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THIESS CONTRACTORS

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 meetings with Thiess Contractors Plant Superintendent, Brian Jury, Maintenance Superintendent, Ray Gobby, and Maintenance Engineer, Douglas Smith, it was agreed that a fuel efficiency study should be conducted on two 785C Caterpillar dump trucks employing "Specific Fuel Consumption Procedure". This trial commenced on 14^{th} November 2001 and was completed on the 12^{th} December 2001.

The net average efficiency gain (reduction in fuel consumption) measured by the SFC test methods was **8.6%**.

BACKGROUND

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/FPC's action in producing fuel efficiency gains is to promote a more complete and 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 two 785C Caterpillar dump trucks operating in the Argo pit at Thiess Contractors St Ives project.

Fuel Technology Pty Ltd supplied, on loan, an air operated FPC catalyst metering system that was calibrated allowing fuel to be FPC treated at time of fuel delivery to main storage tanks.

TEST METHOD

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 the windrow marked. A point at the west waste dump was defined as the end point of the haul route. The distance between these points was measured at 1000 meters.

MacNaught Model M5 flow transducers complete with thermocouple probes were connected to the truck's fuel tank outlet and return fuel pipelines (*Photograph No. 1*).

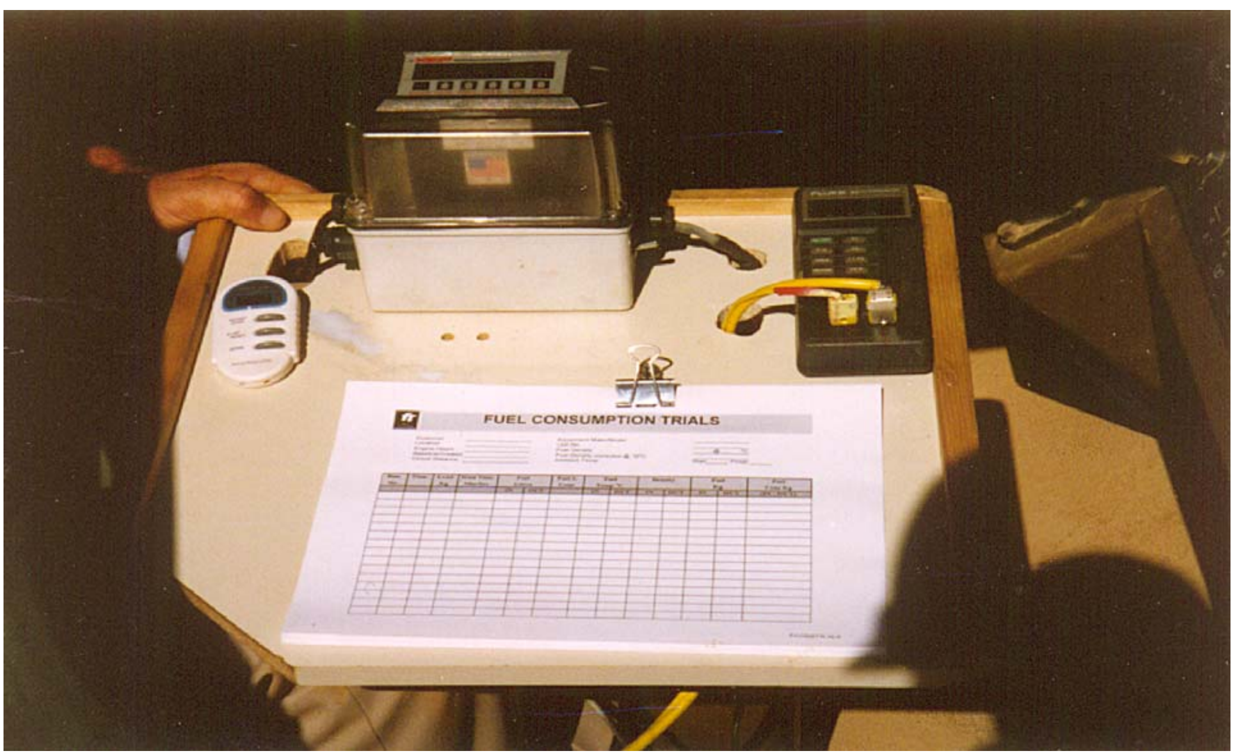
These transducers, which have been calibrated to $\pm$ 0.25% by a NATA certified laboratory, are connected to a KEP Minitrol Totaliser mounted in the truck cab. The thermocouple probes are connected to a dual reading digital thermometer, also mounted in the cab workstation (*Photograph No. 2*).

