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Effect of Honge (H40) Biodiesel on Tribological Property of IC Engine Components

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ABSTRACT: The internal combustion (IC) engine is a heat engine that converts chemical energy into mechanical energy, usually made available on a rotating output shaft. 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. Previous work has concentrated on the engine performance using the different alternative fuel for a particular time period. This period considered for testing the engine performance cannot be compared with actual running of engine for the specified life of the Automobile. In the present work, the surface roughness of the IC Engine components has been recorded for diesel and blend of 60% Diesel+40% Honge oil. The surface roughness (R_a) values for piston, piston ring and cylinder liner of the engine is measured for both diesel (fossil fuel) and alternative fuel (blended 40% Honge oil + 60% Diesel). The use of diesel as a fuel has better tribological properties of the IC Engine components as compared to the blend of 60% Diesel + 40% Honge oil.

Keywords - Honge oil, Diesel, Surface roughness.

I. INTRODUCTION

Internal combustion engines are seen every day in automobiles, trucks, and buses. The name internal combustion refers also to gas turbines except that the name is usually applied to reciprocating internal combustion (I.C.) engines like the ones found in everyday automobiles. There are basically two types of I.C. ignition engines, those which need a spark plug, and those that rely on compression of a fluid. Spark ignition engines take a mixture of fuel and air, compress it, and ignite it using a spark plug. The name `reciprocating' is given because of the motion that the crank mechanism goes through. The piston-cylinder engine is basically a crank-slider mechanism, where the slider is the piston in this case. The piston is moved up and down by the rotary motion of the two arms or links. The crankshaft rotates which makes the two links rotate. The piston is encapsulated within a combustion chamber. The bore is the diameter of the chamber. The valves on top represent induction necessary for the intake of an air-fuel mixture and exhaust of chamber residuals.

Parts of the Engine Block

- Cylinder – the part of the engine block where the combustion takes place.
- Piston – a plunger with rings that fit against the inside cylinder walls and prevent air from leaking past
- Connecting rod – connects the piston to the crankshaft. Fastened by the wrist pin
- Crankshaft – shaft with offsets to which the connecting rods are attached

The large increase in number of automobiles in recent years has resulted in great demand for petroleum products. With crude oil reserves estimated to last only for few decades, there has been an active search for alternate fuels. The depletion of crude oil would cause a major impact on the transportation sector. Of the various alternate fuels under consideration, biodiesel, derived from vegetable oils, is the most promising alternative fuel to conventional diesel fuel due to the following reasons:

- Biodiesel can be used in existing engines without any modifications.

- Biodiesel is made entirely from vegetable sources; it does not contain any sulfur, aromatic hydrocarbons, metals or crude oil residues.
- Biodiesel is an oxygenated fuel; emissions of carbon monoxide and soot tend to be reduced compared to conventional diesel fuel.
- Unlike fossil fuels, the use of biodiesel does not contribute to global warming as CO_2 emitted is once again absorbed by the plants grown for vegetable oil/biodiesel production. Thus CO_2 balance is maintained.
- The Occupational Safety and Health Administration classify biodiesel as a non-flammable liquid.
- The use of biodiesel can extend the life of diesel engines because it is more lubricating than petroleum diesel fuel.
- Biodiesel is produced from renewable vegetable oils/animal fats and hence improves fuel or energy security and economy independence.

A lot of research work has been carried out using vegetable oil, both in its neat form and modified form. Studies have shown that the usage of vegetable oils in neat form is possible but not preferable. The high viscosity of vegetable oils and the low volatility affects the atomization and spray pattern of fuel, leading to incomplete combustion and severe carbon deposits, injector choking and piston ring sticking. Methods such as blending with diesel, emulsification, pyrolysis and transesterification are used to reduce the viscosity of vegetable oils. Among these, the transesterification is the most commonly used commercial process to produce clean and environmentally friendly fuel.

II. LITERATURE SURVEY

Wang Wenzhong, HU Yuanzhong, WANG Hui & LIU Yuchuan [1] 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.

Arka Ghosh [2] has worked on the essentials of combustion chamber, their design, influence in combustion process, timing, etc. They emphasize research on newer designs requirement for combustion chambers.

