EXPERIMENTAL INVESTIGATIONS ON LUBRICANT ADDITIVE ON PERFORMANCE OF SIX CYLINDER DIESEL ENGINE

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Abstract

The scope of this work is to reduce the dynamic friction between the moving parts of the ALH6DTI engine by adding additive in the engine oil. The lubricant additive has the inherent of boric acid used as oil additive in the proportion of 10:1 ratio. SAE 15W40 oil is used as standard engine oil. Interaction of boric acid with the metal surface and water produces a very thin film of boric oxide. Boric oxide film forms corrosive resistant barrier between metal surfaces. Interaction of boric acid with air produces self replenishing of boric acid molecules in the form of acid platelets slide over each other and minimise the dynamic friction. The friction consumption to overcome the friction is considerably reduced. Increase in positive power for the same quantity of fuel injection reflects on the considerable reduction in specific fuel consumption.

I. INTRODUCTION

Friction is a common factor in engines, engines friction and friction in general, can roughly be compartmentalized into two groups: coulomb friction (dry friction) which occurs when asperities come into contact between two surfaces moving relative to each other and fluid friction which develops between adjacent layers of fluid moving at different velocities.

The actual degree of friction in engine components can seldom be put into either of these categories, and instead lies somewhere between these two extremes. There is a continuum is dependent on such factor as: component geometry, surface roughness, relative velocities of the moving surfaces, normal loads, and various rheological properties of the lubricant.[1]

Due to this friction factor, specific fuel consumption increases and the overall efficiency of the engine reduces. This results in customer dissatisfaction and poor sales in the market.

This can be corrected by using motor silk oil (a boron based lubricant additive), containing boron based components that protect vital working parts from friction and corrosive elements. The lubricant additive forms a diamond hard surface on metal parts, providing a super- slick surface. The new surface also blocks oxygen to prevent corrosive activity. This micro layer of protection is bonded to metal surfaces with strong covalent and ionic bond. It provides a long lasting, low friction surface that is impervious to most contaminants.

Fig. 1. Six Cylinder Diesel Engine

II. ENGINE SPECIFICATION

- DISPLACEMENT-5790cc (5.79L)
- NO OF CYLINDERS-6 (in line)
- BORE -104 @BULL = STROKE -113 mm
- BHP -95KW=130HP
- MAX TORQUE -457Nm
- RATED SPEED -2400rpm

III. THE ENGINE LUBRICANT USED

India's first OEM certified super high performance heavy duty diesel engine oil exclusively developed for long drain applications for latest low emission vehicles meeting BS1 and BS2 emission norms is used. Super Fleet LE Max 15 W40 is used here which is formulated using highly refined paraffinic base stocks and advanced additive technology to provide utmost engine protection and extended oil drain interval.

IV. THE LUBRICANT ADDITIVE USED

Motor Silk® CLS Bond® Engine Treatment additive is designed to extend the life and operating range of internal combustion engines. It blends with existing engine oil and contains boron based components that protect vital working parts from friction and corrosive elements. Motor Silk CLS Bond® Engine Treatment actually forms a near-diamond hard surface on metal parts, providing a super-slick surface. The new surface also blocks oxygen to prevent corrosive activity. This micro-layer of protection is bonded to metal surfaces with strong covalent and ionic bonds. It provides a long-lasting, low-friction surface that is impervious to most contaminants. Motor Silk CLS® Bond® Engine Treatment works with any four-cycle engine when added to the crankcase oil at a 10:1 ratio. A single 16-ounce container treats a normal five-quart crankcase.

V. THE WORKING OF LUBRICANT ADDITIVE

Boric acid goes through a complex interaction with virtually all metal surfaces where it creates macro molecular and covalent bonds with the metal surface to form a highly adherent crystal lattice of boric acid platelets. Utilizing minute amounts of by product boric oxide any sheared platelets are rapidly replaced in a self-renewing cycle of solid lubricant-to-metal surface regeneration and bonding.

Once established, the boric-acid boundary layer requires only minimal amounts of "free" boric acid to replenish the crystal lattice boundary layer. The ultimate duration of a CLS Bond system in an internal combustion engine is not currently known and will vary somewhat on circumstances. In addition the Boron CLS Bond boundary layer is resistant to solvents, acids, and corrosives.

