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**BLUE CIRCLE SOUTHERN CEMENT LTD  
FUEL EFFICIENCY TRIAL  
MARULEN QUARRY**

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## *EXECUTIVE SUMMARY*

During September 1995 a proposal was submitted to evaluate the combustion catalyst, FTC-1, at the Marulen works employing the Engineering Standard AS2077 Carbon Balance procedure and statistical analysis of fuel consumption data for each truck supplied by Blue Circle Southern Cement.

Truck number DT7 had an engine change during the carbon balance section of the tests and was eliminated from that analysis. It has been included in the longer-term statistical study.

A summary of the test results below show that fuel consumption was better in the range **6.2%** to **7.0%** during the FTC catalyst treatment period when measured by the statistical and carbon balance methods.

Carbon balance results show a **7.0%** reduction in carbon flow during the treated segment of the controlled test. The fleet statistics show an average **6.2%** improvement during the treated section of analysis.

Mobile equipment involved in the fuel efficiency study were Caterpillar 777A dump trucks.

## *TEST PROCEDURES AND RESULTS*

### **Carbon Balance**

Untreated (baseline) and treated tests employing the Carbon Balance method were conducted at the workshops under identical operating conditions under simulated load condition in reverse gear with the truck fully braked and the engine speed held at a constant 1100 RPM.

Carbon Balance is an International Engineering Standard Test (AS 2077-1982) whereby the mass of carbon in the exhaust gas is calculated as a measure of the fuel being burned. The elements measured in this test include the exhaust gas composition, its temperature and gas flow rate, calculated from the differential pressure and exhaust stack cross sectional area. Once the exhaust gas had stabilised five readings were taken for each parameter and a Bosch smoke sample drawn.

Equipment	Unit No.	Carbon Flow g/sec		
		Baseline 21/2/96	Treated 12/11/96	% Variation
Cat 777 truck	7	6.572	-	N/A
Cat 777 truck	8	5.601	5.194	- 7.3
Cat 777 truck	10	3.478	3.287	- 5.5
Cat 777 truck	11	10.367	9.605	- 7.4
<b>Average # 8, 10 &amp; 11</b>		<b>6.482</b>	<b>6.029</b>	<b>- 7.0</b>

## Bosch Smoke Tests

These tests are conducted by inserting the sampling probe into the exhaust aperture and activating the Bosch sampling pump, drawing a given volume of exhaust gas through a filter disc. The filter disc darkens during this process giving a measure of the soot content of the exhaust gas.

A Bosch evaluating unit is then employed to measure the result photoelectronically. A lower reading or cleaner filter paper represents more efficient combustion.

### Bosch Smoke Measurements

Unit No.	Baseline 21/2/96	Treated 12/11/96	% Variation
7	0.8	-	-
8	0.9	0.9	N/C
10	0.9	1.0	+ 11.1
11	2.2	1.8	- 18.2
<b>Average # 8, 10 &amp; 11</b>	<b>1.3</b>	<b>1.2</b>	<b>- 7.7</b>

*The Bosch Scale ranges from 0.1 clean to 9.9 dirty.*

Bosch patches and computer printouts covering carbon flow calculations in Appendix to this report.

