Experimental Investigation of Effect of Hippe (M30) Biodiesel on Tribological Property of IC Engine New components

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Abstract. The importance of the alternative fuels is gaining importance as the design change of combustion process is very minimum or negligible. Hence it is apparent that the study of the factors which affecting the performance and the credibility of the engine as well. There are several researches undergoing to study the performance of the engines using alternative fuels. Choosing suitable alternate fuel for diesel engine may play a significant role in reducing surface wear of diesel engine components, and also in saving fuel costs. There are several researches undergoing to study the performance of the engines using alternative fuels. 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. Blend of 70% Diesel + 30% Hippe oil has better lubrication properties exhibited as compared to diesel. The results reveal that Ra value is improved significantly for the fuel blended with Hippe oil. Hence, the blending of the bio fuels not only reduces the emission, but also helps in maintaining the mechanical properties of the components of the engine.

Keywords: Hippe oil, Diesel, IC engine, Alternative fuels

1. Introduction

In internal combustion engine, the different components typically the piston experiences force due to high-temperature and high-pressure gases produced by combustion and then this force is transferred to some component of the engine to transform chemical energy into useful mechanical energy. There are several researches undergoing to study the performance of the engines using alternative fuels. Surface wear of diesel engine components results not only in higher cost of replacement or repair but also affects the performance of the engine. Choosing suitable alternate fuel for diesel engine may play a significant role in reducing surface wear of diesel engine components, and also in saving fuel costs. Hence, there is a chance for the improvement of performance of diesel engine that incorporates the alteration of existing technology with suitable alternate fuel. The studies reveal that the combustion performance and the emission are within the acceptable norms and are better than the fossil fuel run engines.

2. Literature survey

Wang Wenzhonget,al [1] used the method of reduced Reynolds equation to find contact pressure in hydrodynamic lubrication of contact regions of piston and cylinder. The main factors which affects the performance of IC engine are piston and piston ring lubrication.

O M I NW AFOR, [2] investigated the diesel engine knock. Many factors have been identified to note the knock characteristics of engines. The factors were ignition delay, engine speed and load, gas flow rate and turbulence.
A.S. Ramadhas et. al [3] have discussed the use of vegetable oils as alternative fuels. They found that vegetable oils are less polluting than fossil fuels. In this review they discussed characterization of vegetable oils and environmental work in different countries.

Avinash Kumar Agarwal, [4] studied on biofuels and effect of biofuels on the performance of IC engines was investigated. Blending of biodiesel of any proportion with diesel was tested on IC engine performance and emissions. They also studied the economic feasibility of biodiesels.

Maro JELIĆ et.al [5] have developed the numerical simulations in modelling IC engine 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 wall of the engine. They developed the thermodynamic model with various insulation schemes.

N.R. Banapurmatha et.al, [7] investigated the performance and emission characteristics of diesel engine run by Honge, Jatropha and Sesame oil methyl ester and found that use of biodiesel can be used in its pure form.

E. Abu-Nada I et.al [8] they developed a thermodynamic model to investigate piston friction during cold starting and running condition. They found that high viscosity of oil could reduce efficiency by more than 50%.

AtulDhar et.al [9] presented the measurement and instrumentation of the effect of thickness of lubricating oil between piston ring and cylinder liner. They validated the instrumentation for the measurement in running engine. The validation between 0.2 to 0.8mm was reported.

Sutaria B.M et.al [10] studied the performance of IC engine for tribological parameters developed using Reayholds equation. Friction force of piston, piston ring and lubrication oil film thickness were compared with the published articles.

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3. Methodology
In the present work, wear of the piston and piston ring is investigated. The experiments have been conducted using diesel and then the fuel is blended with Hippe oil. The materials of the components viz., piston and piston rings, considered for the present work is given in Table 1.

| Sl. No | IC Engine Component | Material                     |
|--------|---------------------|------------------------------|
| 1      | Piston              | AL Alloy                     |
| 2      | Piston Ring         | Chrome Inlaid keystone       |

The corresponding readings of surface roughness ($R_a$) values of the piston and piston ring have been recorded by using the surface measurement test equipment shown in the Figure 1. The two positions at piston TDC, at piston land and at piston skirt is considered for the measurement. The five circumferential measurement points are considered for the piston rings, Ring1 and Ring 2. The comparison of the $R_a$ values is done to investigate the wear of the IC Engine components considered for the study. The duration of the test is 2 hours, 4 hours and 6 hours running of IC Engine.

![Figure 1 Surface Roughness Measuring Equipment](image-url)
4. Results and Discussion

The results have been tabulated for the $R_a$ values considering the conditions of 100% Diesel (B0) and blend of 70% Diesel + 30% Hippe oil (M30) 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 $R_a$ 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 $R_a$ 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.

| Piston Positions | $R_a$ values in microns |
|------------------|-------------------------|
|                  | 2 Hrs (B0) | 2 Hrs (M30) | 4 Hrs (B0) | 4 Hrs (M30) | 6 Hrs (B0) | 6 Hrs (M30) |
| Piston TDC       | 0.564      | 0.501       | 0.612      | 0.390       | 0.633      | 0.369       |
| Piston land      | 0.365      | 0.230       | 0.41       | 0.280       | 0.51       | 0.235       |
| Piston skirt     | 0.651      | 0.439       | 0.721      | 0.392       | 0.744      | 0.352       |

**Figure 2.** Comparison of $R_a$ values for new piston (B0 and M30)
From the Figure 2, it can be concluded that $R_a$ value of 0.230 microns is minimum at piston land – 2 Hrs run with Hippe (M30).

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.

| Piston Rings | $R_a$ values in microns |          |          |          |          |          |
|--------------|-------------------------|----------|----------|----------|----------|----------|
|              | 2 Hrs (B0)              | 2 Hrs (M30) | 4 Hrs (B0) | 4 Hrs (M30) | 6 Hrs (B0) | 6 Hrs (M30) |
| Ring 1       | 0.71                    | 0.270     | 0.729     | 0.101     | 0.732     | 0.098     |
| Ring 2       | 0.62                    | 0.205     | 0.651     | 0.206     | 0.662     | 0.102     |

From the Figure 3, it can be concluded that $R_a$ value of 0.098 microns is minimum for piston ring1 - 6 Hrs run with Hippe - (M30).

5. Conclusions

The wear test reveal the effect of the combustion of diesel and blend of 70% Diesel + 30% Hippe oil on the wear of the materials of the IC Engine components viz., piston and piston rings. The blend of 70% Diesel + 30% Hippe oil has better lubrication properties exhibited as compared to diesel. The results reveal that $R_a$ value is improved significantly for the fuel blended with Hippe oil. Hence, the blending of the bio fuels helps in maintaining the mechanical properties of the components of the engine.

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