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**REPORT ON FUEL EFFICIENCY TRIAL
CATERPILLAR 777C AND 777D TRUCKS
ELTIN LIMITED
KANOWNA-BELLE OPERATIONS**

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Report prepared by:

Fuel Technology Pty Ltd
6a Nairn Street
(PO Box 1271)
FREMANTLE WA 6160

Tel (08) 9335 6899
Fax (08) 9430 5403
E-Mail: fueltech@nettrek.com.au

ACN 063 561 151

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EXECUTIVE SUMMARY

This report outlines the fuel efficiency gains and economic benefits provided by use of Fuel Technology's FTC-3 Combustion Catalyst in a trial comprising four Caterpillar 777C and D model haul trucks operating at Eltin's Kanowna-Belle open pit operations.

Fuel efficiency gains measured ranged, for three of the four trucks, from a low of 4.4% to a high of 5.2%. Averaging 4.8% efficiency gain. One truck returned a lower gain as outlined in the *Results* section.

The trial procedure enables fuel consumption measurements to be made with the truck operating under normal mine operating conditions, monitoring haul times, fuel consumed, fuel temperatures, distance traversed and payload carried.

The results of this multi haul-truck trial are reported in detail on the following pages. They confirm that:-

1. The trial data has uniformity and reproducibility providing confidence in the measuring technique and test protocol.
2. The measured difference in fuel consumption between untreated diesel baseline tests and subsequent FTC-3 treated tests show an average 4% reduction in fuel consumption.
3. The haul times are reduced on average 2.4% indicating increased power per unit of fuel consumed.

The Kanowna-Belle open pit is a mature operation with a deep pit and long 1454 meter climb out. Under these conditions the truck will be operating under full power conditions which is its most fuel efficient mode but also its level of highest consumption.

The fuel consumption reductions monitored are in line with our database for these engines operating at high load factors, namely 4% to 5%.

INTRODUCTION

This fuel efficiency study at Kanowna-Belle was initiated by Mechanical Maintenance Manager, Mr Dan Gray. Four trucks were selected for testing in order to provide a more representative and accurate assessment of the fuel efficiency potential that may be provided by the FTC-3 catalyst.

Two Caterpillar 777C units numbered DT289 and DT313 were selected for the trial. DT289 was considered a problem truck by the drivers who claimed that it lacked power. Also included were two of the latest model Caterpillar 777D units numbered DT342 and DT343. These latter two trucks were new and had very low hours and are in peak mechanical condition.

Baseline tests were conducted between 3rd and 7th April and following a period of FTC-3 fuel treatment re-tested between 1st and 5th May, 1997.

TEST PROCEDURE

The test procedure requires measurement of the mass of fuel consumed related to the work done in hauling a measured load of ore over a defined reproducible distance.

A start point at a given distance from the base of the pit ramp is marked on the pit wall and a finish point at the top of the ramp is marked with sighting pegs. The distance between the start and finish point of the haul cycle is measured by surveyor's wheel. The distance of the haul route at Kanowna-Belle was 1454 meters.

MacNaught Model M5 flow transducers, complete with thermocouple probes, are connected to the truck's fuel tank outlet and return fuel pipelines. These transducers, which have been calibrated to $\pm 0.25\%$ by a NATA Certified Laboratory, are then 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..

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 each haul.

Prior to the test commencing a fuel sample is drawn and the density measured at 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 kilograms is recorded and the truck driven to the bottom pit marker and stopped. The Minitrol totaliser and stopwatch are zeroed. At the signal "GO" the driver accelerates and the engineer activates the totaliser and stopwatch.

To avoid driver variables the truck is driven at full throttle over the haul test circuit. Fuel temperatures are recorded at the mid haul point and upon arrival at the pit haul top marker the

stopwatch and Minitrol totaliser readings recorded. Approximately twenty test runs were recorded for each of the four test trucks.

TEST RESULTS

The individual results achieved by each of the four test trucks are shown in Table I below. The results are reported as fuel consumed in kilograms/tonne (kg/t) which relates to a more accurate mass measurement compared to the usual mine operations method of recording litres/hour (L/h). However, to fully assess fuel consumed for a given amount of work done the formula:-

$$\frac{\text{Distance travelled x load carried}}{\text{Fuel consumed}}$$

Should be employed, thus reporting efficiency as tonne kilometers/kilogram (t km/kg). (Koehler & Doglio, 1987)

TABLE 1

Average Fuel Consumption Reductions

Unit No.	Truck Model	Fuel Consumption Reduction	Fuel Efficiency Gains
		kg/t	t km/kg
DT289	777C	- 4.5%	+ 4.8%
DT313	777C	- 1.4%	+ 1.7%
DT342	777D	- 4.3%	+ 4.4%
DT343	777D	- 4.9%	+ 5.2%

Details of all data extracted during the trial program for each truck are shown in the following computer printouts. The arithmetic mean has been calculated together with the Standard Deviation and Co-efficient of Variation (C.V.)

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer: Eltin Kanowna Belle Engine Hrs 9282
 Date: 5/04/97 Amb; Temp; Start deg; C 16.1
 Truck No: DT289 Amb; Temp; Finish deg; C 25.5
 Make/Model Cat 777C Circuit Distance Metres 1453.5
 Truck Weight kgs 60848

