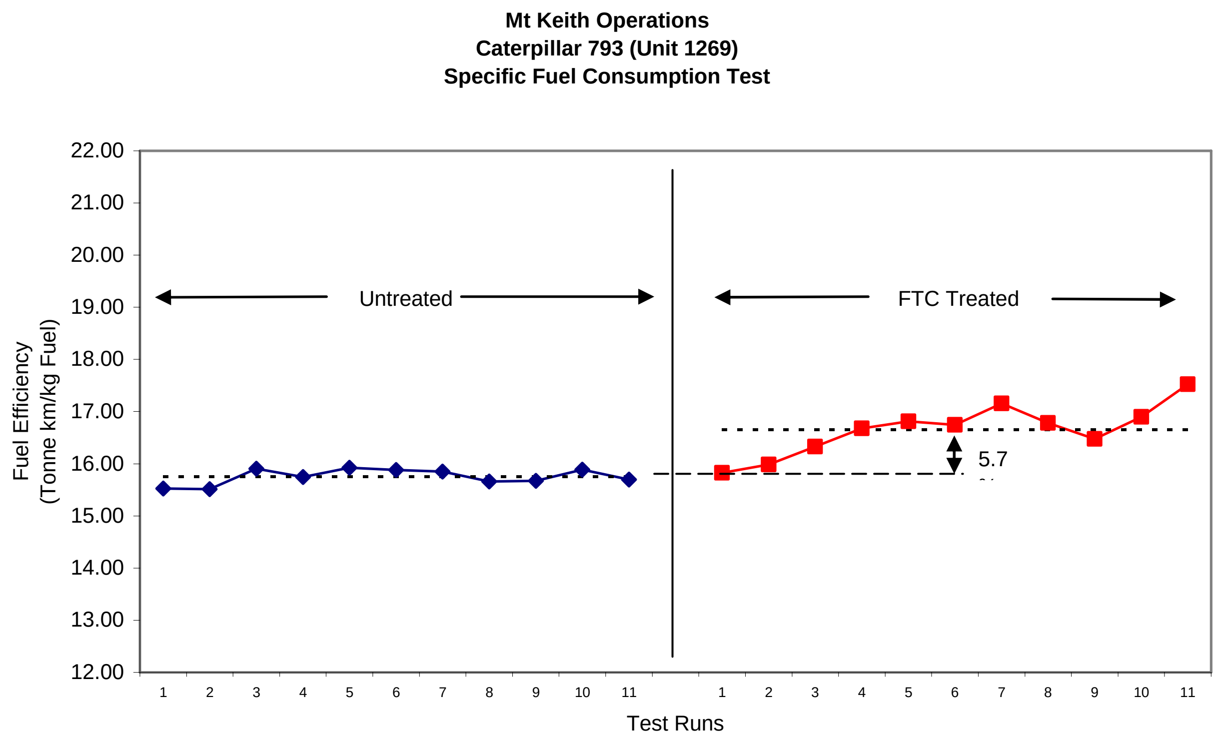
Fuel Sample	Density	Temp Deg C
	0.8244	25
Corrected	0.831	15