Balvinder Budania and Virender Bishnoi [3] developed “A New Concept of I.C. Engine with Homogeneous Combustion in a Porous Medium”. They have proposed a new combustion concept that fulfils all requirements to perform homogeneous combustion in I.C. engines using the Porous Medium Combustion Engine, called “PM - engine”.

S. Jaichandar and K. Annamalai [4], have discussed the effect of use of biodiesel fuel on engine power, fuel consumption and thermal efficiency are collected and analyzed with that of conventional diesel fuel.

Maro JELIĆ and Neven NINIĆ [5], have discussed the “Analysis of Internal Combustion Engine Thermodynamic Using the Second Law of Thermodynamic”. They used the numerical simulations in modeling the ICE engine processes together with the analysis by the second law of thermodynamics. They got a very potent tool for better insight and optimization of spark- and compression-ignition engines achieving lower fuel consumption and lower emissions.

N.H.S.Ray, M.K.Mohanty and R.C.Mohanty [6] have worked on “Biogas as Alternate Fuel in Diesel Engines”. They reviewed the current status and perspectives of biogas production, including the purification & storage methods and its engine applications. Lower hydrocarbon (HC), smoke and particulates emission has been reported in diesel engines operating on biogas diesel dual fuel mode.

C D Rakopoulos, E G Giakoumis, and D C Rakopoulos [7] 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 [8] 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. The parameters like speed of engine, fuel consumption and torque were

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measured at different loads for pure diesel and various combination of dual fuel. Break Power, BSFC, BTE and heat balance were calculated. Paper presents the test results for various blends ranging from 5% to 20%.

III. METHODOLOGY

In the present study, the mechanical property viz., the wear of the piston, piston ring and cylinder liner is investigated. The experiments have been conducted using diesel and then the fuel is blended with Honge oil.

The duration of test is considered for 2 hours, 4 hours and 6 hours run of the engine. The corresponding readings of surface roughness (R_a) values of the piston, piston ring and cylinder liner have been recorded by using the surface measurement test .The measuring points considered at top dead center (TDC), bottom dead center (BDC) and mid of TDC and BDC (MID).

IV. RESULTS AND DISCUSSION

The results of the test using Honge (H40) Biodiesel have been tabulated for the R_a values considering the conditions of 100% Diesel (B0) and blend of 60% Diesel + 40% Honge oil (H40) and the positions of the measurements for different components of the IC Engine are as follows;

a. Cylinder liner – five circumferential points at TDC, MID, BDC positions.

b. Piston – two positions on the TDC, two positions on the land and two positions on the skirt.

c. Piston ring - five circumferential points for two compression rings.

The comparison of the R_a values is done to investigate the surface roughness of the IC Engine 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 R_a values for Cylinder liner positions are tabulated in Table 1. The average of five circumferential measurement points is taken to plot the variation of R_a values and is shown in the Figure 1

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Table 1 R_a values for cylinder liner positions (B0 and H40)

Cylinder Liner Positions	R_a values in microns					
	2 Hrs (B0)	2 Hrs (H40)	4 Hrs (B0)	4 Hrs (H40)	6 Hrs (B0)	6 Hrs (H40)
Liner TDC	0.415	0.417	0.469	0.404	0.37	0.654
Liner MID	0.204	0.287	0.244	0.275	0.27	0.438
Liner BDC	0.694	0.586	0.785	0.570	0.573	0.724