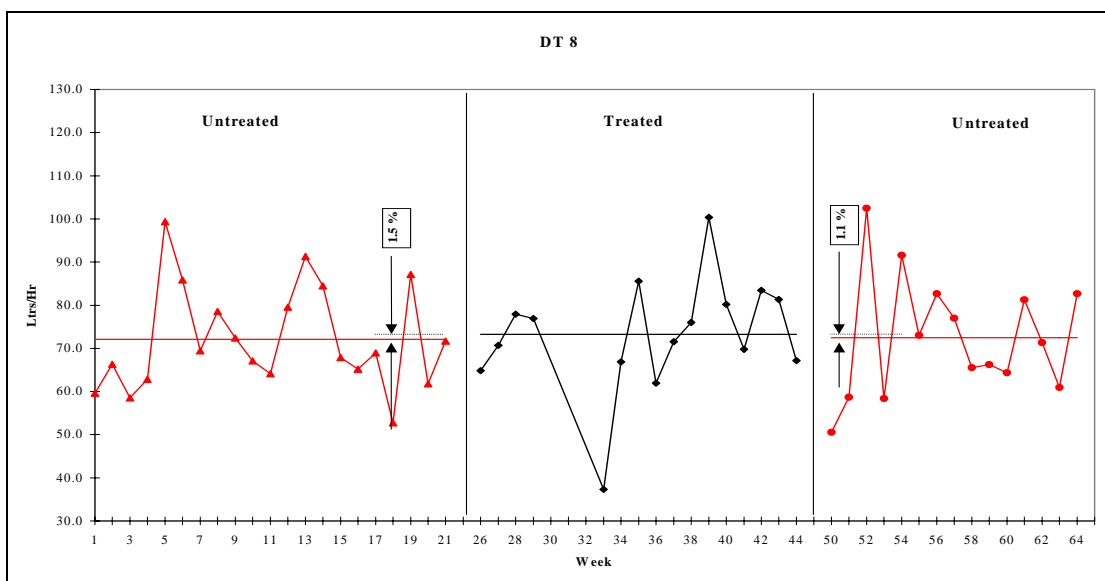
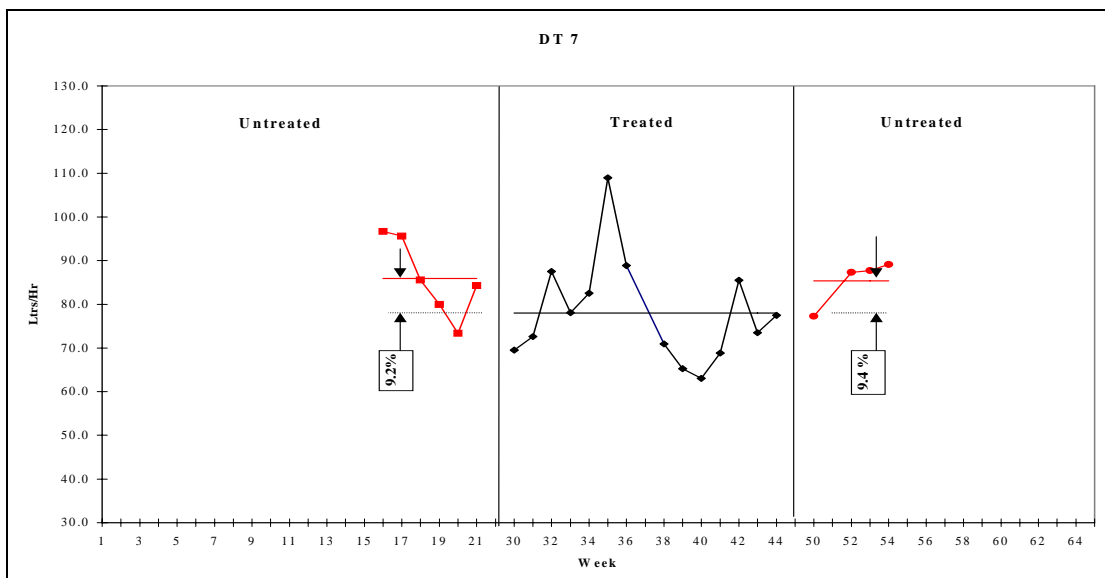
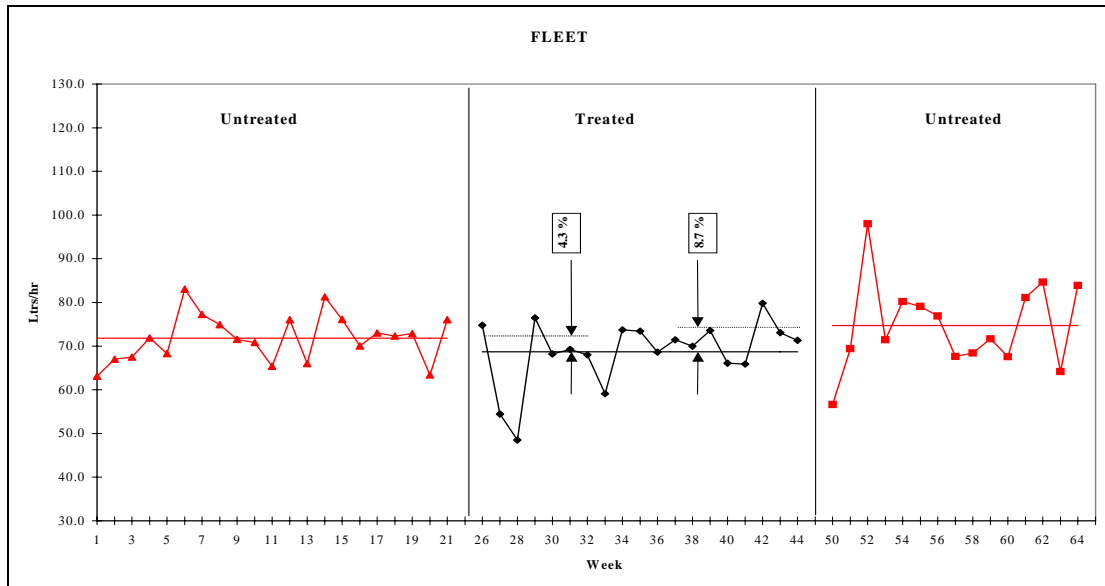
## Statistical