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 the density measured at the observed temperature and then corrected to the industry standard of 15°C by use of the Institute of Petroleum Density Correction Table, Volume VIII, Table 53B.

Following loading of the truck at each cycle, allowing the load monitor to register, the load in Tonnes is recorded and the truck 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.

Photograph No. 1



Photograph No. 2

TEST RESULTS

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer:	Thiess St Ives Argo Pit	Engine Hrs	1404
Date:	15/11/2001	Amb; Temp; Start deg; C	22.7
Truck No;	1213	Amb; Temp; Finish deg; C	32
Make/Model	Cat 785C	Circuit Distance Km	1
		Unit Tare weight	113

Fuel Sample	Density	Temp Deg C
	0.825	42.8
Corrected	0.845	15

UNTREATED

Run No	Time	Load Tonnes	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	8.47	149	4	47	4.78	81.79	62.03	19.76	40.5	52.3	0.827	0.818	67.61	50.75	16.85	0.0643	**15.5447**
2	9.06	148	4	59	4.98	82.38	62.64	19.74	41.3	54.9	0.826	0.816	68.05	51.14	16.91	0.0648	**15.4378**
3	9.25	155	5	01	5.02	82.30	62.50	19.80	42.3	55.6	0.825	0.816	67.92	50.99	16.93	0.0632	**15.8313**
4	9.44	146	4	51	4.85	79.82	60.69	19.13	43.4	56.8	0.825	0.815	65.81	49.47	16.34	0.0631	**15.8476**
5	10.04	135	4	18	4.30	69.72	52.35	17.37	44.5	57.6	0.824	0.815	57.44	42.64	14.80	0.0597	**16.7610**
6	10.22	124	4	10	4.17	67.74	50.97	16.77	45.4	57.5	0.823	0.815	55.76	41.52	14.24	0.0601	**16.6472**
7	10.55	144	4	34	4.57	72.78	54.52	18.26	46.7	57.9	0.822	0.814	59.84	44.40	15.44	0.0601	**16.6407**
8	11.20	145	4	28	4.47	71.46	53.74	17.72	47.7	59.0	0.822	0.814	58.70	43.72	14.99	0.0581	**17.2150**
9	11.39	133	4	16	4.27	68.59	51.50	17.09	48.6	59.7	0.821	0.813	56.31	41.87	14.44	0.0587	**17.0407**
10	12.05	140	4	33	4.55	72.18	54.16	18.02	49.4	60.0	0.820	0.813	59.21	44.02	15.19	0.0600	**16.6579**
11	12.21	143	4	33	4.55	71.85	53.86	17.99	50.2	61.1	0.820	0.812	58.90	43.73	15.16	0.0592	**16.8853**
12	12.38	145	4	31	4.52	71.63	53.58	18.05	50.8	61.1	0.819	0.812	58.69	43.51	15.18	0.0588	**16.9966**
13	14.15	126	4	06	4.10	66.50	50.12	16.38	46.2	58.5	0.823	0.814	54.70	40.79	13.91	0.0582	**17.1816**
14	14.34	133	4	34	4.57	74.33	56.37	17.96	47.2	59.4	0.822	0.813	61.09	45.84	15.25	0.0620	**16.1293**
15	14.57	118	4	03	4.05	65.90	49.56	16.34	48.1	59.0	0.821	0.814	54.12	40.32	13.80	0.0597	**16.7391**
Mean		139			4.52			18.03							15.295	0.0607	**16.5037**
Std Dev		10.42981075			0.3027			1.1619							1.0426	0.0022	**0.5920**
C.V		7.5%			6.7%			6.4%							6.8%	3.7%	**3.6%**

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No:	1213	Engine Hrs	1833
Date:	11/12/2001	Amb; Temp; Start deg; C	29
		Amb; Temp; Finish deg; C	18

