TESTING:
A RANGE OF NEW ZEALAND DIESEL FUELS

TO DETERMINE LUBRICITY EFFECTS OF:
CHORNCO 2082 DIESEL FUEL TREATMENT

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EXPLANATORY INFORMATION ON TERMINOLOGY AND TECHNIQUES USED IN THIS REPORT

The following are brief descriptions of the technical terms used:

TRIBOLOGY: is the study of friction, wear, lubrication, physics, chemistry, metallurgy and root cause failure analysis.

ASPERITIES: Microscopic peaks and troughs derived from the machining process.

STICK-SLIP: is the jerky movement, which can result when an object moves across another. The asperities microscopically weld together for nano seconds causing them to stick together, forming oscillations and inducing vibration. The mass moves rapidly and then tends to re-stick and break away, time and time again as the velocity increases. This is at a microscopic level.

****HARD FUELS:*** Hard fuels are those with low sulphur content designed to reduce sulphur dioxide emissions in exhaust gasses. The process results in aromatics being removed in the refining process, which results in a reduction of the lubrication capability of the fuel.

***TIMKIN TEST (TEST A*)**: is used by oil manufacturers and additive companies.

It consists of an electric motor drive on a Timkin bearing track, through a gearbox. The bearing runs in a bath of lubricant or in this test case diesel fuel. A Timkin roller bearing is locked into a lever system, which is brought into contact with the rotating bearing race. The roller bearing does not move. Weights, or torque is applied to the lever arm forcing the roller into contact with the rotating bearing track. Weights are applied until the unit seizes. The wear mark can be measured in width and length.

BALL ON THREE DISCS (TEST B): test rig is designed for testing diesel fuel. A ball rotates in a bath of diesel fuel across three discs. The temperature can be controlled and after e pre-set time the wear can be measured.

2082: Chornco Diesel Fuel Treatment.

***** Hard fuels can result in excessive wear in the fuel systems of diesel engines. Fuel pumps and injectors require the fuel to cool and lubricate prior to the combustion process.

G & M.E. CONSULTANCY LIMITED: is a New Zealand based organisation Managing and Consulting in matters relating to Tribology and Maintenance to Industrial Engineering Companies.

Within the Consultancy, the services provide include Root Cause Failure Analysis on defective equipment for Industrial and Insurance Company clients.

INTRODUCTION

The purpose of these tests were to select all of the diesel fuels generally available in the New Zealand market, with a view to establishing the overall effects of lubricity by the application of Chornco's 2082 product.

The fuels in New Zealand are known as "hard fuels" which is due to the method used in removing sulphur during the refining process. This has the effect of reducing the lubricating properties of the fuel, which can result in excessive wear on diesel fuel pumps and injectors.

The majority of fuels available in the marketplace are produced at the Marsden Point Oil Refinery. Some fuels are purchased on the open market and imported into the country, which results in different fuels entering the market place, albeit under the same company banner.

TRIAL PROTOCOLS

A total of seven fuel samples were collected from locations throughout New Zealand and from all petroleum suppliers. These samples were recorded and tested in an identical manner as set out below.

TEST A

This test would be a Timkin "OK" Wear Test to determine the wear scar for each brand of fuel under ASTM D 2782

The use of constant weights and a torque gauge provides the load, which was set at 10 ft Lbs/1.5Kg/M as an optimum after pre-trial tests to provide a scar that could be measured down to $1/10^{th}$ of a millimetre. An amp meter indicated the electrical load.

The machine was run for 30 seconds

A series of three tests were carried out on each of the fuel samples, which would allow for the temperature to rise and trigger the additives package blended in by the fuel manufacturer. At 60°C

Following each test the roller was removed and the wear scars were examined under a magnifier with a scale down to one tenth of a millimetre.

This process was repeated using fuel treated with 2082 at the recommended treatment ratios of one litre of 2082 to 1280 litres of diesel (1:1280).

Following each fuel sample test; the machine assembly, track, bath and screws were stripped down, degreased and cleaned thoroughly so as to avoid any residual 2082 remaining in the threads and housing, throwing up onerous readings.

The loads on the machine and the volumes of fuel in the bath were kept constant.

