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Performance Test on Four Stroke Single Cylinder Water Cooled Diesel Engine by Methyl Esters of Olive Oil and Castor Oil with Additive

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Abstract— **With increase in the demand of petroleum products the prices of petrol and diesel are increasing worldwide. This trend is expected in years to come as the resources are also depleting. Hence alternative sources of energy for running our generators, automobiles etc. are being considered worldwide. The possibility of obtaining oil from plant resources has aroused a great interest and in several countries, vegetable oil after esterification being used as "Biodiesel". In the present work, Castor oil and Olive oils are blended with diesel and used as an alternate fuel for CI engines.**

Different proportions of fuel blends have been produced by the process of blending. The fuel properties of each blend are determined. The load test on 4-Stroke Diesel engine with rope brake dynamometer using blends of Castor oil and Olive oil with diesel are done. The performance parameters such as Power, Specific Fuel Consumption, Thermal Efficiencies, Mechanical Efficiency and Mean Effective Pressures are calculated based on the experimental observations of the engine and compared for different blends and also added additive to enhance the efficiency of engine. The sustainability of using alternate fuels in Diesel engines, especially the potential use of Castor oil and Olive oil as biodiesel have been brought to the fore through this work.

Keywords—component, formatting, style, styling, insert *(key words)*

I. Introduction (*Heading 1*)

Biodiesel is made through a transesterification process, which is a chemical process through which one ester is changed into another. When the original ester is reacted with an alcohol, the process is called alcolysis. The production of biodiesel using vegetable oil (an ester compound) and methanol (an alcohol) as the reagents. Vegetable oil is a triglyceride, which is essentially a glycerin molecule connected via ester bonds to three fatty acid molecules. During the reaction, the fatty acids of triglyceride molecule are cleaved and attached to the alkyl group of the alcohol, to form fatty acid alkyl esters which are biodiesel. In the present work, NaOH is used as catalyst in order to increase the rate of chemical reaction.

Esterification process equation:

$$\left\{\begin{array}{c} CH_2\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_1 \\ | \\ CH_2\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_2 \\ | \\ CH_2\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_3 \end{array}\right\} + 3\,CH_3OH \xrightarrow[(Catalyst)]{} \left\{\begin{array}{c} CH_3\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_1 \\ CH_3\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_2 \\ CH_3\text{-}O\text{-}\overset{\overset{O}{\|}}{C}\text{-}R_3 \end{array}\right\} + \left\{\begin{array}{c} CH_2-OH \\ | \\ CH-OH \\ | \\ CH_2-OH \end{array}\right\}$$

triglyceride *methanol* *mixture of fatty acids* *glycerol*

II. Methodology

A. Preparation of Biodiesel

Measure 250ml of vegetable oil by using measuring flask and place in a beaker. Place the beaker on the hot plate and heat it to 54^0. Mix 50ml of methanol with 1.4 grams of NaOH in a beaker until they dissolve as shown in figure 1. After reaching, the temperature mix biodiesel with methanol solution and stir well. The glycerine is settled down after keeping the solution for 24 hours as shown in figure 2. Now separate the glycerine from biodiesel using filter paper.

Fig. 1. Heating of flasks at 54^0

Fig. 2. Settlement of glycerine after 24 hours

The four stroke single cylinder diesel engine is shown in Figure: 3.The engine specifications are

BHP: 5HP

RPM: 1500rpm

Fuel: Diesel

Bore: 80mm

Stroke length: 110mm

Orifice diameter : 20mm

Fig. 3. Four stroke single cylinder diesel

III. Results And Discussions

A. *Performance Characteristics of Olive Oil*

B20 blend offers the best mechanical efficiency of all the mixtures and therefore seems to be the best mixture with regards to minimum frictional power as shown in Figure 4. B5 gives the least mechanical efficiency.

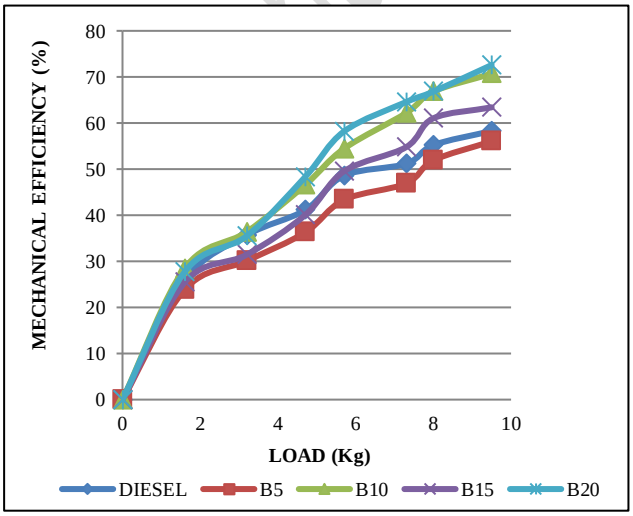

Fig. 4. Mechanical efficiency of olive oil Vs Load

B. *Performance Characteristics of Engine for Olive Oil and its Additive*

B5 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power B5 is having least Mechanical Efficiency as shown in Figure 5.