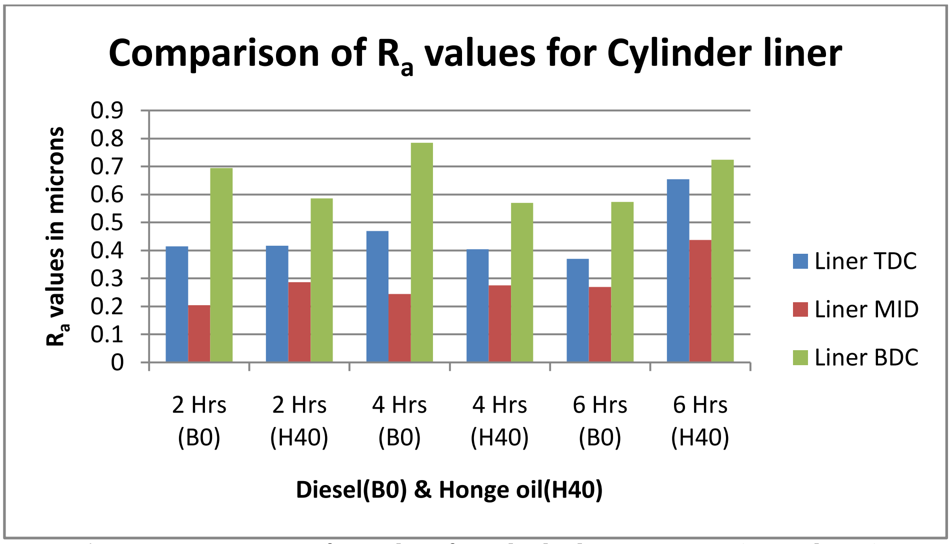

Figure 1 Comparison of R_a values for cylinder liner positions (B0 and H40)

From the above figure it can be concluded that R_a value of 0.204 microns is minimum at Cylinder liner MID - 2Hrs run with Diesel (B0).

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

Table 2 R_a values for piston positions (B0 and H40)

Piston Positions	R_a values in microns					
	2 Hrs (B0)	2 Hrs (H40)	4 Hrs (B0)	4 Hrs (H40)	6 Hrs (B0)	6 Hrs (H40)
Piston TDC	0.566	0.56	0.478	0.540	0.37	0.310
Piston Land	0.366	0.356	0.243	0.298	0.27	0.201
Piston Skirt	0.652	0.55	0.236	0.275	0.573	0.512

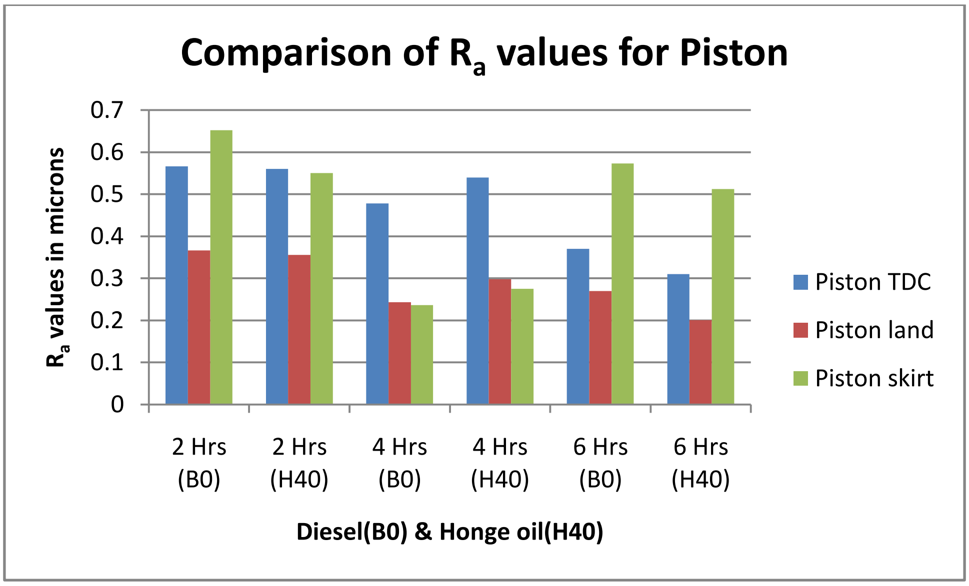

Figure 2 Comparison of R_a values for piston positions (B0 and H40)

From the Figure 2, it can be concluded that R_a value of 0.201 microns is minimum at Piston land – 6 Hrs run with blend of 60% Diesel + 40% Honge oil (H40).

The data pertaining to the R_a values for piston rings are tabulated in Table 3. The average of two measurement points is taken to plot the variation of R_a values and is shown in the Figure 3.

