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Effect of Different Biodiesel blends (80% Diesel + 20% Biodiesel) on Tribological Property of I.C. Engine 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 fuel's chemical energy is first converted to thermal energy using combustion or oxidation with air inside the engine. This thermal energy raises the gases' temperature and pressure, and the high-pressure gas then expands against the engine's mechanical mechanisms. The machine's mechanical linkages convert this expansion to a rotating crankshaft, which is the engine's output. In turn, the crankshaft is connected to a transmission and power train to transmit the rotating mechanical energy to the desired final Use. For engines, this will often be the propulsion of a vehicle. The wear test reveals the effect of different Biodiesel blends (80%Diesel + 20%Biodiesel) on Tribological Property of I.C. Engine components viz., piston, piston rings, and cylinder liner. From the above discussions, it is evident that a blend of 80% diesel + 20% Hippe oil has better lubrication properties than diesel and other combinations of biodiesels considered.

Keywords -*, Diesel, Hippe oil, Surface roughness*

I.INTRODUCTION

Internal Combustion engine (I.C. engine), on the combustion of fossil fuel, high pressure, and high-temperature gases, makes the piston move. This reciprocating motion is converted into a rotary motion for industry, power generation, automotive, and marine applications. The chemical energy of the fuel is converted into mechanical energy in the process of conversion of energy. Tribology is the branch of engineering of studying interacting surfaces in the relative motion of two mating surfaces. Friction, wear, and lubrication are the fields of interest in the study of tribology. The large increase in the number of automobiles has resulted in great demand for petroleum products in recent years. 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.

II. LITERATURE REVIEW

The literature review has been carried out to understand the previous research on I.C. engine performance studies using alternative fuels. The contributions of the researchers have been discussed in the following paragraphs.
Wang Wenzhong et al. [1] used the reduced Reynolds equation method to find contact pressure in hydrodynamic lubrication of piston and cylinder contact regions. They found that piston and piston ring lubrication are the main factors that affect the I.C. engine's performance.

O M I NWAFOR, [2] investigated the diesel engine knock. Many factors have been identified to note the knock characteristics of dual-fuel engines. The factors were ignition delay, engine speed and load, gas flow rate, and turbulence.

A.S. Ramadhas et al. [3] have discussed using vegetable oils as alternative fuels for diesel engines. They found that vegetable oils are less polluting than fossil fuels. In their review, they discussed the characterization of vegetable oils and environmental work in different countries.

Avinash Kumar Agarwal [4] studied on biofuels (especially alcohols and biodiesel). The effect of biofuels on the performance and emission of I.C. engines was investigated. The Use of vegetable oils as biodiesel has been presented. The blending of biodiesel of any proportion with diesel was tested on I.C. engine performance and emissions. They also studied the economic feasibility of biodiesels.
Maro JELIĆ et al. [5] have developed the numerical simulations in modeling I.C. engine processes along with the thermodynamic second law analysis. They achieved lower values of fuel consumption and emissions.

C D Rakopoulos et al. [6] investigated aspects of transient heat transfer of material properties of the engine's wall. They developed the thermodynamic model with various insulation schemes.

III. METHODOLOGY

In the present study, the mechanical property viz., the wear of the piston, piston ring, and cylinder liner is investigated. The test duration 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 using the surface measurement test. The measuring points are considered at the top dead center (TDC), bottom dead center (BDC), and mid of TDC and BDC (MID).

IV. RESULTS AND DISCUSSION

The results have been tabulated for the R_a values considering the conditions of 100% Diesel (B0), blend of 80% Diesel + 20% Honge oil (H20), blend of 80% Diesel + 20% Hippe oil (M20), and blend of 80% Diesel + 20% Rice Bran oil (R20).