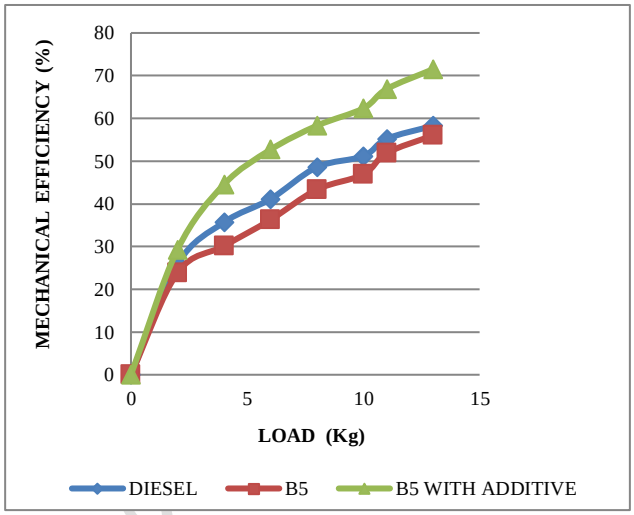

Fig. 5. Mechanical efficiency Vs Load for Diesel, B5 Olive oil and its additive

B10 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 6.

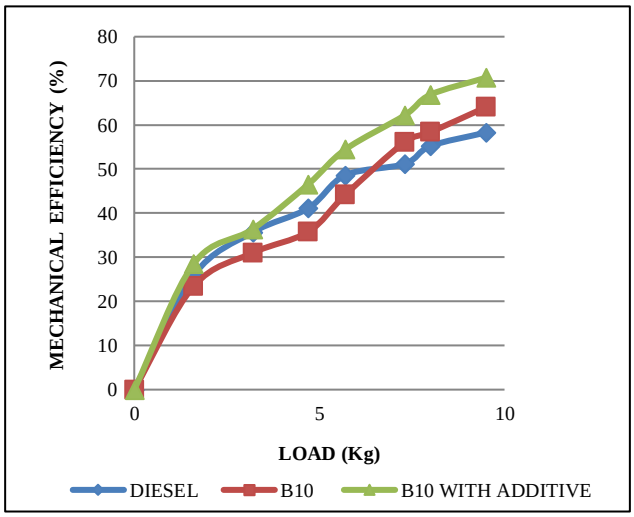

Fig. 6. Mechanical efficiency Vs Load for Diesel, B10 Olive oil and its additive

B15 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 7.

B20 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 8.