Fuel Sample	Density	Temp Deg C
	0.829	41.9
Corrected	0.848	15

TREATED

Run No	Time	Load Tonnes	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		122	3	41	3.68	61.84	46.67	15.17	47.5	57.6	0.825	0.818	51.02	38.17	12.85	0.0547	**18.2840**
2		118	3	46	3.77	61.67	46.65	15.02	47.5	57.8	0.825	0.818	50.88	38.15	12.73	0.0551	**18.1411**
3		122	3	45	3.75	61.19	46.14	15.05	47.7	57.5	0.825	0.818	50.48	37.74	12.73	0.0542	**18.4558**
4		116	3	45	3.75	60.95	46.04	14.91	48.2	57.4	0.825	0.818	50.26	37.67	12.59	0.0550	**18.1832**
5		128	3	51	3.85	62.59	47.09	15.50	48.8	57.9	0.824	0.818	51.58	38.51	13.07	0.0543	**18.4322**
6		129	3	52	3.87	62.30	46.86	15.44	48.9	58.7	0.824	0.817	51.34	38.29	13.05	0.0539	**18.5410**
7		122	3	50	3.83	62.22	47.16	15.06	49.4	58.7	0.824	0.817	51.25	38.53	12.72	0.0541	**18.4804**
8		119	3	47	3.78	61.35	46.31	15.04	49.8	58.1	0.823	0.818	50.52	37.86	12.65	0.0545	**18.3362**
9		117	3	44	3.73	60.99	46.09	14.90	50.1	58.8	0.823	0.817	50.21	37.66	12.55	0.0546	**18.3313**
10		133	4	23	4.38	71.29	54.24	17.05	50.3	58.7	0.823	0.817	58.68	44.32	14.36	0.0584	**17.1318**
11		125	3	48	3.80	61.24	46.00	15.24	50.6	58.7	0.823	0.817	50.39	37.59	12.81	0.0538	**18.5824**
12		132	3	55	3.92	62.59	46.95	15.64	51.0	58.1	0.823	0.818	51.49	38.39	13.10	0.0535	**18.7020**
13		136	4	07	4.12	65.82	49.48	16.34	50.6	57.9	0.823	0.818	54.16	40.46	13.70	0.0550	**18.1706**
14		120	3	44	3.73	60.57	45.71	14.86	49.5	56.3	0.824	0.819	49.89	37.43	12.46	0.0535	**18.7027**
15		117	3	42	3.70	60.77	45.87	14.90	49.4	56.9	0.824	0.818	50.06	37.54	12.52	0.0544	**18.3761**
Mean		124			3.84			15.34							12.935	0.0547	**18.3001**
Std Dev		6.441679757			0.1835			0.6121							0.5057	0.0012	**0.3738**
C.V		5.2%			4.8%			4.0%							3.9%	2.1%	**2.0%**

% CHANGE: **Treated-Baseline**	Load Tonnes			Haul Time Mins		Fuel (Lt) Consumed		Fuel (kg) Consumed	Fuel (kg) Per Tonne	**Tonne/km Per kg Fuel**
Baseline	-10.94%			-14.89%		-14.93%		-15.43%	**-9.9%**	**10.9%**

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer:	Thiess St Ives Argo Pit	Engine Hrs	1298
Date:	14/11/2001	Amb; Temp; Start deg; C	24.7
Truck No;	1214	Amb; Temp; Finish deg; C	32.6
Make/Model	Cat 785C	Circuit Distance Km	1
		Unit Tare weight	113