Table 1 Comparison of R_a Value for Cylinder liner with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

Cylinder Liner Positions	R_a values in microns											
	2 Hrs (B0)	2 Hrs (H20)	2 Hrs (M20)	2 Hrs (R20)	4 Hrs (B0)	4 Hrs (H20)	4 Hrs (M20)	4 Hrs (R20)	6 Hrs (B0)	6 Hrs (H20)	6 Hrs (M20)	6 Hrs (R20)
Liner TDC	0.415	0.412	0.401	0.421	0.469	0.409	0.398	0.381	0.37	0.337	0.339	0.305
Liner MID	0.204	0.208	0.198	0.218	0.244	0.248	0.224	0.256	0.27	0.266	0.212	0.224
Liner BDC	0.694	0.537	0.492	0.585	0.785	0.64	0.620	0.575	0.573	0.598	0.557	0.521

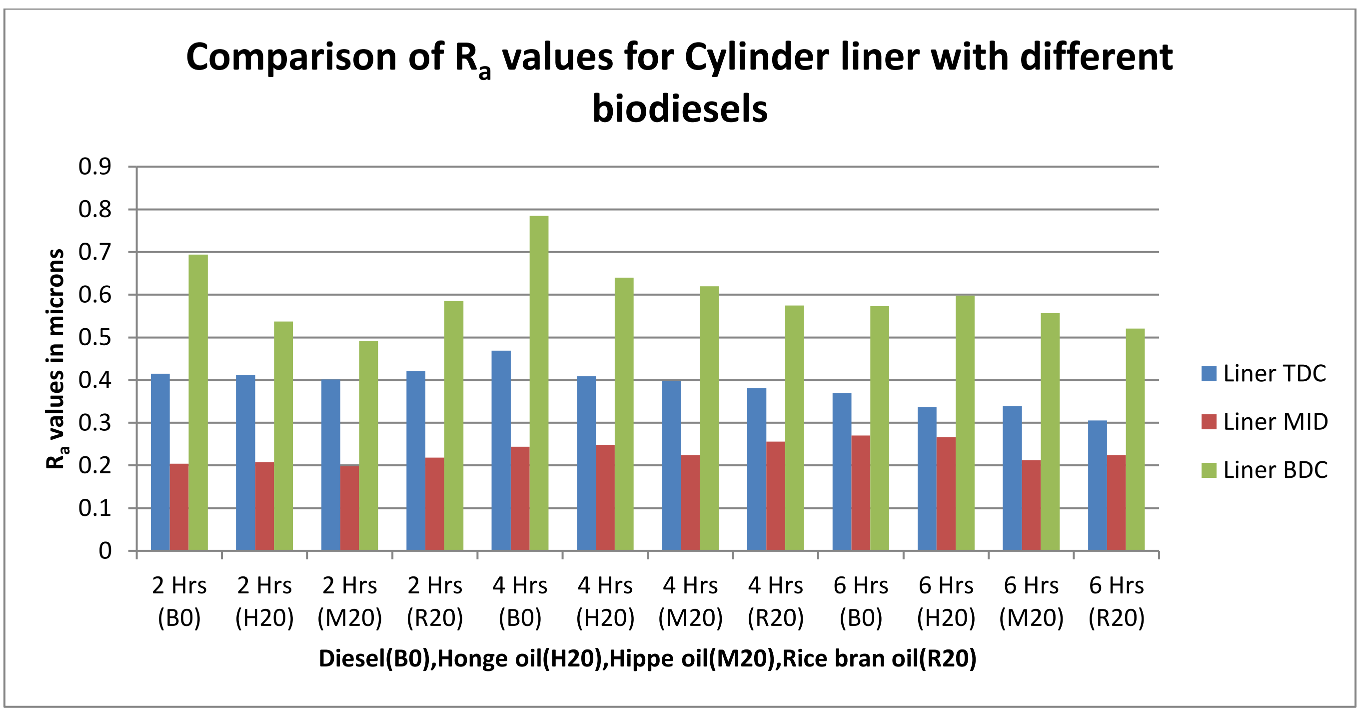

Figure 1 Comparison of R_a Value for Cylinder liner with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

Figure 1 shows that the Ra value of 0.198microns is minimum for Cylinder liner MID position for 2Hrs run with a blend of 80% Diesel + 20% Hippe oil (M20). It depicts the minimum amount of wear on the cylinder liner's middle surface, using a blend of 80% Diesel + 20% Hippe oil (M20).