When boric acid establishes its solid-lubricant boundary layer, it does so by forming a 0.5 micron thick crystal lattice structure (CLS) of individual platelets approximately 500 angstroms thick that form like a loosely dispersed deck of playing cards. These platelets cover all the metal surfaces and align themselves in planer configuration parallel to the metal surface and conforming to the direction of movement. Each CLS Bond platelet has strong intra-molecule bonding, giving it the equivalent of 85 percent of the hardness of diamonds. Only weak Vander Wahl's forces attract the platelets to each other allowing virtually frictionless platelet-to-platelet interaction and translating to extremely low friction coefficients between the metal surfaces. The Boron Crystal Lattice Structure (Boron CLS Bond) usually takes several hours to fully form its boundary layer but over time completely covers the surfaces and orients itself so as to virtually eliminate asperities in the metal surface [4].

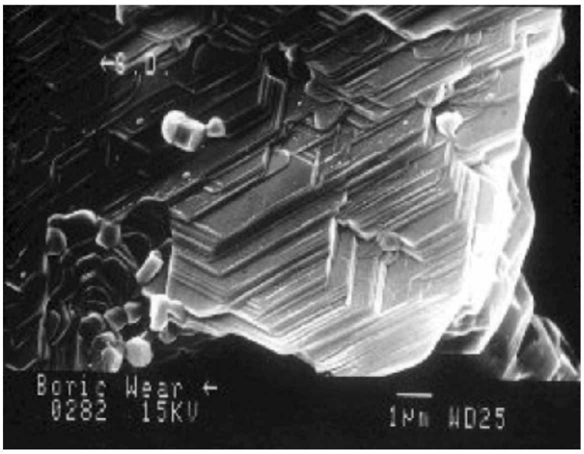

Fig. 2. Covalent Lattice Structure

Test Combination

Combination	Running in	Performance		Durability	Identification need
		FTP parameters	PTP paramets	FHP	
Standard engine oil	2 hrs	SMK/Blowby/ Exh temp ATC/Boost pr/Boost	SMK/Blowby/Exh temp ATC/Boost pr/Boost	Willians line test	Friciton horse power/SFC
Additive added engine oil	2hrs				

TEST PROCEDURE

Engine mounting

↓

Oil filling to dipstick mark

↓

Start engine & check for leak

↓

Running

↓

Full throttle performance
- With standard engine oil
- With additive engine oil

Part throttle performance
- With standard engine oil
- With additive engine oil

Frictional horse power test
- With standard engine oil
- With additive engine oil

VI. FULL THROTTLE PERFORMANCE

The full throttle performance is carried out from 2400 rpm to 1300 rpm reducing 100 rpm from the previous one. This performance test is used to determine parameters such as Injection Quantity, Specific Fuel Consumption, Torque, Power, Boost Pressure, Air Inlet Depression, Exhaust Temperature, Smoke, Blowby etc. as shown in fig 3, 4, 5, 6, 7, 8.

VII. PART THROTTLE PERFORMANCE

The part throttle performance is carried out, particularly taking any four rpm's into consideration for example 2400rpm, 2000 rpm, 1600 rpm and 1000 rpm. This performance test is carried out to find the frictional horse power (FHP).The values of power and injection quantity is obtained from this test is plotted on a graph and the FHP is determined by drawing the willan's line across the X-axis (Power) and Y-axis (Injection Quantity). Extrapolation of the willan's line to zero fuel consumption gives a measure of frictional losses in the engine. as shown in fig. 9, 10, 11, 12, 13, 14.