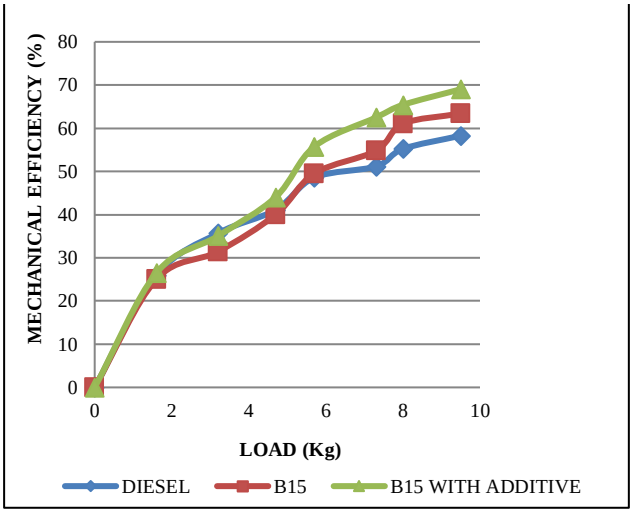

Fig. 7. Mechanical efficiency Vs Load for Diesel, B15 Olive oil and its additive

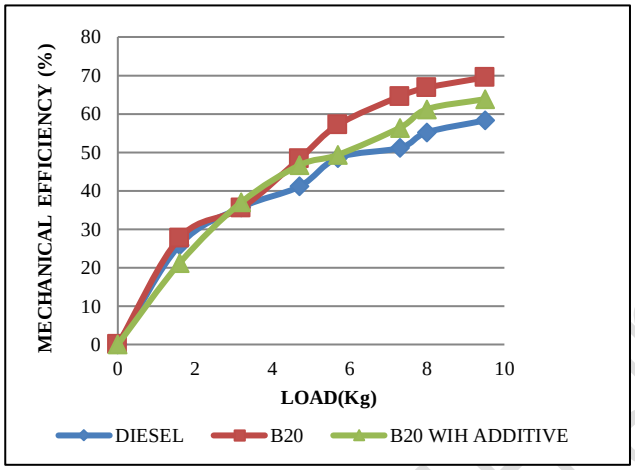

Fig. 8. Mechanical efficiency Vs Load for Diesel, B20 Olive oil and its additive

C. Performance Characteristics of Engine for Castor Oil

B20 blend offers the best mechanical efficiency of all the mixtures and therefore seems to be the best mixture with regards to minimum frictional power. Diesel gives the least mechanical efficiency as shown in Figure 9.

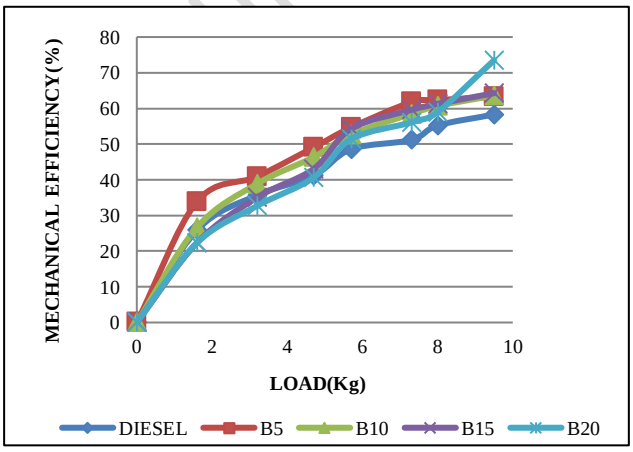

Fig. 9. Mechanical efficiency of Castor oil Vs Load

B5 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 10.

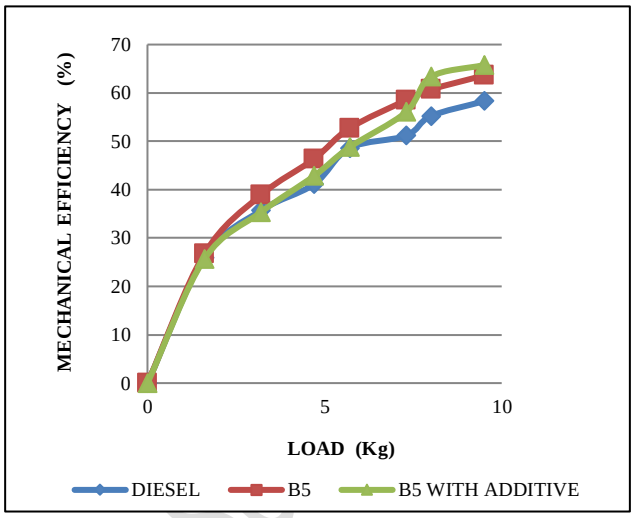

Fig. 10. Mechanical efficiency Vs Load for Diesel, B5 Castor oil and its additive

B10 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 11.

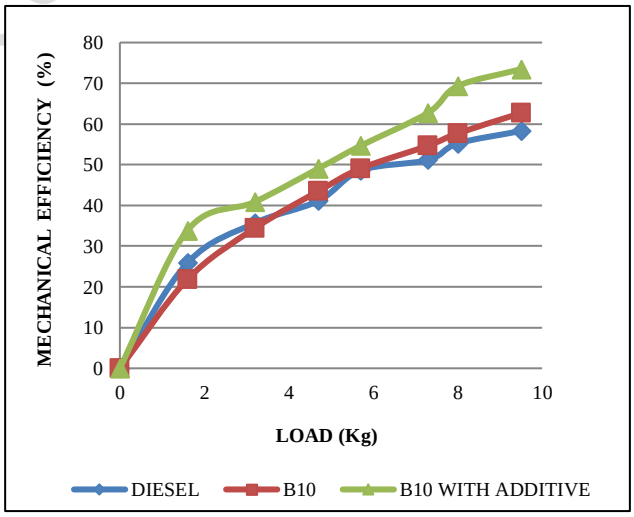

Fig. 11. Mechanical efficiency Vs Load for Diesel, B10 Castor oil and its additive

B15 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 12.