Fuel Sample	Density	Temp Deg C
	0.83	37.6
Corrected	0.846	15

UNTREATED

Run No	Time	Load kg	Haul Time		Haul Time		Fuel (Lt)		Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km Per kg Fuel
			Mins	Secs	Mins	Secs	In	Out	In	Out	In	Out	In	Out	Consumed	Per Tonne	
1	6.50	128000	10	38	10.63	126.71	100.69	26.02	34.8	44.0	0.832	0.825	105.41	83.11	22.30	0.1181	9.7044
2	7.20	119000	10	40	10.67	127.37	101.64	25.73	35.9	46.6	0.831	0.824	105.87	83.71	22.16	0.1232	9.3601
3	7.45	111000	9	44	9.73	119.85	94.08	25.77	37.2	47.6	0.830	0.823	99.50	77.42	22.08	0.1285	9.0309
4	8.15	107000	9	47	9.78	118.88	94.93	23.95	38.4	48.7	0.829	0.822	98.60	78.04	20.56	0.1225	9.5058
5	8.40	105000	9	21	9.35	114.74	90.77	23.97	39.5	48.9	0.829	0.822	95.07	74.61	20.46	0.1234	9.4529
6	9.05	116000	9	53	9.88	119.22	95.02	24.20	40.7	50.3	0.828	0.821	98.69	78.01	20.68	0.1169	9.8851
7	9.30	118000	10	11	10.18	122.00	97.11	24.89	40.7	50.1	0.828	0.821	100.99	79.74	21.25	0.1188	9.7114
8	10.20	130000	10	50	10.83	128.54	102.18	26.36	39.9	49.8	0.828	0.821	106.47	83.92	22.55	0.1182	9.6860
9	10.45	110000	9	54	9.90	119.68	95.58	24.10	41.5	52.4	0.827	0.820	99.00	78.33	20.67	0.1210	9.5983
10	11.05	115000	9	56	9.93	119.69	95.45	24.24	41.7	51.9	0.827	0.820	99.00	78.25	20.75	0.1180	9.8050
11	11.30	106000	9	27	9.45	115.94	91.85	24.09	43.1	53.0	0.826	0.819	95.78	75.23	20.54	0.1231	9.4633
12	12.00	118000	10	09	10.15	121.20	96.44	24.76	44.7	54.9	0.825	0.818	99.98	78.86	21.12	0.1181	9.7738
13	12.30	109000	9	53	9.88	119.00	94.89	24.11	46.9	56.0	0.823	0.817	97.98	77.52	20.47	0.1205	9.6445
14	12.55	124000	10	21	10.35	122.52	97.39	25.13	46.8	56.5	0.823	0.817	100.88	79.53	21.35	0.1155	9.9470
15	1.20	114000	10	03	10.05	119.91	95.46	24.45	47.0	56.5	0.823	0.817	98.72	77.95	20.77	0.1188	9.7458
16	2.50	127000	10	38	10.63	127.11	101.61	25.50	32.1	45.9	0.834	0.824	105.98	83.74	22.25	0.1184	9.6825
17	3.15	109000	9	44	9.73	118.24	94.94	23.30	35.7	50.1	0.831	0.821	98.29	77.96	20.34	0.1197	9.7067
18	3.40	102000	9	37	9.62	117.11	93.99	23.12	38.3	51.8	0.830	0.820	97.14	77.06	20.08	0.1233	9.4825
19	4.05	116000	9	44	9.73	117.68	94.29	23.39	40.7	53.5	0.828	0.819	97.42	77.20	20.22	0.1143	10.1093
20	4.30	118000	10	20	10.33	122.82	98.02	24.80	42.4	55.2	0.827	0.818	101.52	80.13	21.39	0.1196	9.6492
Mean		115100			10.04			24.59							21.100	0.120	9.647
Std Dev		7919.995			0.4213			0.9241							0.7786	0.0033	0.2303
C.V		6.9%			4.2%			3.8%							3.7%	2.7%	2.4%

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No: DT289 Engine Hrs 9645
 Date: 1/05/97 Amb; Temp; Start deg; C 16.7
 Truck Weight kgs 60848 Amb; Temp; Finish deg; C 18.7

Fuel Sample	Density	Temp Deg C
	0.828	38.9
Corrected	0.845	15

TREATED

Run No	Time	Load kg	Haul Time		Haul Time		Fuel (Lt)		Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km Per kg Fuel
			Mins	Secs	Mins	Secs	In	Out	In	Out	In	Out	In	Out	Consumed	Per Tonne	
1	7.15	109000	9	15	9.25	114.33	91.98	22.35	27.8	43.0	0.836	0.825	95.57	75.89	19.68	0.1158	10.0333
2	7.40	113000	9	31	9.52	115.87	93.00	22.87	31.4	45.7	0.833	0.823	96.55	76.56	20.00	0.1150	10.0722
3	8.00	112000	9	23	9.38	115.03	92.43	22.60	34.8	48.6	0.831	0.821	95.58	75.90	19.67	0.1138	10.1862
4	8.25	116000	9	54	9.90	121.04	97.16	23.88	38.1	50.7	0.829	0.820	100.29	79.64	20.65	0.1168	9.8981
5	8.45	113000	9	25	9.42	115.28	92.52	22.76	40.8	52.2	0.827	0.819	95.30	75.74	19.57	0.1125	10.2945
6	9.15	109000	9	12	9.20	113.59	91.05	22.54	43.1	52.7	0.825	0.818	93.72	74.51	19.22	0.1131	10.2728
7	10.25	118000	10	44	10.73	126.99	102.65	24.34	45.4	53.5	0.823	0.818	104.56	83.94	20.63	0.1153	10.0071
8	10.50	109000	9	52	9.87	120.77	96.55	24.22	46.9	56.3	0.822	0.816	99.32	78.76	20.57	0.1211	9.5992
9	11.15	112000	9	23	9.38	114.32	91.39	22.93	48.4	57.3	0.821	0.815	93.89	74.48	19.41	0.1123	10.3262
10	11.35	115000	10	18	10.30	123.76	98.64	25.12	49.6	57.3	0.821	0.815	101.55	80.39	21.15	0.1203	9.6160
11	12.00	122000	9	54	9.90	120.16	96.05	24.11	50.8	59.3	0.820	0.814	98.48	78.15	20.34	0.1112	10.3463
12	12.25	117000	9	35	9.58	115.71	92.34	23.37	52.1	60.2	0.819	0.813	94.73	75.07	19.66	0.1105	10.4486
13	12.45	114000	9	45	9.75	116.95	93.30	23.65	53.2	61.1	0.818	0.812	95.65	75.79	19.87	0.1136	10.1890
14	1.10	112000	9	44	9.73	118.23	94.46	23.77	54.3	61.1	0.817	0.812	96.61	76.73	19.88	0.1150	10.0832
15	2.30	113000	9	27	9.45	115.48	92.97	22.51	32.7	45.1	0.832	0.824	96.13	76.57	19.56	0.1125	10.2995
16	2.50	117000	9	34	9.57	116.26	93.36	22.90	35.2	49.9	0.831	0.820	96.57	76.57	19.99	0.1124	10.2749
17	3.15	106000	9	23	9.38	114.86	92.21	22.65	37.7	51.8	0.829	0.819	95.21	75.51	19.70	0.1181	9.8703
18	3.41	112000	9	23	9.38	114.77	92.12	22.65	39.6	52.9	0.828	0.818	94.97	75.36	19.61	0.1134	10.2205
19	4.05	122000	9	58	9.97	121.48	97.38	24.10	41.4	54.2	0.826	0.817	100.38	79.58	20.80	0.1138	10.1160
20	4.25	109000	9	25	9.42	114.92	92.15	22.77	43.4	56.4	0.825	0.816	94.79	75.16	19.63	0.1156	10.0574
Mean		113500			9.65			23.30							19.978	0.1146	10.1106
Std Dev		4261.208			0.3777			0.7852							0.5284	0.0028	0.2287
C.V		3.8%			3.9%			3.4%							2.6%	2.4%	2.3%

