Effect of Hippe (M40) Biodiesel on Tribological Property of IC Engine New Components

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***Abstract* - The internal combustion engine is a heat engine that converts chemical energy into mechanical energy, usually made available on a rotating output shaft. The chemical energy of the fuel is first converted to thermal energy by means of combustion or oxidation with air inside the engine. This thermal energy raises the temperature and pressure of the gases within the engine, and the high-pressure gas then expands against the mechanical mechanisms of the engine. This expansion is converted by the mechanical linkages of the engine to a rotating crankshaft, which is the output of the engine. The crankshaft, in turn, is connected to a transmission and/or power train to transmit the rotating mechanical energy to the desired final use. In the present study, the surface roughness of the IC Engine components has been recorded for diesel and blend of 60% Diesel + 40% Hippe oil. The use of the blend of 60% Diesel + 40% Hippe oil has better tribological properties of the IC Engine components as compared to the diesel as a fuel.**

***Index Terms* - Diesel, Hippe oil, Surface roughness.**

I.INTRODUCTION

In the diesel engine, only air is initially introduced into the combustion chamber. This high compression causes the temperature of the air to rise. At about the top of the compression stroke, fuel is injected directly into the compressed air in the combustion chamber. This may be into a void in the top of the piston or a pre-chamber depending upon the design of the engine. The fuel injector ensures that the fuel is broken down into small droplets, and that the fuel is distributed evenly. The heat of the compressed air vaporises fuel from the surface of the droplets. The vapour is then ignited by the heat from the compressed air in the combustion chamber, the droplets continue to vaporise from their surfaces and burn, getting smaller, until all the fuel in the droplets has been burnt. The combustion occurs at a substantially constant pressure during the initial part of the power stroke. The start of vaporisation causes a delay before ignition and the characteristic diesel knocking sound as the vapour reaches ignition temperature and causes an abrupt increase in pressure above the piston. When combustion is complete, the combustion gases expand as the piston descends further; the high pressure in the cylinder drives the piston downward, supplying power to the crankshaft. As well as the high level of compression allowing combustion to take place without a separate ignition system, a high compression ratio greatly increases the engine's efficiency. Increasing the compression ratio in a spark-ignition engine where fuel and air are mixed before entry to the cylinder is limited by the need to prevent pre-ignition, which would cause engine damage. Since only air is compressed in a diesel engine, and fuel is not introduced into the cylinder until shortly before top dead centre, premature detonation is not a problem and compression ratios are much higher.

II. LITERATURE SURVEY

C D Rakopoulos, E G Giakoumis, and D C Rakopoulos [1] have discussed the Study of the short-term cylinder wall temperature oscillations during transient operation of a turbo- charged diesel engine with various insulation schemes. The work investigates the phenomenon of short-term temperature (cyclic) oscillations in the combustion chamber walls of a turbocharged diesel engine during transient operation after a ramp increase in load. The investigation reveals many interesting aspects of transient engine heat transfer, regarding the influence that the engine wall material properties have on the values of cyclic temperature swings.

Er. Milind S Patil, Dr. R. S. Jahagirdar, and Er. Eknath R Deore [2] have worked on Performance Test of IC Engine Using Blends of Ethanol and Kerosene with Diesel. They used 3.75 kW diesel engine, AV1 Single Cylinder, water cooled, Kirloskar Make, to test blends of diesel with kerosene and Ethanol. This paper presents a study report on the performance of IC engine using blends of kerosene and ethanol with diesel with various blending ratio. The parameters like speed of engine, fuel consumption and torque were measured at different loads for pure diesel and various combination of dual fuel. The Break Power, BSFC, BTE and heat balance were calculated. Paper represents the test results for blends ranging from 5% to20%.

M. Lackner, F. Winter [3] have discussed the Laser Ignition in Internal Combustion Engines. The Laser ignition tests were performed with the fuels hydrogen and biogas in a static combustion cell and with gasoline in a spray-guided internal combustion engine. A Nd:YAG laser with 6 ns pulse duration, 1064 nm wavelength and 1-50 mJ pulse energy was used to ignite the fuel/air mixtures at initial pressures of 1-3 MPa. Compared to a conventional spark plug, a laser ignition system should be a favourable ignition source in terms of lean burn characteristics and system flexibility. Yet several problems remain unsolved, e.g. cost issues and the stability of the optical window.

Sutaria B.M, Bhatt D.V and Mistry K.N [4] have worked on study of basic tribological parameters that influences performance of an internal combustion engine. A Mathematical model is developed using average Reynolds equation. Parametric study is performed on 150 cc, 2 Stroke Internal Combustion Engine. The oil film thickness (OFT), piston friction forces (PFF), and Ring friction variations are simulated under different variable i.e. engine speed, lubricants and different ring geometry. The simulated results of piston friction force, ring friction force and oil film thickness are compared with published literature.