The following results were obtained:

DIESEL FUEL SUPPLIER & TEST	UNTREATED WEAR SCAR LENGTH (mm)	UNTREATED WEAR SCAR WIDTH (mm)	TREATED WEAR SCAR LENGTH (mm)	TREATED WEAR SCAR WIDTH (mm)	% REDUCTION IN LENGTH	% REDUCTION IN WIDTH
Sample ID	*CAL/A/UT*		*CAL/A/T*			
CALTEX						
TEST 1	5.2	2.4	3.3	1.4	**-36.5**	**-41.7**
TEST 2	4.5	2.2	2.5	1.3	**-44.4**	**-40.9**
TEST 3	4.5	2.0	2.4	1.2	**-46.7**	**-40.0**
	1.0 amp		0.85 amp			
Sample ID	*MOB/A/UT*		*MOB/A/T*			
MOBIL SYNERGY						
TEST 1	4.6	2.1	3.1	1.5	**-32.6**	**-28.6**
TEST 2	3.7	1.8	3.1	1.4	**-16.2**	**-22.2**
TEST 3	2.9	1.5	2.4	1.0	**-17.2**	**-33.3**
	0.9 amp		0.9 amp			
Sample ID	*SH/A/UT*		*SH/A/T*			
SHELL						
TEST 1	5.4	2.4	3.4	1.5	**-37.0**	**-37.5**
TEST 2	5.1	2.3	3.3	1.5	**-35.3**	**-34.8**
TEST 3	4.8	2.4	2.6	1.2	**-45.8**	**-50.0**
	1.05 amp		0.9 amp			
Sample ID	*CH/A/UT*		*CH/A/T*			
CHALLENGE						
TEST 1	4.5	2.2	4.0	2.0	**-11.1**	**-9.1**
TEST 2	4.4	2.1	3.5	1.7	**-20.5**	**-19.0**
TEST 3	4.2	2.0	3.2	1.5	**-23.8**	**-25.0**
	0.95 amp		0.9 amp			
Sample ID	*BP/W/INFA/UT*		*BP/W/INFA/T*			
BP WANGANUI						
TEST 1	5.5	2.5	4.3	2.0	**-21.8**	**-20.0**
TEST 2	5.4	2.3	4.1	1.9	**-24.1**	**-17.4**
TEST 3	4.8	2.2	3.8	1.8	**-20.8**	**-18.2**
	1.0 amp		0.9 amp			
Sample ID	*CAL/T/INFA/UT*		*CAL/T/INFA/T*			
CATEX TAUMARUNUI						
TEST 1	5.3	2.5	3.4	1.5	**-35.8**	**-40.0**
TEST 2	4.6	2.2	3.0	1.5	**-34.8**	**-31.8**
TEST 3	3.9	1.6	2.7	1.0	**-30.8**	**-37.5**
	1.2 amp		0.85 amp			
Sample ID	*BP/A/UT*		*BP/A/UT*			
BP	3.6	1.7	3.2	1.5	**-11.1**	**-11.8**
TEST 1	3.5	1.4	3.2	1.4	**-8.6**	**0.0**
TEST 2	3.3	1.4	2.6	1.1	**-21.2**	**-21.4**
TEST 3	0.95 amp		0.90 amp			

The test results demonstrated that there was a wide variation in the lubricity performance of the tested fuels, with some forming smaller wear scars than others.

In general there was a progressive decrease in the size of the wear scar from test 1 to test 3, which can be contributed to the sulphur and additives in the fuel coming into place as the temperature rose. Once the temperature rose above 60° centigrade, the sulphur would start to form a protective oxide on the test piece reducing the wear scar size.

OBSERVATIONS

It was noted that where the lubricity of the fuel was poor, the Torque Meter needle vibrated considerably. This was due to Stick Slip as the Asperities welded and were torn apart. When 2082 was applied there was no such vibration. The only reason for this, given the strict regime of the trial, was that the additional lubrication provided by 2082 reduced the asperity contact.

When testing the treated fuel samples there was a reduction in the current consumption recorded by the ammeter on the test instrument. This is due to the fact, that wear scars cause frictional loads to be exerted and the load carried by the electric motor increases and the current rises as the scar is formed. It follows that the smaller the wear scar, the better the lubrication, hence less friction, and the current decreases.

SUMMARY

The methods employed in removing sulphur from the fuel also results in the removal of aromatics. Hence lubrication properties of the fuel will be compromised and a suitable additive package will need to be introduced by the manufacturer to prevent the negative effects of hard fuels.

In all cases, the addition of 2082 resulted in an immediate and noticeable decrease in vibration; wear scar length and width when added to standard fuels.

It is our opinion that the use of 2082 could provide a solution to the wear effects brought about as a result of having to use hard fuels.

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