% CHANGE:	Load kg	Haul Time Mins	Fuel (Lt) Consumed	Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Treated-Baseline	-1.39%	-3.86%	-5.24%	-5.32%	-4.5%	4.8%
Baseline						

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer: Eltin Kanowna Belle Engine Hrs 6022
 Date: 4/04/97 Amb; Temp; Start deg; C 17.8
 Truck No; DT313 Amb; Temp; Finish deg; C 18.3
 Make/Model Cat 777C Circuit Distance Metres 1453.5
 Truck Weight kgs 60848

Fuel Sample	Density	Temp Deg C
	0.832	34.3
Corrected	0.846	15

UNTREATED

Run No	Time	Load kg	Haul Time		Fuel (Lt)		Fuel (Lt) Consumed	Fuel Temp		Density		Fuel (kg)		Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel	
			Mins	Secs	Mins	In		Out	In	Out	In	Out	In				Out
1	7.15	107000	8	23	8.38	125.36	102.29	23.07	36.8	45.1	0.830	0.825	104.10	84.34	19.76	0.1177	9.8889
2	7.40	125000	8	55	8.92	130.75	106.11	24.64	38.6	46.0	0.829	0.824	108.40	87.42	20.98	0.1129	10.1718
3	8.05	112000	8	29	8.48	125.93	102.50	23.43	40.4	47.3	0.828	0.823	104.26	84.36	19.90	0.1151	10.0710
4	8.30	116000	8	33	8.55	126.39	102.56	23.83	41.6	47.7	0.827	0.823	104.52	84.38	20.15	0.1139	10.1453
5	8.55	113000	8	40	8.67	128.42	104.42	24.00	42.8	49.0	0.826	0.822	106.10	85.81	20.29	0.1167	9.9275
6	9.15	128000	8	56	8.93	131.02	106.23	24.79	43.9	49.8	0.825	0.821	108.14	87.24	20.91	0.1107	10.3508
7	9.40	121000	8	51	8.85	130.01	105.31	24.70	44.6	50.2	0.825	0.821	107.25	86.45	20.80	0.1144	10.0697
8	10.40	117000	9	00	9.00	131.92	106.57	25.35	43.5	47.1	0.826	0.823	108.93	87.72	21.21	0.1193	9.6853
9	11.05	93000	8	19	8.32	123.66	100.69	22.97	44.1	49.7	0.825	0.821	102.06	82.70	19.36	0.1258	9.3705
10	11.25	114000	8	43	8.72	128.30	104.07	24.23	44.5	49.4	0.825	0.822	105.85	85.49	20.35	0.1164	9.9446
11	11.50	115000	8	47	8.78	128.66	104.20	24.46	45.0	49.8	0.825	0.821	106.09	85.57	20.52	0.1167	9.9109
12	12.15	120000	8	49	8.82	129.22	104.72	24.50	45.4	50.9	0.824	0.820	106.52	85.91	20.60	0.1139	10.1152
13	2.15	111000	8	48	8.80	129.87	105.09	24.78	34.0	40.4	0.832	0.828	108.10	87.00	21.10	0.1228	9.4509
14	2.40	97000	8	20	8.33	125.18	102.26	22.92	35.1	43.4	0.832	0.826	104.10	84.44	19.66	0.1246	9.4292
15	3.00	111000	8	28	8.47	126.75	103.33	23.42	36.2	44.1	0.831	0.825	105.30	85.28	20.03	0.1165	9.9578
16	3.25	121000	8	52	8.87	129.84	105.25	24.59	37.2	44.8	0.830	0.825	107.78	86.81	20.97	0.1153	9.9863
17	3.50	110000	8	38	8.63	127.43	103.44	23.99	37.8	44.9	0.830	0.825	105.73	85.31	20.42	0.1195	9.7157
18	4.10	115000	8	32	8.53	126.79	103.10	23.69	38.2	45.7	0.829	0.824	105.16	84.96	20.19	0.1148	10.0724
19	4.35	122000	8	58	8.97	130.73	105.96	24.77	38.4	45.8	0.829	0.824	108.41	87.32	21.09	0.1154	9.9756
20	4.55	114000	8	32	8.53	126.62	102.88	23.74	38.4	46.3	0.829	0.824	105.01	84.74	20.26	0.1159	9.9889
Mean		114100			8.68			24.09						20.428	0.1169	9.9114	
Std Dev		8422.401			0.2177			0.6952						0.5283	0.0038	0.2595	
C.V		7.4%			2.5%			2.9%						2.6%	3.3%	2.6%	

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No: DT313 Engine Hrs 6545
 Date: 3/05/97 Amb; Temp; Start deg; C 16.3
 Truck Weight kgs 60848 Amb; Temp; Finish deg; C 19.4