VIII. RESULTS AND DISCUSSION

A. Full Throttle Performance

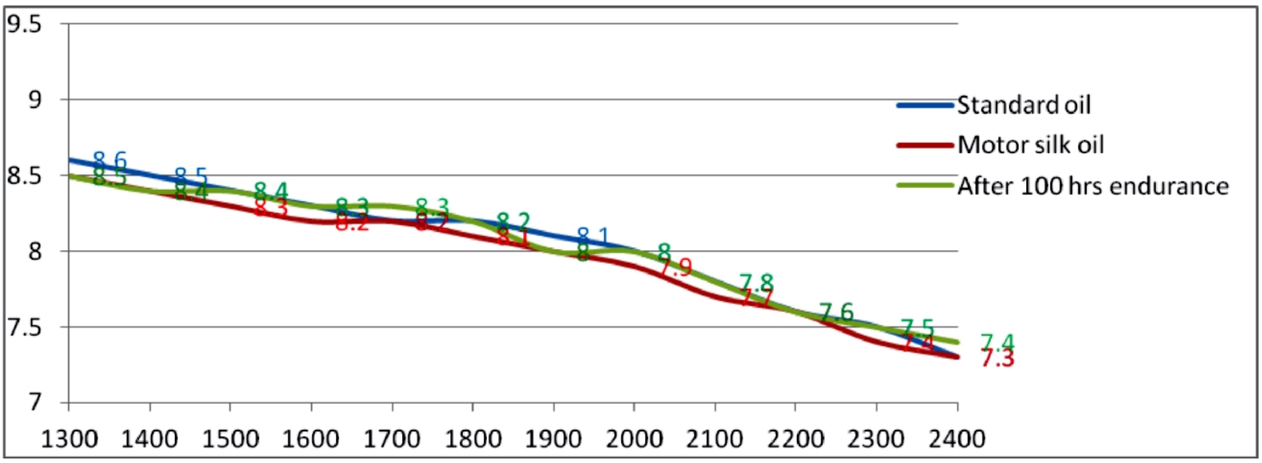

Fig. 3. Injection Quantity (mm^3/st)

In this above graph the Speed (rpm) is plotted in x-axis and Injection Quantity in y-axis (mm^3/st). The Injection Quantity increases from 7.3 mm^3/st to 7.4 mm^3/st after 100 hrs endurance test. There is no marginal difference in Injection Quantities, it maintains constant with slight differences after 100 hrs endurance test.

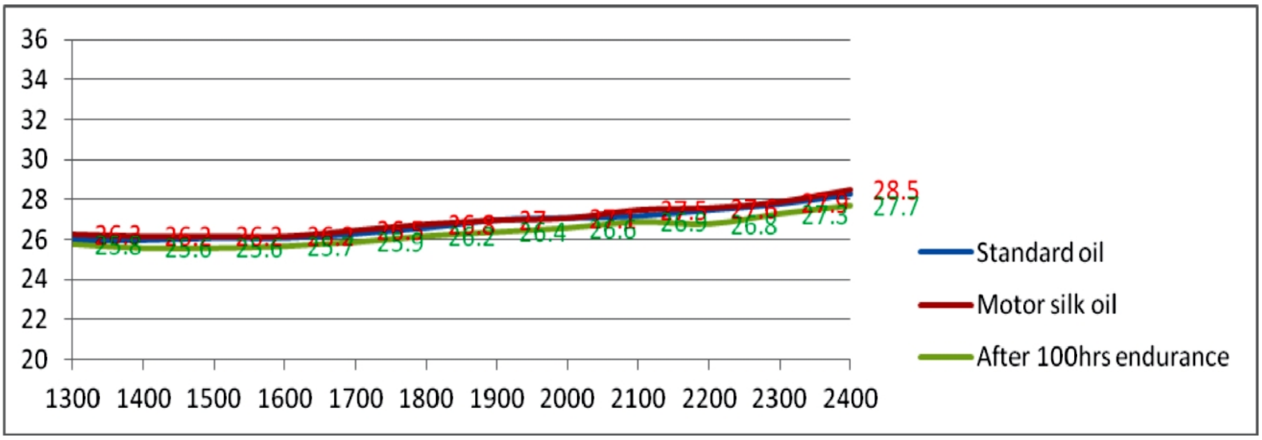

Fig. 4. Specific Fuel Consumption (g/Kw-hr)

In this above graph, the Speed (rpm) is plotted in x-axis and SFC (g/Kw-hr) in y-axis. There is a marginal reduction in SFC from 28.5 g/Kw-hr to 27.7 g/Kw-hr after 100 hrs endurance test. This reduction in SFC is due to the overall reduction in friction due to adding of lubricant additive to the lubricant.