Fuel Sample	Density	Temp Deg C
	0.830	38.7
Corrected	0.847	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	7.05	139	4	18	4.30	69.64	52.00	17.64	45.5	55.7	0.825	0.818	57.47	42.53	14.94	0.0593	**16.8718**
2	7.26	146	4	35	4.58	73.16	54.61	18.55	45.7	56.5	0.825	0.817	60.36	44.64	15.72	0.0607	**16.4771**
3	7.46	136	4	15	4.25	68.84	51.30	17.54	46.5	57.7	0.825	0.817	56.76	41.89	14.87	0.0597	**16.7427**
4	8.04	154	4	55	4.92	80.74	60.77	19.97	47.4	58.8	0.824	0.816	66.51	49.58	16.94	0.0634	**15.7639**
5	8.22	119	3	57	3.95	64.64	48.34	16.30	48.2	59.0	0.823	0.816	53.22	39.43	13.79	0.0594	**16.8213**
6	8.40	146	4	26	4.43	71.24	53.07	18.17	49.0	59.6	0.823	0.815	58.61	43.26	15.35	0.0593	**16.8768**
7	9.00	136	4	17	4.28	69.18	51.52	17.66	49.9	60.2	0.822	0.815	56.87	41.98	14.89	0.0598	**16.7177**
8	9.19	124	4	00	4.00	65.42	48.89	16.53	50.7	60.8	0.822	0.814	53.74	39.81	13.93	0.0588	**17.0119**
9	9.36	117	3	54	3.90	64.22	48.05	16.17	51.5	61.3	0.821	0.814	52.72	39.11	13.61	0.0592	**16.9049**
10	10.11	107	3	50	3.83	63.69	47.72	15.97	52.3	60.7	0.820	0.814	52.25	38.86	13.39	0.0609	**16.4325**
11	10.34	144	4	30	4.50	71.65	53.34	18.31	53.0	62.1	0.820	0.813	58.75	43.39	15.36	0.0598	**16.7328**
12	11.37	144	4	33	4.55	72.19	53.71	18.48	54.0	63.0	0.819	0.813	59.14	43.66	15.48	0.0602	**16.5993**
13	11.55	133	4	10	4.17	67.14	50.07	17.07	54.8	63.7	0.819	0.812	54.96	40.67	14.29	0.0581	**17.2161**
14	13.02	133	4	16	4.27	68.86	51.56	17.30	47.7	59.8	0.824	0.815	56.71	42.02	14.69	0.0597	**16.7442**
15	13.25	135	4	17	4.28	69.22	51.76	17.46	48.9	61.2	0.823	0.814	56.95	42.14	14.82	0.0597	**16.7382**
Mean		134			4.28			17.54							14.804	0.0599	**16.7101**
Std Dev		12.7234317			0.2913			1.0693							0.9253	0.0012	**0.3267**
C.V		9.5%			6.8%			6.1%							6.3%	2.0%	**2.0%**

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No:	1214	Engine Hrs	1748
Date:	12/12/2001	Amb; Temp; Start deg; C	16
		Amb; Temp; Finish deg; C	25

Fuel Sample	Density	Temp Deg C
	0.827	41.9
Corrected	0.846	15

TREATED

Run No	Time	Load Tonnes	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	6.23	126	3	49	3.82	61.84	46.84	15.00	42.5	52.0	0.827	0.820	51.12	38.40	12.71	0.0532	**18.7999**
2	6.42	137	4	13	4.22	67.35	51.06	16.29	43.2	53.7	0.826	0.819	55.64	41.80	13.84	0.0553	**18.0701**
3	7.02	121	3	55	3.92	62.83	47.57	15.26	43.8	54.3	0.826	0.818	51.88	38.92	12.96	0.0554	**18.0598**
4	7.20	140	4	25	4.42	71.77	54.82	16.95	44.6	55.8	0.825	0.817	59.22	44.80	14.42	0.0570	**17.5469**
5	7.36	129	3	51	3.85	61.46	43.57	17.89	45.1	55.8	0.825	0.817	50.69	35.61	15.08	0.0623	**16.0470**
6	7.54	135	4	05	4.08	65.55	49.70	15.85	45.7	56.5	0.824	0.817	54.03	40.59	13.44	0.0542	**18.4484**
7	8.10	146	4	44	4.73	78.48	60.29	18.19	46.4	57.6	0.824	0.816	64.65	49.19	15.46	0.0597	**16.7516**
8	8.27	124	3	48	3.80	60.90	46.05	14.85	47.1	57.9	0.823	0.816	50.14	37.56	12.58	0.0531	**18.8454**
9	8.45	138	4	04	4.07	65.12	49.25	15.87	47.6	57.8	0.823	0.816	53.59	40.18	13.42	0.0534	**18.7095**
10	9.02	133	3	58	3.97	63.34	47.89	15.45	48.1	58.2	0.823	0.816	52.10	39.05	13.05	0.0530	**18.8517**
11	9.20	154	4	45	4.75	78.50	60.21	18.29	48.7	59.3	0.822	0.815	64.54	49.05	15.49	0.0580	**17.2374**
12	9.50	143	4	46	4.77	78.65	60.26	18.39	49.3	59.6	0.822	0.815	64.63	49.08	15.55	0.0608	**16.4601**
13	10.05	148	4	47	4.78	78.73	60.32	18.41	50.0	61.3	0.821	0.813	64.66	49.06	15.60	0.0598	**16.7279**
14	10.43	140	4	09	4.15	64.85	49.09	15.77	51.0	60.1	0.821	0.814	53.22	39.96	13.26	0.0524	**19.0860**
15	11.05	153	4	48	4.80	79.00	60.45	18.55	51.5	61.6	0.820	0.813	64.80	49.15	15.64	0.0588	**17.0034**
Mean		138			4.27			16.73							14.166	0.0564	**17.7763**
Std Dev		10.07968253			0.3937			1.4095							1.1915	0.0033	**1.0129**
C.V		7.3%			9.2%			8.4%							8.4%	5.8%	**5.7%**