Fuel Sample	Density	Temp Deg C
	0.828	38.9
Corrected	0.845	15

TREATED

Run No	Time	Load kg	Haul Time		Fuel (Lt)		Fuel (Lt) Consumed	Fuel Temp		Density		Fuel (kg)		Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel	
			Mins	Secs	Mins	In		Out	In	Out	In	Out	In				Out
1	7.30	111000	8	46	8.77	126.83	102.80	24.03	42.5	49.2	0.826	0.821	104.70	84.37	20.33	0.1183	9.8087
2	7.55	115000	8	45	8.75	127.24	103.45	23.79	43.7	51.2	0.825	0.819	104.92	84.76	20.17	0.1147	10.0871
3	8.15	114000	8	44	8.73	126.77	103.08	23.69	44.7	52.4	0.824	0.819	104.45	84.37	20.07	0.1148	10.0829
4	8.40	106000	8	42	8.70	126.28	102.67	23.61	46.0	53.9	0.823	0.817	103.93	83.92	20.01	0.1199	9.7177
5	9.00	105000	8	42	8.70	127.07	103.46	23.61	47.5	54.9	0.822	0.817	104.44	84.50	19.94	0.1202	9.6982
6	9.25	99000	8	25	8.42	123.65	100.98	22.67	48.8	55.8	0.821	0.816	101.52	82.41	19.11	0.1195	9.8086
7	10.30	128000	8	55	8.92	132.76	107.65	25.11	50.5	56.6	0.820	0.816	108.84	87.79	21.05	0.1115	10.2818
8	10.55	119000	8	51	8.85	128.66	104.54	24.12	51.9	58.8	0.819	0.814	105.35	85.09	20.26	0.1127	10.2367
9	11.15	118000	8	51	8.85	128.62	104.65	23.97	53.4	60.6	0.818	0.813	105.19	85.05	20.14	0.1126	10.2507
10	11.40	113000	8	45	8.75	126.52	102.97	23.55	55.0	61.7	0.817	0.812	103.32	83.60	19.71	0.1134	10.2162
11	12.05	112000	8	49	8.82	128.03	104.23	23.80	56.2	62.5	0.816	0.811	104.45	84.56	19.89	0.1150	10.0785
12	2.15	108000	8	29	8.48	125.72	102.76	22.96	37.2	46.5	0.829	0.823	104.25	84.54	19.71	0.1167	9.9669
13	2.40	103000	8	14	8.23	122.28	101.09	21.19	39.9	51.8	0.827	0.819	101.16	82.78	18.38	0.1122	10.4144
14	3.00	105000	8	28	8.47	126.14	103.94	22.20	42.4	55.1	0.826	0.817	104.14	84.88	19.26	0.1162	10.0402
15	3.25	102000	8	19	8.32	122.30	100.29	22.01	45.1	56.1	0.824	0.816	100.73	81.83	18.90	0.1161	10.0749
16	3.50	104000	8	26	8.43	122.53	100.13	22.40	47.0	57.4	0.822	0.815	100.76	81.60	19.16	0.1162	10.0421
17	4.35	91000	8	03	8.05	118.80	97.72	21.08	50.5	59.7	0.820	0.813	97.39	79.48	17.92	0.1180	10.0138
18	4.55	116000	8	03	8.05	125.47	102.31	23.16	51.8	60.6	0.819	0.813	102.75	83.15	19.60	0.1108	10.4292
19	5.15	110000	8	28	8.47	123.20	100.52	22.68	53.2	61.7	0.818	0.812	100.77	81.61	19.15	0.1121	10.3593
Mean		109421			8.57			23.14						19.619	0.115	10.085	
Std Dev		8348.758			0.2678			1.0358						0.7396	0.0030	0.2197	
C.V		7.6%			3.1%			4.5%						3.8%	2.6%	2.2%	

% CHANGE:	Load kg	Haul Time Mins	Fuel (Lt) Consumed	Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Treated-Baseline						
Baseline	-4.10%	-1.29%	-3.96%	-3.96%	-1.4%	1.7%

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer: Eltin Kanowna Belle Engine Hrs 397
 Date: 7/04/97 Amb; Temp; Start deg; C 18.8
 Truck No; DT342 Amb; Temp; Finish deg; C 22
 Make/Model Cat 777D Circuit Distance Metres 1453.5
 Truck Weight kgs 64359
UNTREATED

Fuel Sample	Density	Temp Deg C
	0.83	37.6
Corrected	0.846	15

Run No	Time	Load kg	Haul Time		Fuel (Lt)		Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km		
			Mins	Secs	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel				
1	10.25	118000	7	23	7.38	102.27	80.22	22.05	31.7	42.1	0.834	0.827	85.30	66.33	18.98	0.1041	11.1455
2	10.50	121000	7	30	7.50	102.41	80.68	21.73	33.8	47.4	0.833	0.823	85.27	66.40	18.87	0.1018	11.3698
3	11.20	98000	6	42	6.70	91.36	71.63	19.73	35.9	48.4	0.831	0.822	75.94	58.90	17.04	0.1049	11.2410
4	11.45	112000	7	01	7.02	94.69	74.25	20.44	37.8	50.4	0.830	0.821	78.57	60.95	17.62	0.0999	11.6624
5	12.05	117000	7	25	7.42	101.11	79.56	21.55	39.2	51.5	0.829	0.820	83.80	65.25	18.55	0.1023	11.3467
6	12.30	105000	6	54	6.90	93.60	73.39	20.21	41.2	52.4	0.827	0.820	77.44	60.14	17.30	0.1022	11.4738
7	12.55	120000	7	36	7.60	103.77	81.62	22.15	42.9	53.6	0.826	0.819	85.73	66.81	18.92	0.1026	11.2847
8	1.20	106000	6	54	6.90	93.53	73.42	20.11	44.6	55.2	0.825	0.818	77.16	60.02	17.14	0.1006	11.6393
9	2.35	102000	6	42	6.70	91.37	71.68	19.69	39.8	51.9	0.828	0.820	75.69	58.76	16.93	0.1018	11.5500
10	3.00	123000	7	33	7.55	103.26	81.39	21.87	41.7	53.7	0.827	0.819	85.41	66.63	18.78	0.1002	11.5286
11	3.30	109000	6	58	6.97	94.18	73.85	20.33	43.8	54.7	0.826	0.818	77.76	60.40	17.35	0.1001	11.6702
12	3.55	115000	6	59	6.98	94.48	73.09	21.39	45.1	55.7	0.825	0.817	77.91	59.72	18.19	0.1014	11.4654
13	4.15	128000	7	40	7.67	105.11	81.86	23.25	46.0	56.1	0.824	0.817	86.61	66.87	19.74	0.1026	11.2220
14	4.45	115000	6	53	6.88	94.18	72.90	21.28	46.6	56.3	0.824	0.817	77.57	59.54	18.03	0.1005	11.5653
15	5.15	113000	7	04	7.07	95.90	75.21	20.69	47.7	56.4	0.823	0.817	78.91	61.42	17.48	0.0986	11.8126
16	5.35	107000	7	06	7.10	96.11	75.37	20.74	48.5	57.3	0.822	0.816	79.02	61.50	17.52	0.1022	11.4450
Mean		113063			7.15			21.08							18.027	0.1016	11.4639
Std Dev		8160.627			0.3232			0.9963							0.8517	0.0016	0.1864
C.V		7.2%			4.5%			4.7%							4.7%	1.6%	1.6%