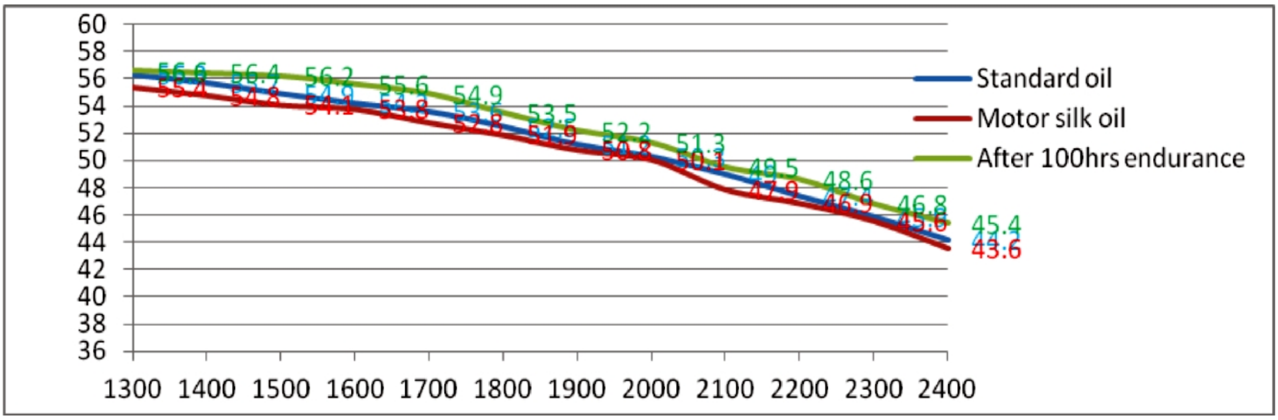

Fig. 5. Torque (Nm)

The Torque which is plotted in the y-axis with speed in the x-axis shows that the torque has increased from 43.6Nm to 45.4Nm. The increase in torque is due to reduction in overall friction in moving parts of the engine.

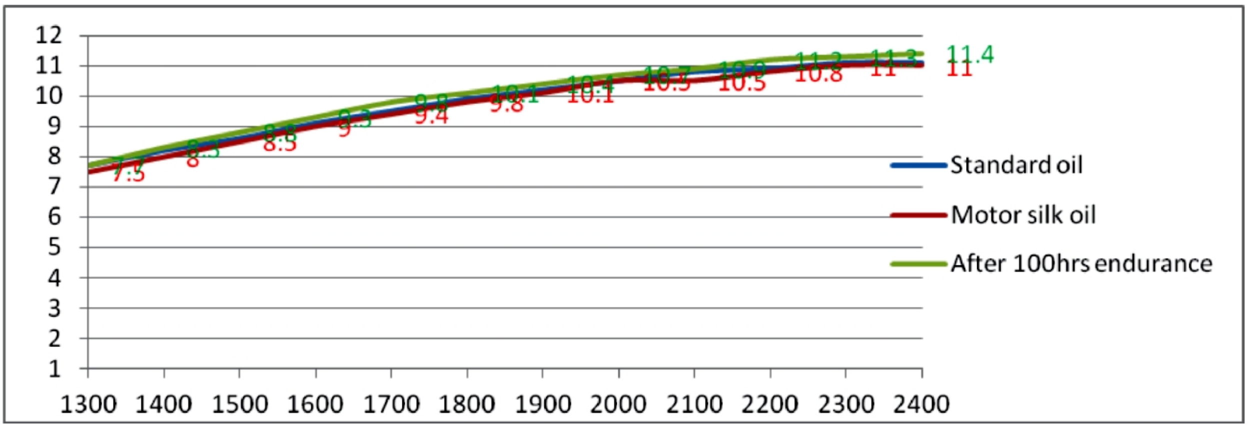

Fig. 6. Power (Kw)

The power in Kw is plotted in y-axis with speed in x-axis shows that the power has increased from 11Kw to 11.4Kw due to increased torque in the performance test carried out.