% CHANGE: **Treated-Baseline**	Load Tonnes			Haul Time Mins		Fuel (Lt) Consumed		Fuel (kg) Consumed	Fuel (kg) Per Tonne	**Tonne.km Per kg Fuel**
Baseline	2.68%			-0.16%		-4.60%		-4.31%	**-5.7%**	**6.4%**

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

TABLE 1
Specific Fuel Consumption Test Results
(kg fuel per Tonne of Ore)

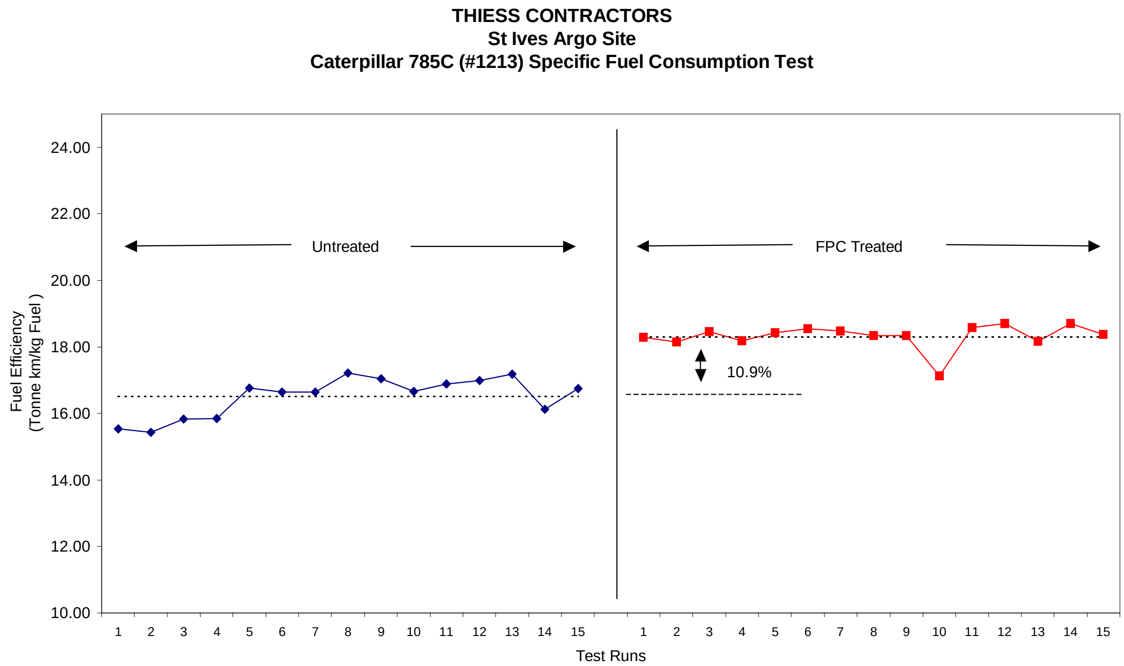
Unit No.	Untreated 14/11/01 Fuel kg per tonne	Treated 12/12/01 Fuel kg per tonne	Variation
1213	0.0607	0.0547	-9.9%
1214	0.0599	0.0564	-5.7%
TOTAL	**0.121**	**0.111**	**-8.3%**