B20 with additive offers the best mechanical efficiency and therefore it seems to be the best mixture with regarding to the minimum frictional power diesel is having least Mechanical Efficiency as shown in Figure 13.

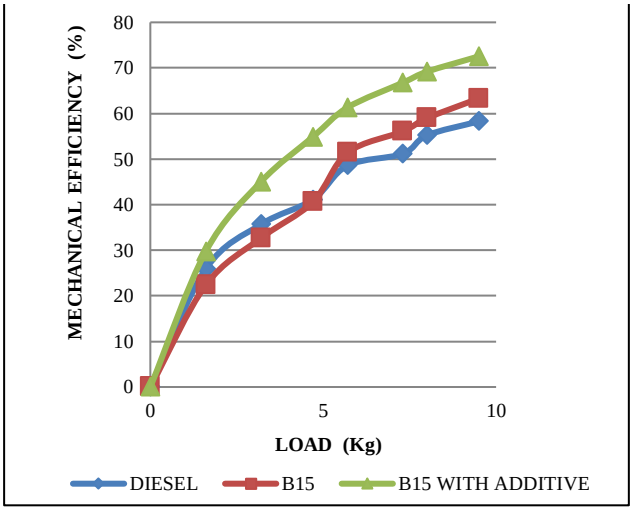

Fig. 12. Mechanical efficiency Vs Load for Diesel, B15 Castor oil and its additive

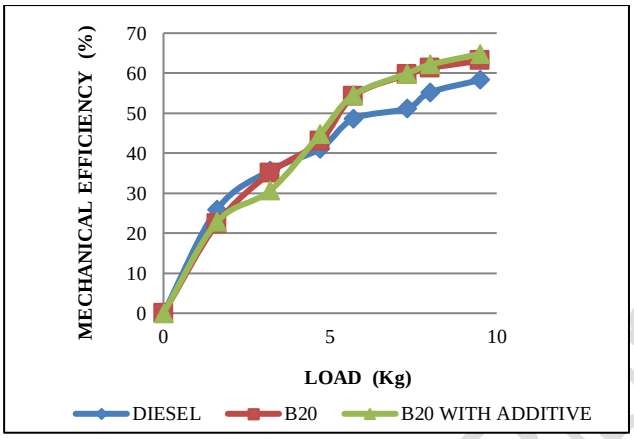

Fig. 13. Mechanical efficiency Vs Load for Diesel, B20 Castor oil and its additive

IV. Conclusion

From the experimental values of olive oil for various blends, the brake thermal efficiency is increasing for various blends than that of diesel. Out of various blends, B20 has higher efficiency of 3.27% than diesel. The mechanical efficiency is higher for blend B20 at different loads. The specific fuel consumption is less for blend B20. The volumetric efficiency is higher for blends than diesel.

From the experimental values of castor oil for various blends, the brake thermal efficiency is increasing for various blends than that of diesel. Out of various blends, B20 has higher efficiency of 4% than diesel. The mechanical efficiency is higher for blend B5 at different loads. The specific fuel consumption is less for blend B20. The volumetric efficiency is higher for blends than diesel.

From the experimental values of olive oil for various blends with additive, the brake thermal efficiency is increasing for various blends than that of diesel. Out of various blends B20 with additive has higher efficiency of 5.39% than diesel. The mechanical efficiency is higher for blend B20 at different loads. The specific fuel consumption is less for blend B20. The volumetric efficiency is higher for blends than diesel.

From the experimental values of castor oil for various blends with additives, the brake thermal efficiency is increasing for various blends than that of diesel. Out of various blends, B15 has higher efficiency of 5.37% than diesel. The mechanical efficiency is higher for blend B20 at different loads. The specific fuel consumption is less for blend B20. The volumetric efficiency is higher for blends than diesel.

Therefore, Castor oil with blend B20 with additive gives best performance with 5.3% higher break thermal efficiency than diesel. Castor oil with bend B20 with additive gives highest mechanical efficiency compared to other blends and diesel alone. Blend B20 of castor oil has least specific fuel consumption. Volumetric efficiency is offered better with all the blends of both the oils compared to diesel. From the above all, the blend B20 is the best among the blends of both the oils and castor oil gives the better performance compare to that of diesel.

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