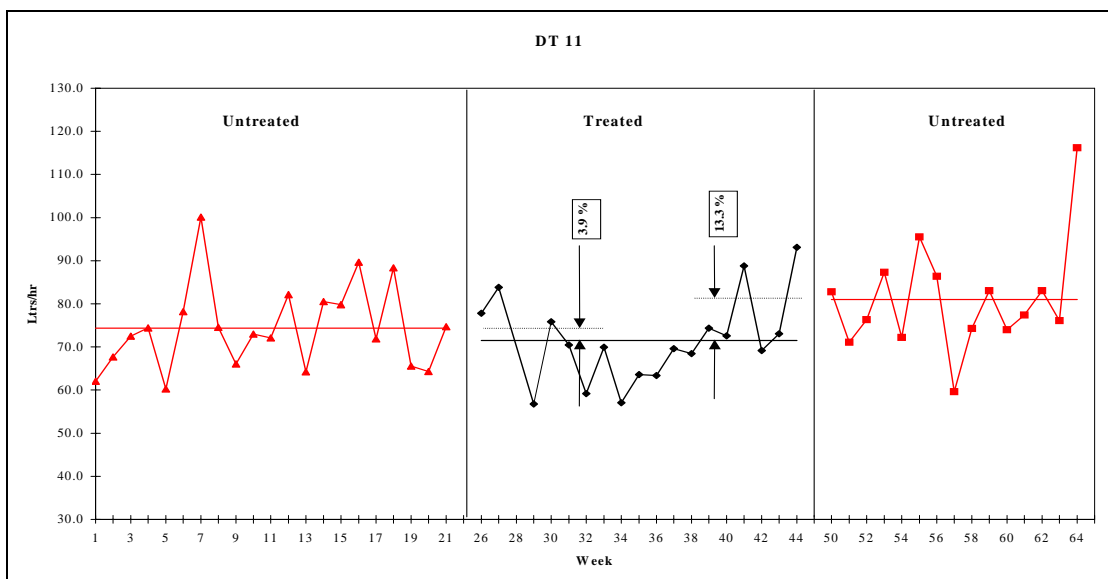
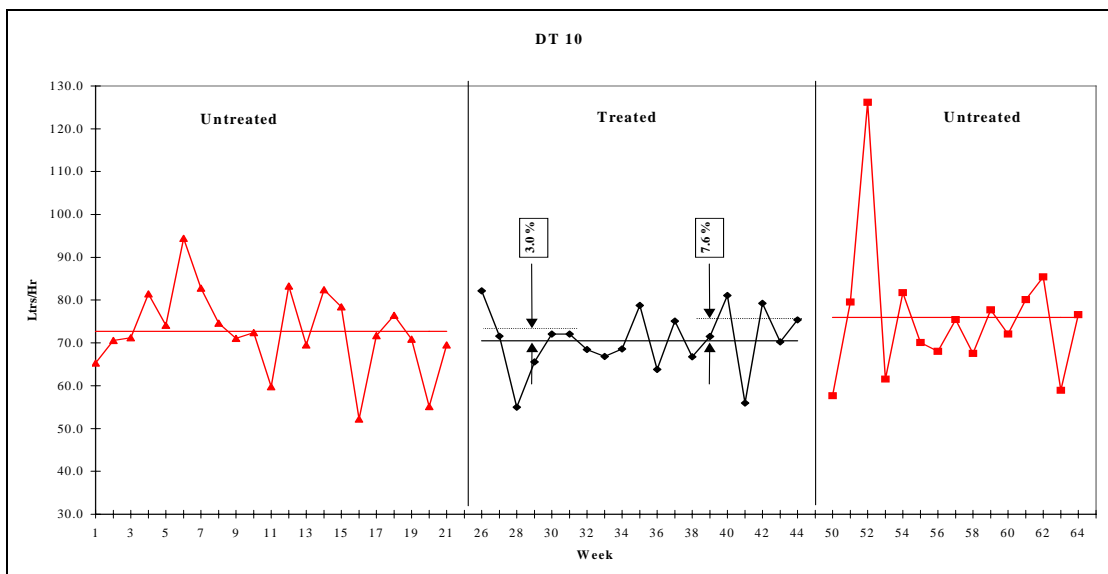
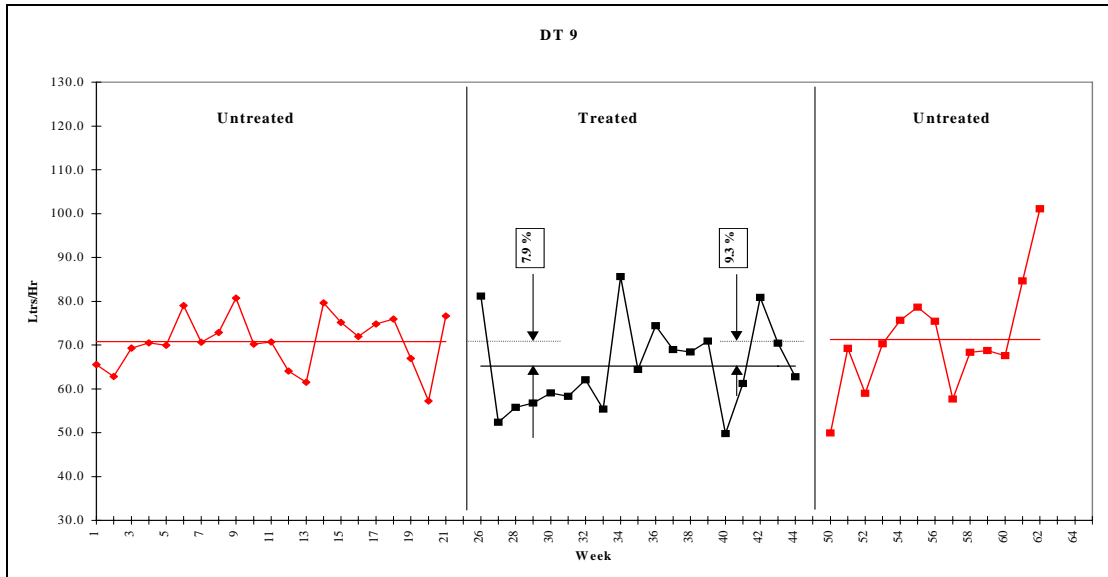
The fleet operating data was supplied during the period of review from December 1995 to March 1997. Data collected included operating hours and litres of fuel consumed and was analysed to determine weekly L/h fuel consumption. With the exception of truck number 8 all other trucks showed a significant reduction in L/h fuel consumption during the FTC treated period and a significant increase following withdrawal of FTC treatment.