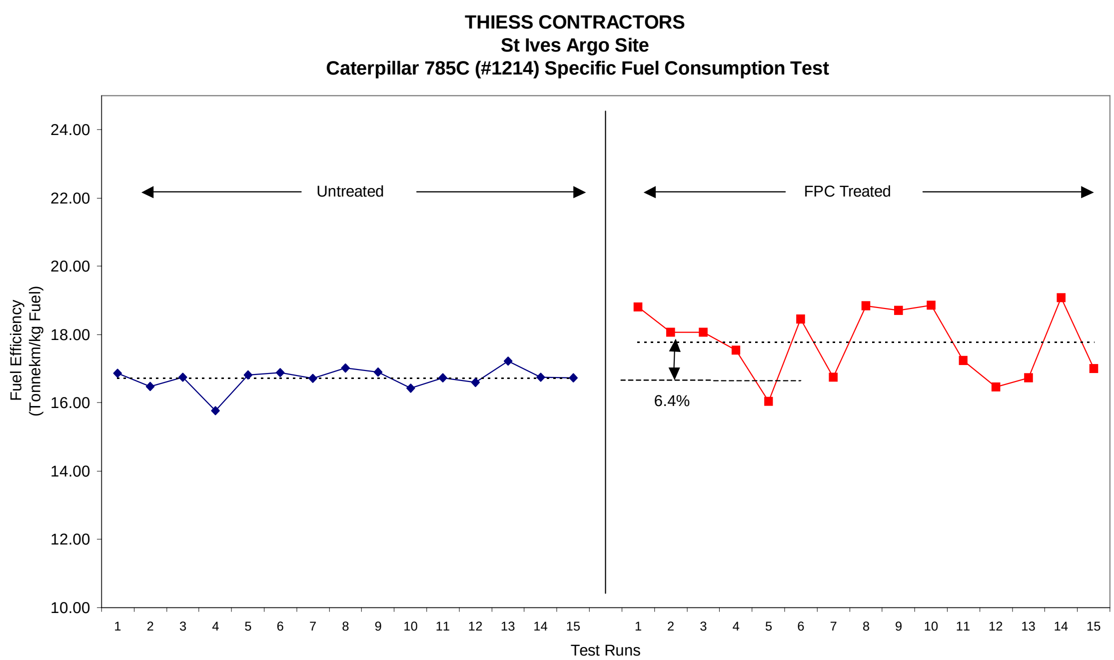
As outlined in SAE paper "Specific Fuel Consumption Measurements" to accurately calculate fuel consumption, the distance travelled must be used in the calculation to determine Tonne km per kg fuel.

TABLE 2
Specific Fuel Consumption Test Results
(Tonne km per kg fuel)

Unit No.	Untreated 14/11/01 Tonne km per kg fuel	Treated 12/12/01 Tonne km per kg fuel	Variation
1213	16.5037	18.3001	10.9%
1214	16.7101	17.7763	6.4%
TOTAL	**33.214**	**36.076**	**8.6%**

GRAPHICAL REPRESENTATION OF TEST RESULTS





The SFC test procedure provides confirmation that addition of the Catalyst to the fuel supply has resulted in an average efficiency gain of **8.6%.** The raw data sheets are contained in the *Appendix*.

GREENHOUSE GAS REDUCTION

A gross reduction of **8.6%** of the current estimated annual fuel consumption of 24,000 KL translates to a **5,967 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:-

(24,000 KL x 38.6 x 74.9) ÷ 1000 = 69,387 tonnes CO_2 per annum

- 8.6% (21,936 KL x 38.6 x 74.9) ÷ 1000 = 63,420 tonnes CO_2 per annum

CO_2 reduction by application FPC Catalyst
69,387 – 63,420 = 5,967 tonnes

CONCLUSION

These carefully controlled engineering standard test procedures conducted on a selection of Thiess Contractors fleet provide clear evidence of average reduced fuel consumption of **8.6%**.

A fuel efficiency gain of **8.6%** as measured by the International Engineering Test Procedure SFC, if applied to the total fuel currently consumed by Thiess Contractors St Ives Project will result in a **net** saving of in excess of **$700,000 per annum.**

Additional to the fuel economy benefits measured, is a reduction in greenhouse gas emissions of 5,900 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 "A"

Raw Data Sheets