Wang Wenzhong, HU Yuanzhong, WANG Hui & LIU Yuchuan [5] have found that Piston and piston ring lubrication is a factor that strongly affects the performance of the reciprocating internal combustion engine. Their work is based on a unified numerical approach assuming that the pressure distribution obeys Reynolds equation in hydrodynamic lubrication regions, while in asperities contact regions, the contact pressure can be obtained through the so-called reduced Reynolds equation.

III.METHODOLOGY

In the present study, the mechanical property viz., the wear of the piston, piston ring and cylinder liner is investigated. The duration of test is considered for 2 hours, 4 hours and 6 hours run of the engine. The corresponding readings of surface roughness (Ra) values of the piston, piston ring and cylinder liner have been recorded by using the surface measurement test.

IV. RESULTS AND DISCUSSION

The results have been tabulated for the Ra values considering the conditions of 100% Diesel (B0) and blend of 60% Diesel + 40% Hippe oil (M40) and the positions of the measurements for different new components of the IC Engine are as follows;

a. Piston - two positions on the TDC, two positions on the land and two positions on the skirt.

b. Piston ring - two points for two compression rings.

The comparison of the Ra values is done to investigate the surface roughness of the IC Engine new components considered for the study. The duration of the test considered is 2 hours, 4 hours and 6 hours running of IC Engine.

The data pertaining to the Ra values for piston are tabulated in Table 1. The average of two measurement points is taken to plot the variation of Ra values and is shown in the Figure 1.

Table 1 R_a values for new piston (B0 and M40)

Piston Positions	R_a values in microns					
	2 Hrs (B0)	2 Hrs (M40)	4 Hrs (B0)	4 Hrs (M40)	6 Hrs (B0)	6 Hrs (M40)
Piston TDC	0.564	0.486	0.612	0.350	0.633	0.312
Piston Land	0.365	0.245	0.41	0.230	0.51	0.225
Piston Skirt	0.651	0.436	0.721	0.581	0.744	0.423

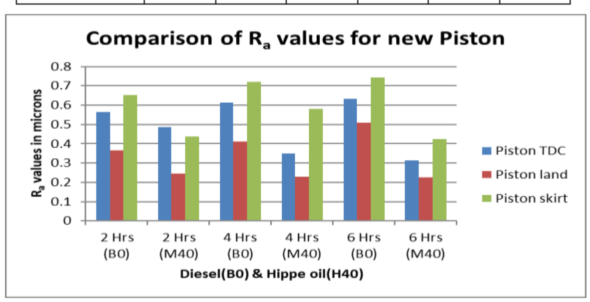

Figure 1 Comparison of Ra values for new piston (B0 and M40)

From the Figure 1, it can be concluded that Ra value of 0.225 microns is minimum at piston land -6Hrs run with Hippe-(M40).

The data pertaining to the Ra values for piston rings are tabulated in Table 2. The average of two measurement points is taken to plot the variation of Ra values and is shown in the Figure 2.

Table 2 R_a values for new piston rings (B0 and M40)

Piston Rings	R_a values in microns					
	2 Hrs (B0)	2 Hrs (M40)	4 Hrs (B0)	4 Hrs (M40)	6 Hrs (B0)	6 Hrs (M40)
Ring 1	0.71	0.252	0.729	0.09	0.732	0.082
Ring 2	0.62	0.201	0.651	0.110	0.662	0.098

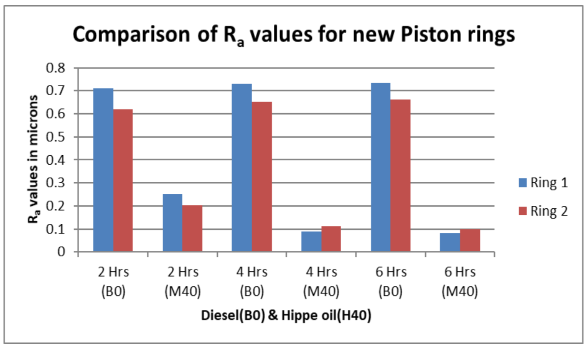

Figure 2 Comparison of Ra values for new piston rings (B0 and M40)

From the Figure 2, it can be concluded that Ra value of 0.082 microns is minimum for piston ring1 - 6 Hrs run with Hippe - (M40).

V. CONCLUSIONS

The wear test reveals the effect of the combustion of diesel and blend of 60% Diesel + 40% Hippe oil on the wear of the materials of the IC Engine components viz., piston and piston rings. In the present study the surface roughness of the IC Engine components has been recorded for diesel and blend of 60% Diesel + 40% Hippe oil. The use of the blend of 60% Diesel + 40% Hippe oil has better tribological properties of the IC Engine components as compared to the diesel as a fuel.

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