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No: DT342 Engine Hrs 890
 Date: 5/05/97 Amb; Temp; Start deg; C 8.2
 Truck Weight kgs 64359 Amb; Temp; Finish deg; C 22.7
TREATED

Fuel Sample	Density	Temp Deg C
	0.828	38.9
Corrected	0.845	15

Run No	Time	Load kg	Haul Time		Fuel (Lt)		Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km		
			Mins	Secs	Mins	In	Out	In	Out	In	Out	Consumed	Per Tonne	Per kg Fuel			
1	7.05	102000	6	38	6.63	89.64	70.42	19.22	37.8	48.2	0.829	0.821	74.29	57.84	16.45	0.0989	11.8849
2	7.55	117000	6	54	6.90	92.52	72.45	20.07	39.2	49.9	0.828	0.820	76.59	59.42	17.16	0.0946	12.2644
3	8.40	119000	7	13	7.22	97.51	76.69	20.82	41.1	51.8	0.827	0.819	80.59	62.80	17.79	0.0970	11.9453
4	9.05	113000	7	15	7.25	97.68	76.79	20.89	42.8	52.8	0.825	0.818	80.62	62.83	17.79	0.1003	11.6112
5	9.25	114000	6	57	6.95	93.02	72.91	20.11	45.0	54.5	0.824	0.817	76.62	59.57	17.05	0.0956	12.1687
6	9.45	115000	6	58	6.97	93.25	73.09	20.16	46.1	55.3	0.823	0.816	76.74	59.67	17.06	0.0951	12.2190
7	10.50	108000	7	01	7.02	94.50	74.17	20.33	48.1	56.8	0.822	0.815	77.63	60.48	17.15	0.0995	11.7476
8	11.35	112000	7	04	7.07	94.74	74.34	20.40	50.4	58.4	0.820	0.814	77.68	60.53	17.15	0.0972	11.9835
9	12.00	113000	6	52	6.87	92.21	72.24	19.97	51.2	59.3	0.819	0.814	75.55	58.77	16.77	0.0946	12.3121
10	12.15	111000	6	56	6.93	92.98	72.91	20.07	52.3	60.2	0.819	0.813	76.10	59.28	16.83	0.0960	12.1530
11	2.05	125000	7	32	7.53	102.28	80.75	21.53	35.9	49.2	0.830	0.821	84.91	66.27	18.64	0.0984	11.7220
12	2.30	115000	6	58	6.97	93.19	73.35	19.84	37.9	50.6	0.829	0.820	77.23	60.13	17.09	0.0953	12.1979
13	2.55	109000	6	54	6.90	92.84	72.97	19.87	40.1	52.8	0.827	0.818	76.80	59.70	17.09	0.0986	11.8476
14	3.15	118000	7	15	7.25	98.17	77.50	20.67	41.9	54.4	0.826	0.817	81.08	63.33	17.75	0.0974	11.9140
15	3.40	112000	7	10	7.17	97.02	76.26	20.76	43.6	54.7	0.825	0.817	80.01	62.29	17.72	0.1005	11.5957
Mean		113533			7.04			20.31							17.301	0.0973	11.9711
Std Dev		5303.189			0.2146			0.5556							0.5442	0.0020	0.2385
C.V		4.7%			3.0%			2.7%							3.1%	2.1%	2.0%

% CHANGE:	Load kg	Haul Time Mins	Fuel (Lt) Consumed	Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Treated-Baseline						
Baseline	0.42%	-1.47%	-3.61%	-4.03%	-4.3%	4.4%

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Customer: Eltin Kanowna Belle Engine Hrs 395
 Date: 6/04/97 Amb; Temp; Start deg; C 17.2
 Truck No; DT343 Amb; Temp; Finish deg; C 26.3
 Make/Model Cat 777D Circuit Distance Metres 1453.5
 Truck Weight kgs 64359