TREATED

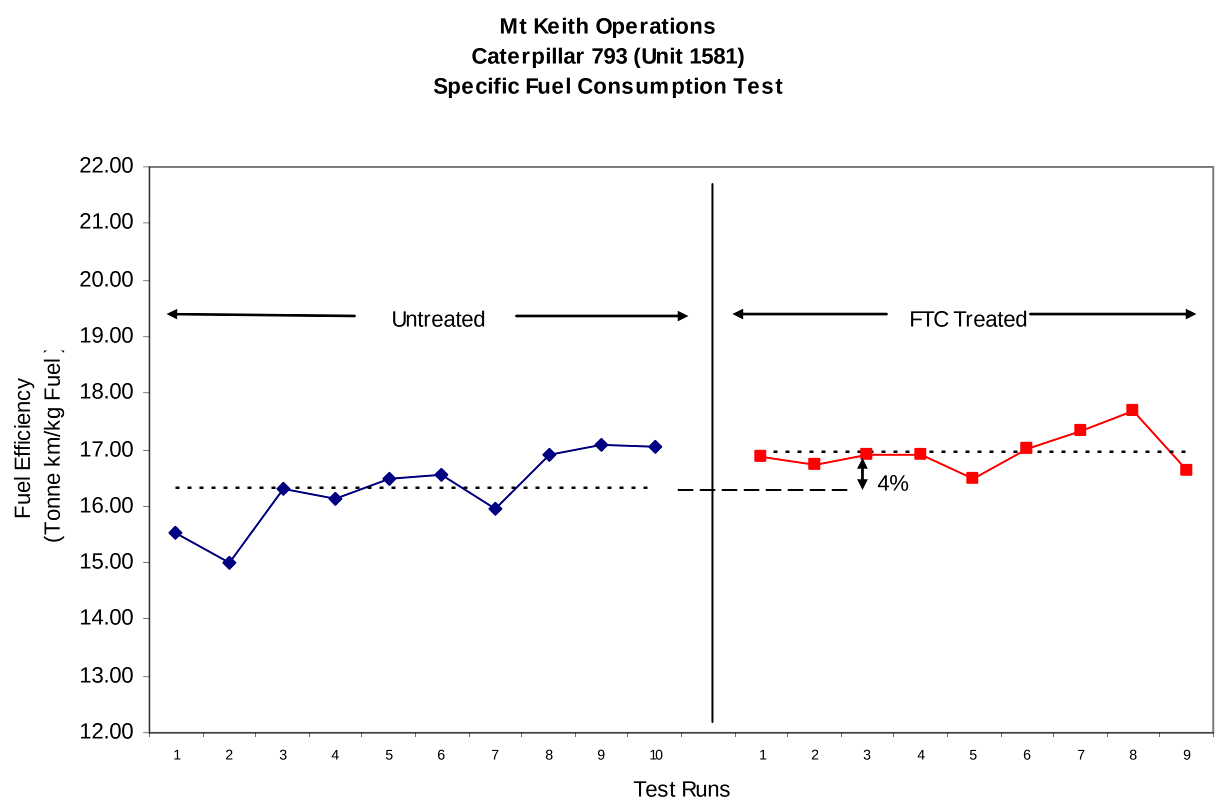
Run No	Time	Load Tonne	Haul Time		Haul Time	Fuel (Lt)		Fuel (Lt)	Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km
			Mins	Secs	Mins	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel
1	7.35	229	8	31	8.52	124.70	69.10	55.60	33.2	51.4	0.819	0.806	102.08	55.67	46.41	0.1172	16.879
2	8.10	235	8	41	8.68	127.30	70.20	57.10	34.7	52.5	0.818	0.805	104.07	56.50	47.56	0.1183	16.718
3	8.40	223	8	34	8.57	126.00	71.20	54.80	35.9	53.6	0.817	0.804	102.90	57.26	45.65	0.1170	16.900
4	9.05	230	8	36	8.60	126.20	70.30	55.90	37.4	54.5	0.816	0.804	102.93	56.49	46.44	0.1170	16.908
5	9.35	205	8	26	8.43	124.80	71.10	53.70	38.1	55.0	0.815	0.803	101.72	57.11	44.62	0.1199	16.492
6	10.05	218	8	34	8.57	125.60	71.70	53.90	39.1	56.0	0.814	0.803	102.29	57.54	44.75	0.1162	17.018
7	10.55	230	8	28	8.47	124.80	71.10	53.70	28.8	51.4	0.822	0.806	102.55	57.29	45.26	0.1140	17.349
8	11.20	242	8	33	8.55	125.20	70.70	54.50	32.8	54.1	0.819	0.804	102.53	56.83	45.70	0.1117	17.703
9	11.45	210	8	29	8.48	123.80	70.20	53.60	34.2	54.7	0.818	0.803	101.26	56.40	44.86	0.1190	16.624
Mean		225			8.54			54.76							45.693	0.1167	16.9546

% CHANGE: Treated-Baseline	Load kg			Haul Time Mins		Fuel (Lt) Consumed		Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Baseline	4.50%			0.48%		-2.83%		-1.47%	**-4.0%**	**4.0%**

Graph # 1



Graph # 2



GREENHOUSE GAS REDUCTION

A gross reduction of **4.85%** of the current estimated annual fuel consumption of 57,000 KL translates to a **7,438 tonnes per annum** reduction in CO_2 emissions, based on the formula outlined in Worksheet 1 of the “Electricity Supply Business Greenhouse Change Workbook”. Our estimate is based on the following calculations:-

KL/Fuel x energy content (diesel 38.6) x emission factor (diesel 69.7) / 1000 = Tonnes CO^2

(57,000 KL x 38.6 x 69.7) ÷ 1000 = 153,354 tonnes CO_2 per annum

- 4.85% (54,235 KL x 38.6 x 69.7) ÷ 1000 = 145,916 tonnes CO_2 per annum

CO_2 reduction by application FPC Catalyst
153,354 – 145,916 = 7,438 tonnes

CONCLUSION

These carefully controlled engineering standard test procedures conducted on a selection of Mt Keith Operations fleet provide clear evidence of average reduced fuel consumption of **4.85%**.

A fuel efficiency gain of **4.85%** as measured by SAE Specific Fuel Consumption method, if applied to the total fuel currently consumed by Mt Keith’s mobile equipment of approximately 57ML p.a. at an estimated cost of $0.53/L, will result in a **net** saving of in excess of **$1,100,000 per annum.**

Additional to the fuel economy benefits measured, is a reduction in greenhouse gas emissions of 7,591 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.