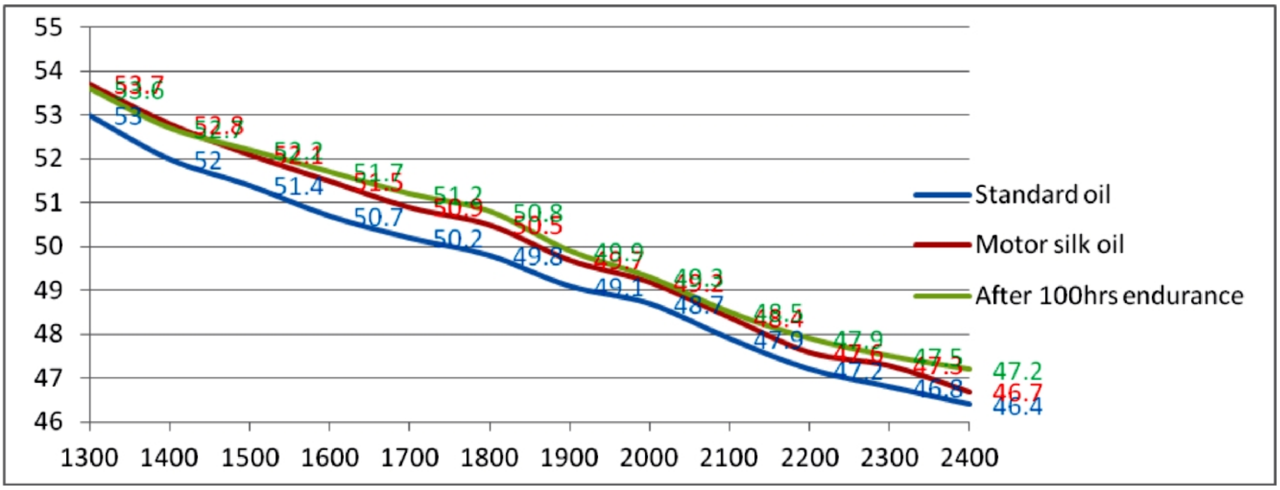

Fig. 7. Exhaust Temperature (deg C)

In the above graph the Exhaust temperature is plotted in the y-axis with speed in the x-axis. The Exhaust temperature has increased from 46.4deg C to 47.2deg C. This increase in temperature is due to effective transfer of heat from engine parts by the additive added lubricant.

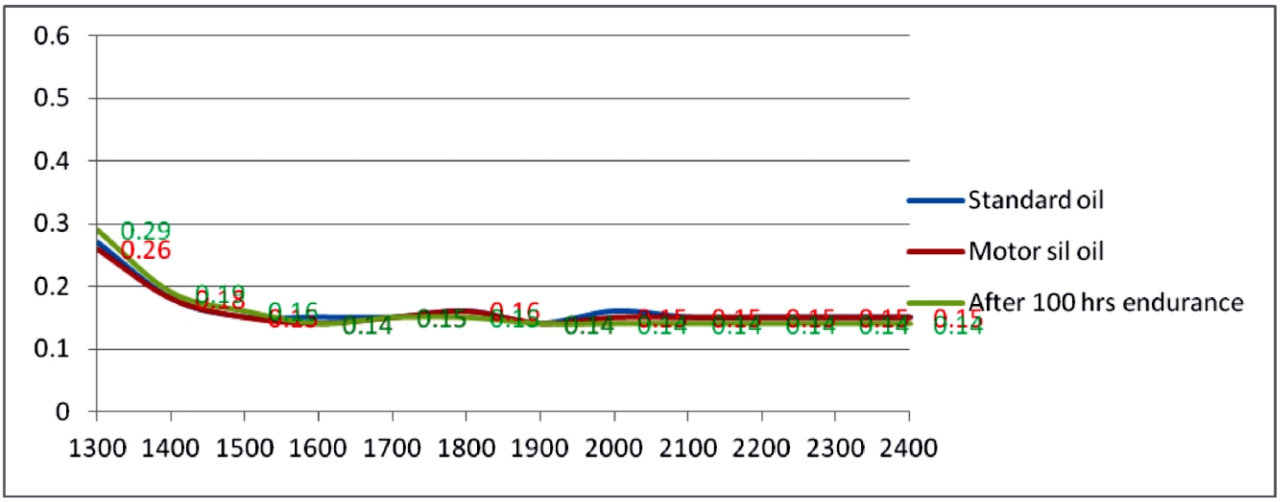

Fig. 8. Smoke (FSN)

In this above graph the quantity of smoke has decreased from 0.15 FSN to 0.14FSN due to reduced friction in the engine parts.