Table 3 R_a values for piston rings (B0 and H40)

Piston rings	R_a values in microns					
	2 Hrs (B0)	2 Hrs (H40)	4 Hrs (B0)	4 Hrs (H40)	6 Hrs (B0)	6 Hrs (H40)
Ring 1	0.73	0.18	0.72	0.28	0.086	0.32
Ring 2	0.65	0.17	0.37	0.23	0.134	0.23

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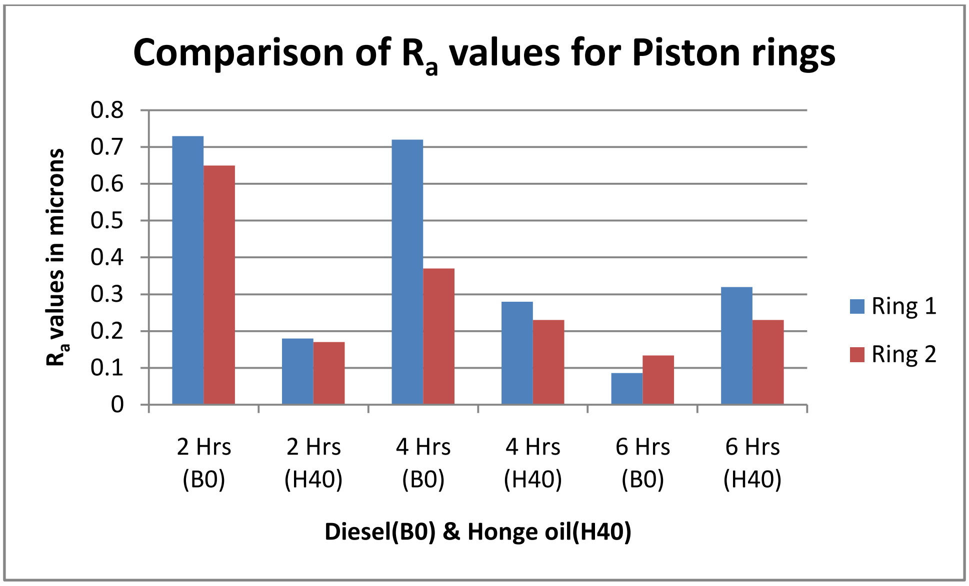

Figure 3 Comparison of R_a values for piston rings (B0 and H40)

From the above figure, it can be concluded that R_a value of 0.086 microns is minimum for piston ring1 – 6 Hrs run with Diesel (B0).

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

REFERENCES

[1]. WANG Wenzhong, HU Yuanzhong, WANG Hui & LIU Yuchuan, "Numerical simulation of piston ring in the mixed lubrication" State Key Laboratory of Tribology, Tsinghua University, Beijing 100084, China, 2001

[2]. ARKA GHOSH, "COMBUSTION CHAMBERS IN CI ENGINES" SRM University

[3]. Balvinder Budania, Virender Bishnoi, "A New Concept of I.C. Engine with Homogeneous Combustion in a Porous Medium" International Journal of Latest Trends in Engineering and Technology (IJLTET)

[4]. S. Jaichandar and K. Annamalai, "The Status of Biodiesel as an Alternative Fuel for Diesel Engine" Journal of Sustainable Energy & Environment 2 (2011) 71-75

[5]. Maro JELIĆ and Neven NINIĆ, "Analysis of Internal Combustion Engine Thermodynamic Using the Second Law of Thermodynamics"

[6]. M. JELIĆ et. al., A Review of Internal Combustion Engine, Strojarstvo 50 (2) 85-94 (2008)

[7]. N.H.S.Ray, M.K.Mohanty and R.C.Mohanty, "Biogas as Alternate Fuel in Diesel Engines" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 9, Issue 1 (Sep. - Oct. 2013), PP 23-28 www.iosrjournals.org

[8]. C D Rakopoulos, E G Giakoumis, and D C Rakopoulos, "Study of the short-term cylinder wall temperature oscillations during transient operation of a turbo- charged diesel engine with various insulation schemes" 4 February 2008

[9]. Er. Milind S Patil, Dr. R. S. Jahagirdar, and Er. Eknath R Deore, "Performance Test of IC Engine Using Blends of Ethanol and Kerosene with Diesel" International Journal of Engineering Science and Technology Vol. 2(8), 2010, 3503-3509