Fuel Sample	Density	Temp Deg C
	0.83	37.6
Corrected	0.846	15

UNTREATED

Run No	Time	Load kg	Haul Time		Fuel (L)			Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km	
			Mins	Secs	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne		Per kg Fuel
1	6.55	122000	7	37	7.62	104.09	81.74	22.35	41.7	50.9	0.827	0.821	86.09	67.07	19.03	0.1021	11.3278
2	7.20	120000	7	22	7.37	100.10	77.55	22.55	42.8	53.0	0.826	0.819	82.71	63.52	19.19	0.1041	11.1255
3	7.45	128000	7	51	7.85	108.31	84.25	24.06	43.9	53.8	0.826	0.819	89.41	68.96	20.45	0.1063	10.8313
4	8.10	121000	7	33	7.55	102.94	80.73	22.21	44.6	54.1	0.825	0.818	84.93	66.06	18.86	0.1018	11.3715
5	8.30	109000	6	58	6.97	93.47	73.12	20.35	45.7	56.0	0.824	0.817	77.04	59.73	17.31	0.0998	11.7018
6	8.50	116000	7	11	7.18	96.49	75.33	21.16	45.9	55.0	0.824	0.818	79.52	61.59	17.93	0.0994	11.6867
7	9.15	126000	7	41	7.68	106.00	82.32	23.68	46.8	56.9	0.823	0.816	87.28	67.20	20.08	0.1055	10.9305
8	9.40	126000	7	42	7.70	106.20	82.59	23.61	47.6	57.0	0.823	0.816	87.39	67.41	19.98	0.1050	10.9856
9	10.30	112000	6	54	6.90	92.75	72.08	20.67	47.3	55.2	0.823	0.818	76.34	58.93	17.42	0.0988	11.7995
10	11.00	107000	6	59	6.98	93.25	72.53	20.72	48.4	56.8	0.822	0.816	76.68	59.21	17.47	0.1019	11.4802
11	11.25	111000	7	11	7.18	96.54	75.46	21.08	49.5	58.6	0.822	0.815	79.31	61.51	17.80	0.1015	11.4894
12	11.50	103000	6	44	6.73	91.27	71.17	20.10	50.5	58.9	0.821	0.815	74.91	58.00	16.92	0.1011	11.6157
13	12.15	107000	6	56	6.93	92.82	72.18	20.64	51.9	60.9	0.820	0.814	76.09	58.72	17.38	0.1014	11.5401
14	2.10	110000	7	10	7.17	96.49	75.47	21.02	39.1	51.3	0.829	0.820	79.98	61.91	18.07	0.1037	11.2609
15	2.35	117000	7	18	7.30	98.86	77.60	21.26	40.9	53.6	0.828	0.819	81.82	63.52	18.29	0.1009	11.5078
16	3.00	113000	7	16	7.27	97.79	76.64	21.15	42.8	54.4	0.826	0.818	80.80	62.70	18.10	0.1021	11.4066
17	3.20	111000	7	09	7.15	96.40	75.58	20.82	44.6	55.9	0.825	0.817	79.53	61.75	17.78	0.1014	11.5017
18	3.40	115000	7	21	7.35	99.37	77.95	21.42	46.1	57.3	0.824	0.816	81.87	63.61	18.26	0.1018	11.4168
19	4.05	127000	7	30	7.50	103.13	79.22	23.91	47.7	58.3	0.823	0.815	84.86	64.59	20.27	0.1059	10.8803
20	4.25	112000	7	08	7.13	95.62	74.77	20.85	49.0	58.7	0.822	0.815	78.59	60.94	17.65	0.1001	11.6422
Mean		115650			7.28			21.68							18.412	0.1022	11.3751
Std Dev		7428.785			0.3018			1.2598							1.0831	0.0022	0.2873
C.V		6.4%			4.1%			5.8%							5.9%	2.1%	2.5%

SPECIFIC FUEL CONSUMPTION TRUCK TRIAL

Truck No: DT343 Engine Hrs 873
 Date: 4/05/97 Amb; Temp; Start deg; C 11.3
 Truck Weight kgs 64359 Amb; Temp; Finish deg; C 18.3

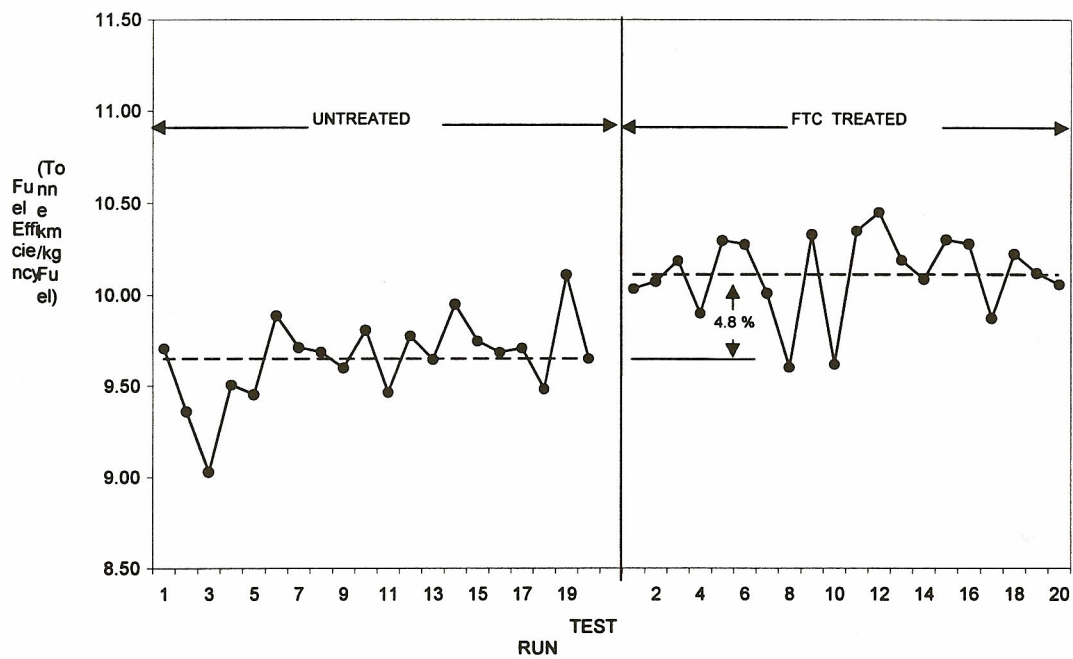
Fuel Sample	Density	Temp Deg C
	0.828	38.9
Corrected	0.845	15