A. Part Throttle Performance

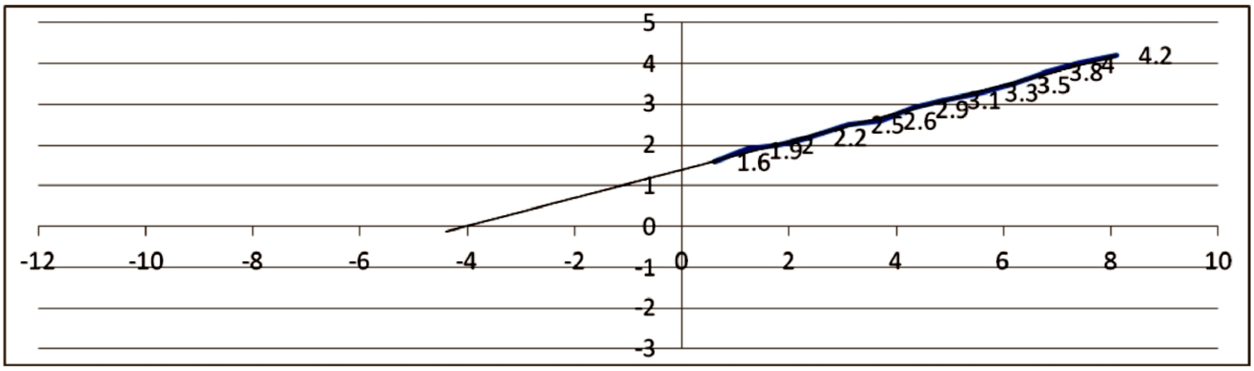

Fig. 9. Willans Line Test on 2400 rpm standard oil

In this above graph power is plotted in x-axis with injection qty in y-axis. The frictional horse power is 4PS.

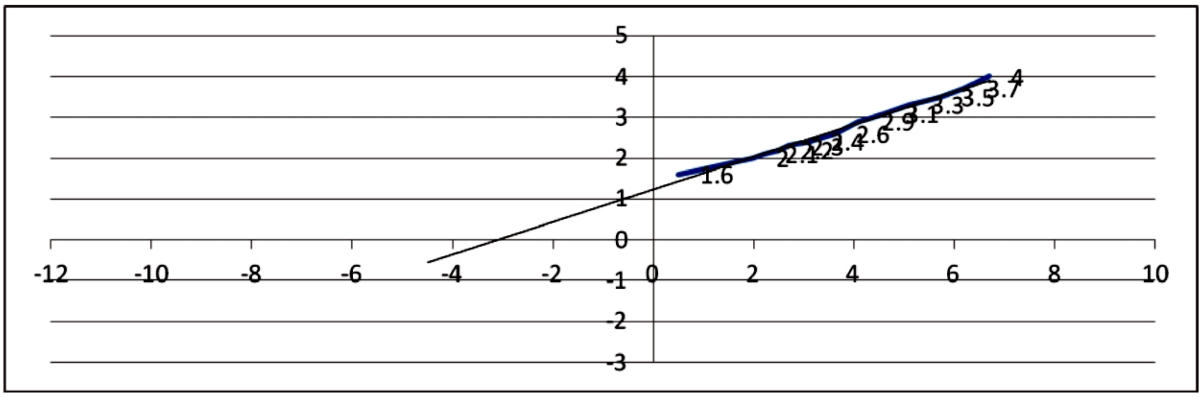

Fig. 10. Willans Line Test on 2400 rpm additive oil

In this graph it shows that the frictional horse power is 3.5 PS when additive oil is used.

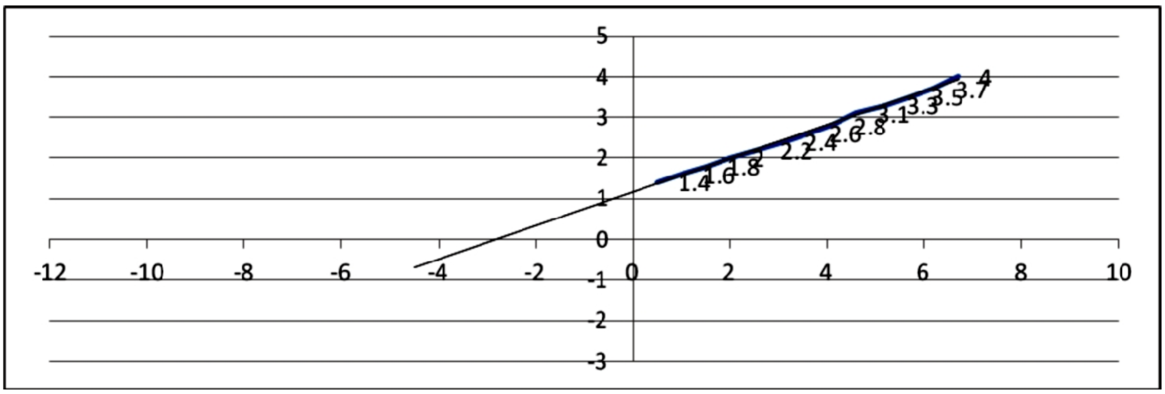

Fig. 11. Willans Line Test on 2000 rpm standard oil

In this above graph, the FHP is 3PS at 2000rpm for standard oil.