The data about 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 Figure 2

Table 2 R_a Value for piston with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

Piston Positions	R_a values in microns											
	2 Hrs (B0)	2 Hrs (H20)	2 Hrs (M20)	2 Hrs (R20)	4 Hrs (B0)	4 Hrs (H20)	4 Hrs (M20)	4 Hrs (R20)	6 Hrs (B0)	6 Hrs (H20)	6 Hrs (M20)	6 Hrs (R20)
Piston TDC	0.566	0.490	0.333	0.881	0.478	0.311	0.147	0.845	0.37	0.412	0.301	0.586
Piston Land	0.366	0.306	0.239	0.268	0.243	0.544	0.206	0.421	0.27	0.315	0.202	0.532
Piston Skirt	0.652	0.398	0.339	0.487	0.236	0.321	0.216	0.384	0.573	0.618	0.312	0.373

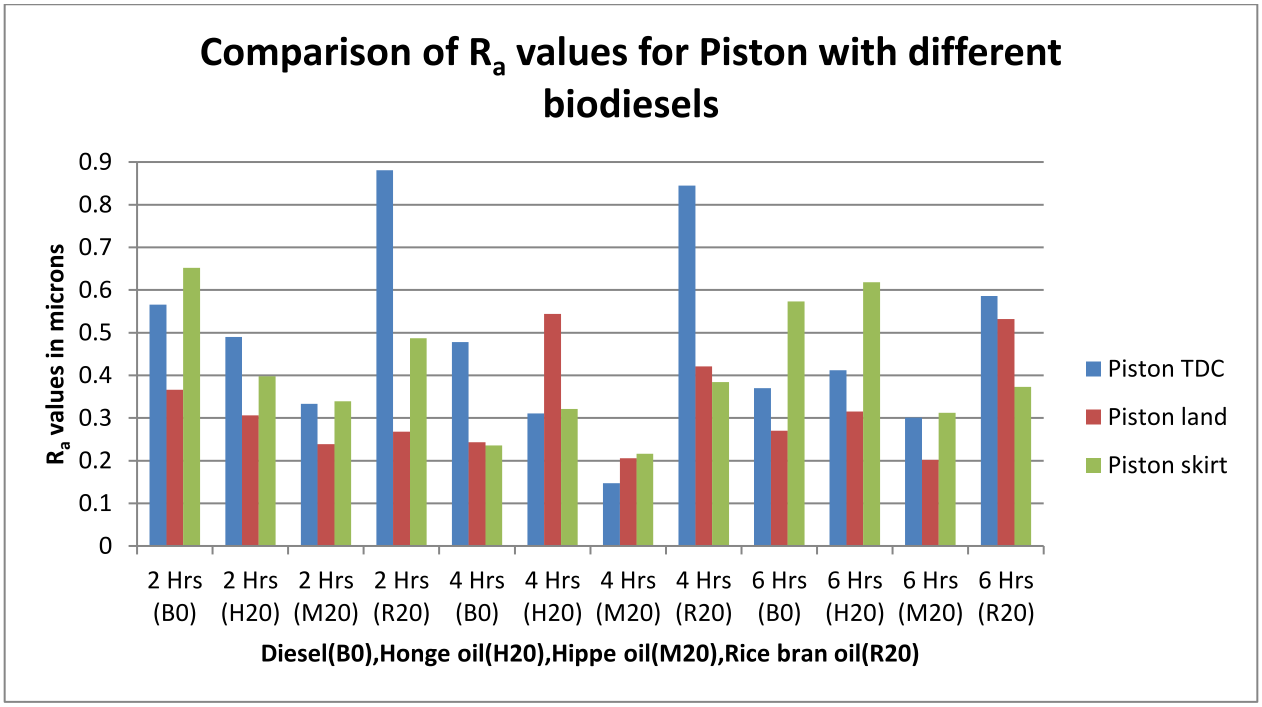

Figure 2 Comparison of R_a values for piston positions with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

Figure 2 shows that the Ra value of 0.202 microns is minimum at Piston land position for 6 Hrs run with a blend of 80% Diesel + 20% Hippe oil (M20). The same tribological character is observed for the piston surface as that of cylinder liner using a 20% blend of biodiesels.

The data about 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 Figure 3.