TREATED

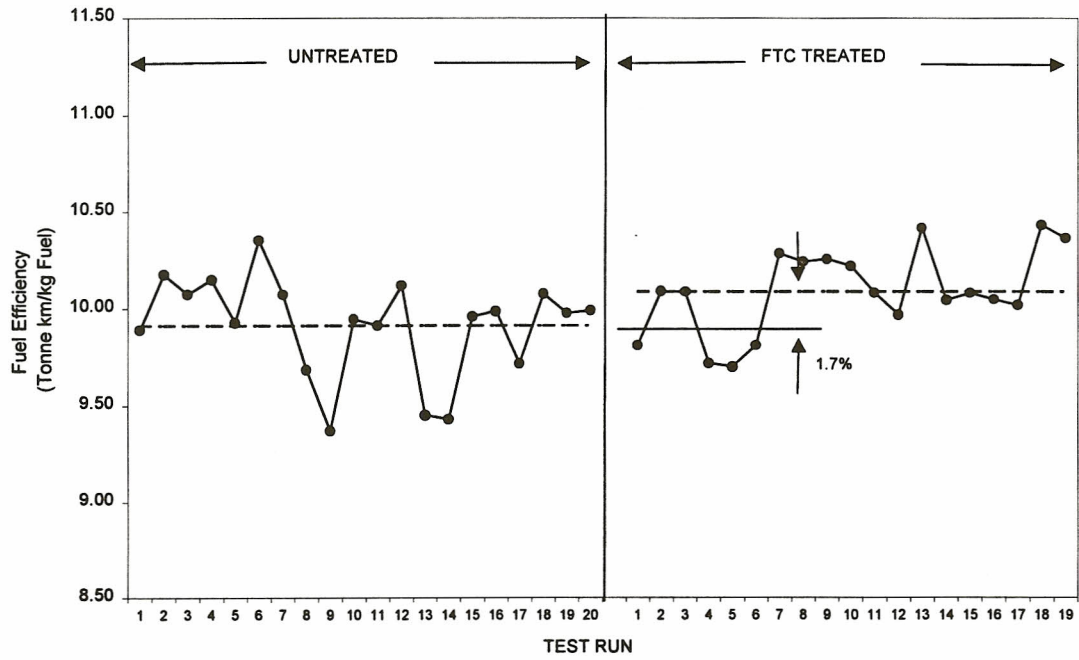
Run No	Time	Load kg	Haul Time		Fuel (L)			Fuel Temp		Density		Fuel (kg)		Fuel (kg)	Fuel (kg)	Tonne/km	
			Mins	Secs	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	Per Tonne		Per kg Fuel
1	8.35	103000	6	51	6.85	90.87	70.65	20.22	37.1	47.3	0.829	0.822	75.36	58.08	17.28	0.1032	11.3742
2	8.55	100000	6	44	6.73	89.78	69.90	19.88	39.1	49.5	0.828	0.821	74.33	57.35	16.98	0.1033	11.3993
3	9.45	112000	7	05	7.08	94.46	73.92	20.54	42.2	51.9	0.826	0.819	78.00	60.53	17.47	0.0991	11.7639
4	10.30	120000	7	06	7.10	95.51	74.65	20.86	42.2	50.9	0.826	0.820	78.86	61.18	17.69	0.0959	12.0718
5	11.00	123000	7	12	7.20	96.19	75.26	20.93	43.6	52.8	0.825	0.818	79.33	61.58	17.75	0.0947	12.1978
6	11.30	122000	7	18	7.30	98.59	77.17	21.42	45.0	54.2	0.824	0.817	81.21	63.06	18.15	0.0974	11.8771
7	12.05	122000	7	15	7.25	97.11	75.88	21.23	46.7	54.4	0.823	0.817	79.87	62.00	17.87	0.0959	12.0591
8	12.30	119000	7	15	7.25	97.26	76.18	21.08	47.7	56.1	0.822	0.816	79.93	62.16	17.77	0.0969	11.9571
9	12.50	117000	7	09	7.15	95.83	75.03	20.80	48.8	56.8	0.821	0.815	78.68	61.18	17.50	0.0965	12.0314
10	1.15	102000	6	51	6.85	90.91	70.77	20.14	50.0	58.2	0.820	0.814	74.56	57.64	16.93	0.1018	11.5488
11	1.35	126000	7	09	7.15	95.16	74.41	20.75	50.9	58.3	0.820	0.814	77.98	60.59	17.39	0.0914	12.6219
12	2.50	132000	7	33	7.55	102.21	80.22	21.99	36.4	48.7	0.830	0.821	84.81	65.87	18.95	0.0965	11.9035
13	3.15	122000	7	17	7.28	97.44	76.51	20.93	38.6	51.5	0.828	0.819	80.70	62.67	18.03	0.0968	11.9527
14	3.35	108000	6	44	6.73	90.04	70.42	19.62	40.6	52.6	0.827	0.818	74.45	57.62	16.82	0.0976	11.9803
15	3.55	112000	6	46	6.77	90.31	70.54	19.77	42.1	53.4	0.826	0.818	74.58	57.69	16.89	0.0958	12.1675
16	4.15	125000	7	16	7.27	97.69	76.68	21.01	43.7	54.4	0.825	0.817	80.56	62.66	17.90	0.0945	12.2075
17	4.40	120000	7	20	7.33	98.32	77.10	21.22	44.9	55.0	0.824	0.817	81.00	62.96	18.04	0.0978	11.8381
18	5.00	104000	6	28	6.47	88.37	69.35	19.02	46.2	55.1	0.823	0.817	72.72	56.63	16.09	0.0956	12.2767
19	5.25	110000	6	45	6.75	90.39	70.61	19.78	46.9	56.1	0.822	0.816	74.34	57.61	16.73	0.0959	12.1675
Mean		115737			7.06			20.59							17.484	0.0972	11.9682
Std Dev		9224.617			0.2799			0.7388							0.6509	0.0029	0.3036
C.V		8.0%			4.0%			3.6%							3.7%	3.0%	2.5%