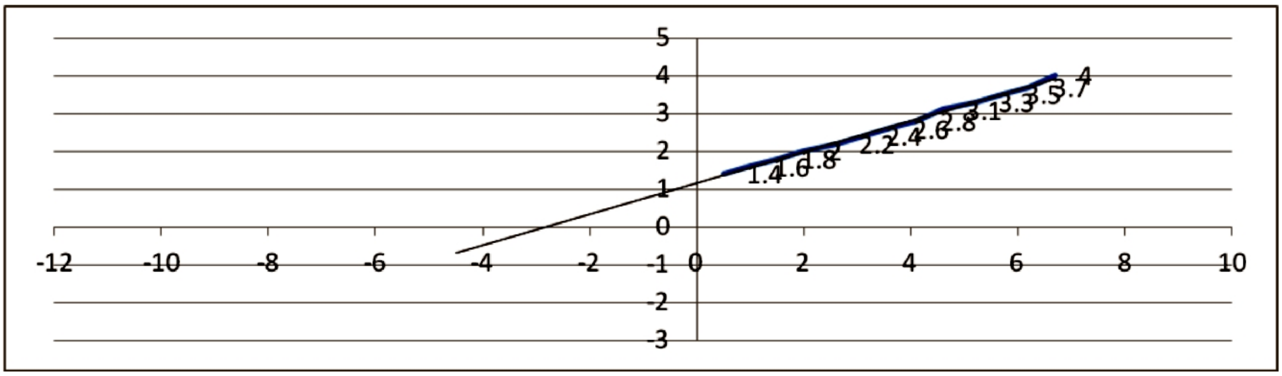

Fig. 12. Willans Line Test on 2000 rpm additive oil

In this graph the FHP is 2.8 ps for 2000rpm for additive oil.

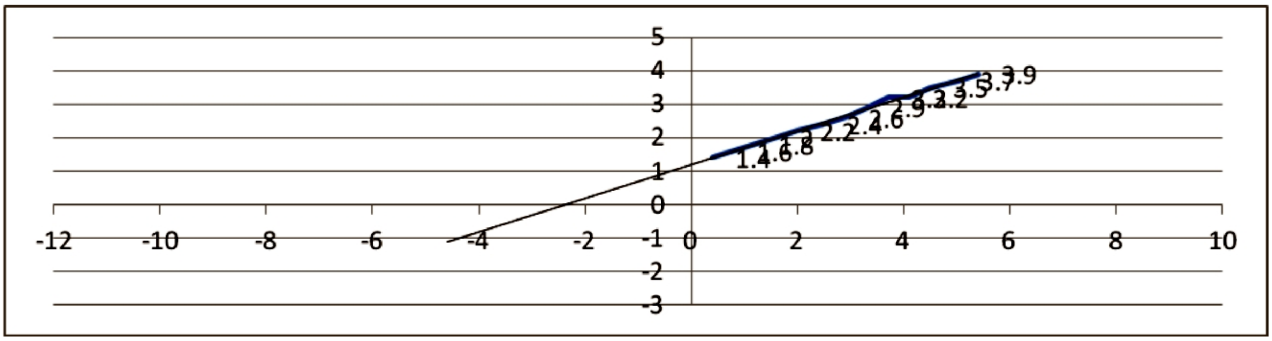

Fig. 13. Willans Line Test on 1600 rpm standard oil

The FHP is 2.2ps for 1600 rpm for standard oil.