### Operating Data Summary L/h

Unit No	Baseline 1 (untreated fuel)	Treated	% Change	Baseline 2 (untreated fuel)	% Change
7	85.9	78.0	- 9.2	85.3	+ 9.4
8	72.1	73.2	+ 1.5	72.4	- 1.1
9	70.8	65.2	- 7.9	71.2	+ 9.3
10	72.7	70.5	- 3.0	75.9	+ 7.6
11	74.4	71.5	- 3.9	81.0	+ 13.3
<b>Fleet Average</b>	<b>71.8</b>	<b>68.7</b>	<b>- 4.3</b>	<b>74.7</b>	<b>+ 8.7</b>

The following graphical representations show clearly the improved fuel efficiencies during the FTC period of treatment.





Data sheets are contained in the Appendix.

## *CONCLUSION*

The efficiency study conducted at Blue Circle Southern Cement Works in a fleet of Caterpillar 777 dump trucks provides clear evidence of reductions in fuel consumption following the introduction of the combustion catalyst, FTC-1.

The measured average reduction in carbon flow (fuel consumption) under controlled static conditions was **7.0%**, which is in the range of our database of results for similar equipment.

The statistical study of daily operating data, summarised on a weekly basis, shows a clear reduction in fuel consumption of 4.3% following introduction of the catalyst to the fuel and an increase in consumption of 8.7% following cessation of fuel treatment. The average benefit attributed to FTC treatment is **6.2%**.

$$\frac{73.25 \text{ L/h} - 68.7 \text{ L/h}}{73.25 \text{ L/h}} \times 100$$

Average smoke output of the three trucks tested was also lower by 7.7%.

The results achieved and substantiated by this test program are in line with our experience for similar equipment in open pit mining operations.

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## Appendix

“A”	Bosch Patches
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“C”	Data Sheets

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# BOSCH SMOKE METER FILTER TEST RESULTS

<b>Unit No.</b>	<b>Baseline</b>	<b><i>Bosch No.</i></b>	<b>Treated</b>	<b><i>Bosch No.</i></b>
7		0.8		-
8		0.9		0.9
10		0.9		1.0
11		2.2		1.8

*Appendix “C”*

**Data Sheets**