% CHANGE:	Load kg	Haul Time Mins	Fuel (L) Consumed	Fuel (kg) Consumed	Fuel (kg) Per Tonne	Tonne/km Per kg Fuel
Treated-Baseline						
Baseline	0.08%	-3.02%	-5.03%	-5.04%	-4.9%	5.2%

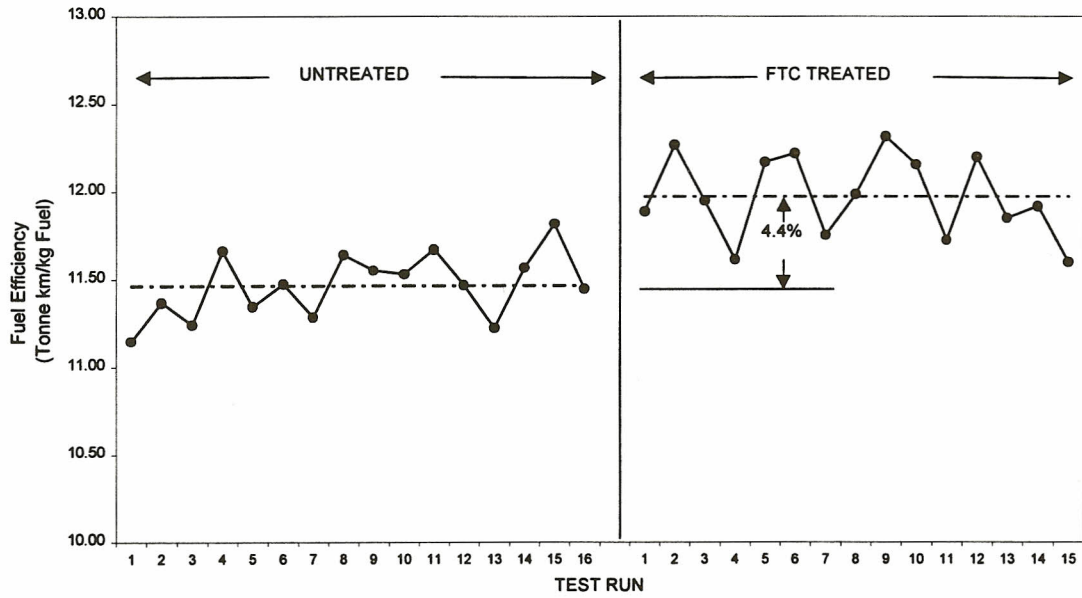
ELTINS KANOWNA BELLE
Caterpillar 777C (DT289) Specific Fuel Consumption Test



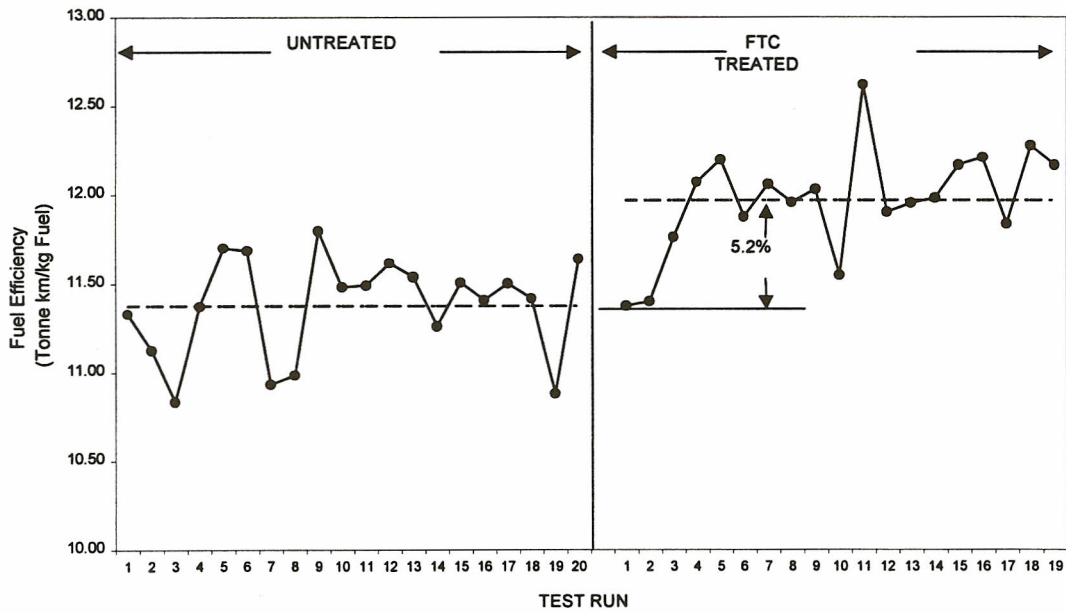
ELTINS KANOWNA BELLE
Caterpillar 777C (DT313) Specific Fuel Consumption Test



ELTINS KANOWNA BELLE
Caterpillar 777D (DT342) Specific Fuel Consumption Test



ELTINS KANOWNA BELLE
Caterpillar 777D (DT343) Specific Fuel Consumption Test



To prove the statistical significance of the difference in means between baseline and treated tests a Student t-test was performed.

Units DT289, DT342, and DT343 show that the difference between FTC treated and untreated test means are significant at a 99% confidence level.

Unit DT313 showed a slightly lower confidence level between FTC treated and untreated test means of 95%.

CONCLUSION

The results of this extensive multi-truck evaluation of the FTC-3 catalyst at Eltin's Kanowna-Belle open pit operation provides accurate and conclusive evidence of economic fuel consumption reductions.

The measured efficiency gain of the four truck test fleet represents a 4% improvement. If the results of DT313 are discarded as an outlier then the average of the other three trucks is a **4.8%** efficiency gain.

The reduction in haul times also confirm that the FTC family of catalysts improve combustion efficiency resulting in increased power per unit of energy consumed.

Efficiency gains measured in the Kanowna-Belle test fleet, under normal operating conditions, correlate well with other haul truck tests conducted and also static carbon balance testing on this class of equipment over the past fifteen years.

BIBLIOGRAPHY

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