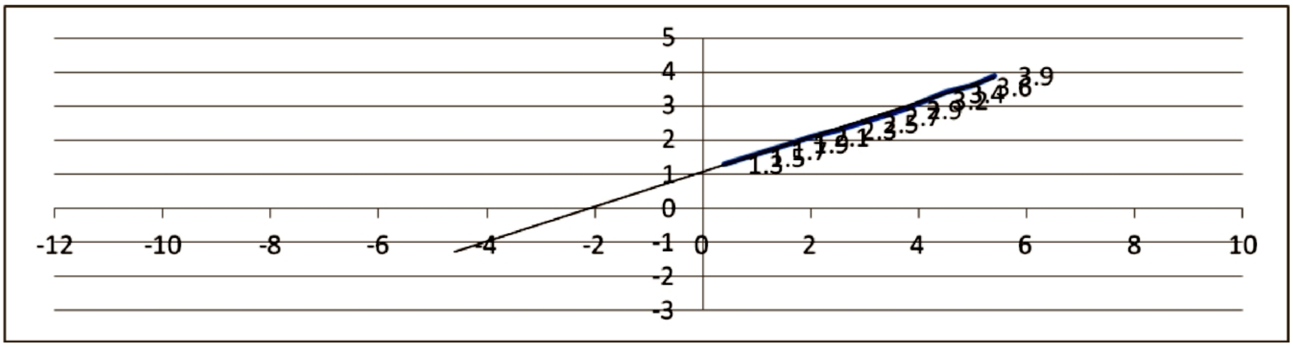

Fig. 14. Willans Line Test on 1600 rpm additive oil

The FHP is 2ps at 1600 rpm for additive oil.

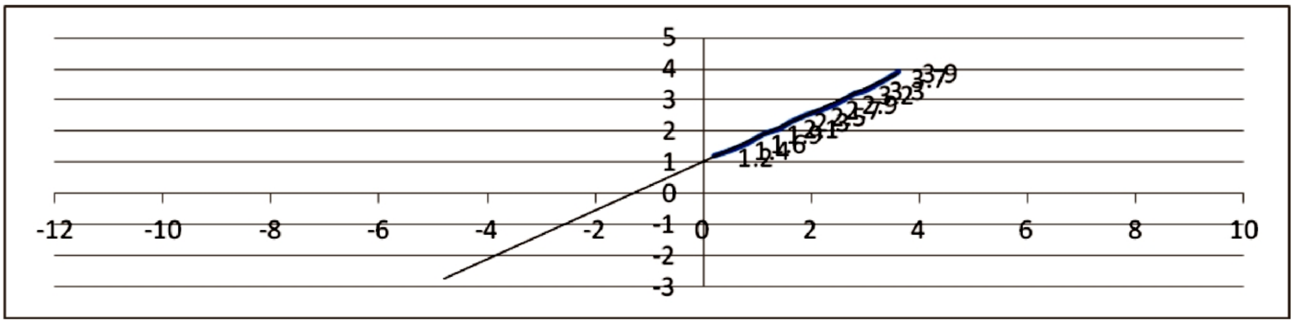

Fig. 15. 1000 rpm standard oil

The frictional horse power is 1ps for 1000 rpm for std oil.

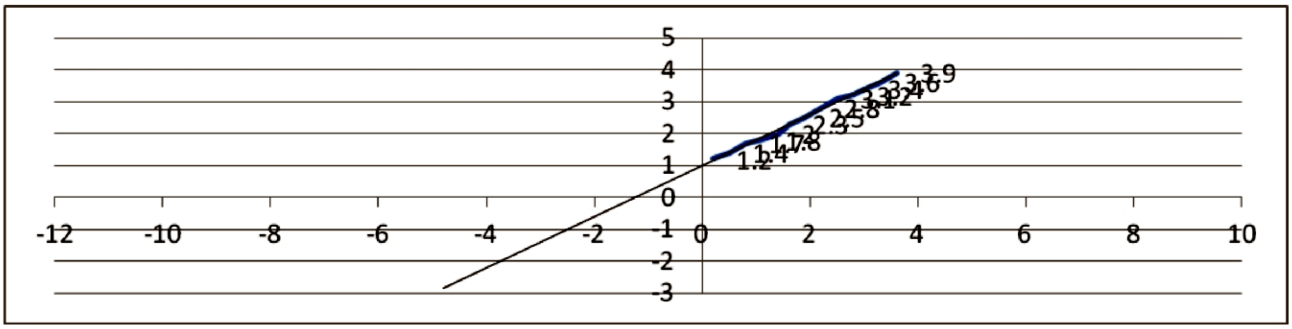

Fig. 16. 1000 rpm additive oil

The frictional horse power is 0.8 ps at 1000 rpm for additive oil.

Mechanical Efficiency

Mechanical Efficiency by Using Standard Oil:

Max power/power + FHP * 100 (2400 RPM)

= 11.1/11.1+4*100 = **73.5%**

Mechanical Efficiency by Using Additive Oil:

Max power/power + FHP * 100 (2400 RPM)

=11.4/11.4+3.5*100 = **76.5%**

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