Table 3 R_a Value for piston ring with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

Piston Rings	R_a values in microns											
	2 Hrs (B0)	2 Hrs (H20)	2 Hrs (M20)	2 Hrs (R20)	4 Hrs (B0)	4 Hrs (H20)	4 Hrs (M20)	4 Hrs (R20)	6 Hrs (B0)	6 Hrs (H20)	6 Hrs (M20)	6 Hrs (R20)
Ring 1	0.73	0.36	0.098	0.1	0.72	0.54	0.042	0.122	0.086	0.07	0.054	0.08
Ring 2	0.65	0.22	0.102	0.178	0.37	0.04	0.086	0.068	0.134	0.091	0.06	0.084

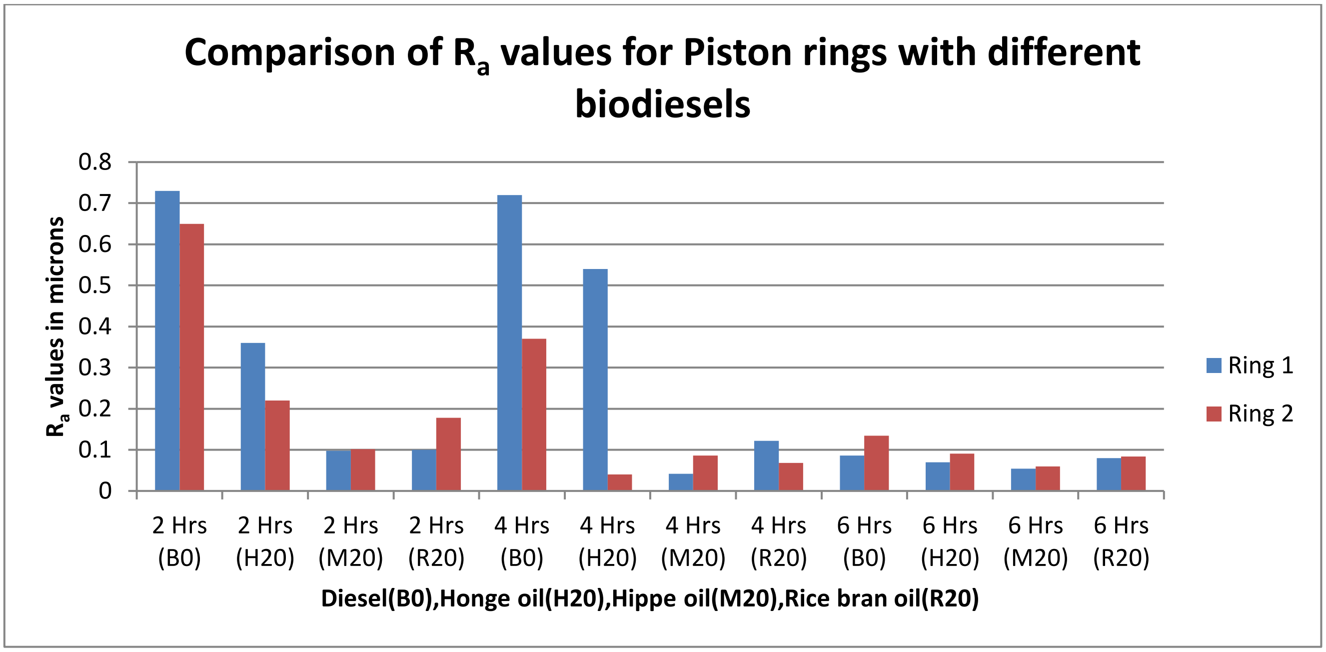

Figure 3 Comparison of R_a values for piston rings with Diesel (B0) and different Biodiesels (80% Diesel + 20% Biodiesel)

From Figure 3, it can be concluded that the R_a value of 0.04 microns is minimum for piston ring2 position for 4Hrs run with Honge-(H20). A similar trend follows the rings like that of cylinder liner and piston using a 20% blend of biodiesels.

V. CONCLUSION

The wear test reveals the effect of different Biodiesel blends (80%Diesel + 20%Biodiesel) on Tribological Property of I.C. Engine components viz., piston, piston rings, and cylinder liner. From the above discussions, it is evident that a blend of 80% diesel + 20% Hippe oil has better lubrication properties than diesel and other combinations of biodiesels considered.

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