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Analysis of effects of different blends of Linseed Biodiesel on the Performance of Four-Stroke Engine

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***Abstract:** As the increase in demand and more consumption of diesel and petrol the non-renewable resources are decreasing day by day. To utilize the consumption renewable sources are prepared on the economic level. Linseed oil is the non-edible oil. It is used for industrial purposes. To make biodiesel economically and ecologically suitable many researches are being done. The biodiesel is prepared from the Linseed oil by transesterification process and different blends are prepared with diesel (B15, B30, B45, B60) and different blends are tested on the Four-Stroke engine to check the performance parameters (Brake Thermal Efficiency and Brake-Specific Fuel Consumption).*
***Keywords:** Biodiesel, Linseed Oil, Blends, Transesterification process.*

I. INTRODUCTION TO LINSEED OIL

Linseed (Linum usitatissimum L.) belonging to Linaceae is an annual dicotylednous crop. Linseed oil is obtained by pressing, sometimes followed by solvent extraction. Linseed oil is a drying oil, meaning it can polymerize into a solid form. Due to its polymer-forming properties, linseed oil is used on its own or blended with other oils, resins, and solvents as an impregnator and varnish in wood finishing, as a pigment binder in oil paints, as a plasticizer and hardener in putty, and in the manufacture of linoleum [1].

Linseed oil is a common carrier used in oil paint. It can also be used as a painting medium, making oil paints more fluid, transparent and glossy. Traditional glazing putty, consisting of a paste of chalk powder and linseed oil, is a sealant for glass windows that hardens within a few weeks of application and can then be painted over. The utility of putty is owed to the drying properties of linseed oil.

Figure 1: Linseed Oil and Seeds

II. PRODUCTION OF BIODIESEL

Biodiesel is prepared by the Transesterification process. Trans esterification (also called alcoholises) is the reaction of a fat or oil with an alcohol to form esters and glycerol. This reaction requires heat and a strong catalyst to achieve complete conversion of oil into the separated esters and glycerin [2]. A catalyst potassium hydroxide (KOH) is usually used to improve the reaction rate and yield [3]. Because the reaction is reversible, excess alcohol is used to shift the equilibrium to the products side.

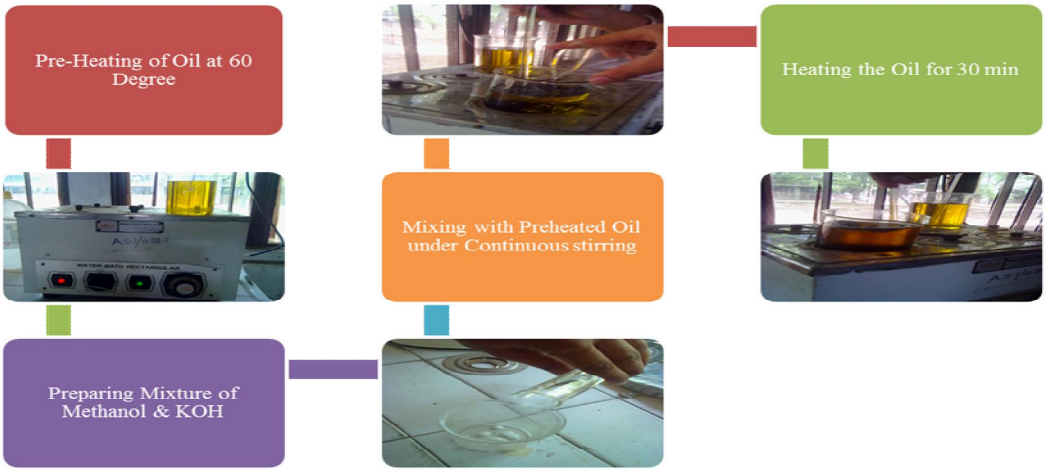

Figure 2: Process of Preparation of Methyl Esters (Biodiesel)

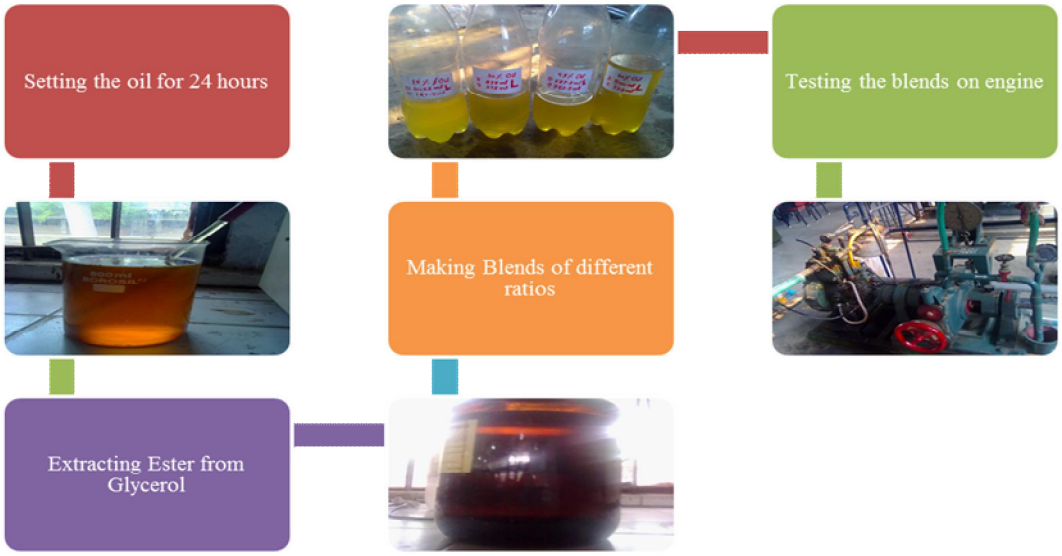

Figure 3: Process of Preparation of Biodiesel Blends

III. LABORATORY PROCEDURES FOR THE PRODUCTION OF LINSEED ESTER

Various steps used in preparation of ester from linseed oil are described as below [4]:

1) Step 1: Firstly the sample of Linseed oil was taken in a conical flask and preheated to 60^0C.

Figure 4: Pre-Heating Linseed raw oil on water-bath with stirrer

2) *Step 2:* Then methanol (1:7 by volume) and KOH (Potassium hydroxide pellets) (0.75% by weight) was mixed and stirred in a separate flask.

Figure 5: Mixing of KOH & methanol

3) *Step 3:* After that the stirred sample was added in the preheated linseed oil sample and again mixed properly by stirring.

Figure 6: Stirring of Linseed oil and mixture of KOH & methanol at constant temperature 60^0C

4) *Step 4:* This mixture was constantly stirred for 30 minutes at constant temperature 60^0C in water bath tank.

Figure 7: Stirring of Linseed oil and mixture for 30 min

5) *Step 5:* After this the stirred sample was taken out and was poured in a separating container to separate the glycerol from the methyl ester.

Figure 8: Pouring of mixture in separate container after stirring at constant temperature

6) *Step 6:* After 24 hours the glycerol was removed and separated to obtain the methyl ester.

Figure 9: Separations of biodiesel and glycerol [4]

Separation of biodiesel and glycerol takes place by gravity. The black part is glycerol in the separation container as shown in the Figure 10. Settling is carried out in the decanter for 24 Hrs and the settled glycerol will be drained out.

Figure 10: After 24 hours the glycerol sets down and methyl ester stay above

IV. PREPARING BLENDS OF LINSEED OIL AND DIESEL

After the transestarification of Linseed oil, the ester of oil and glycerol of transestarified oil is left below. The methyl ester of Linseed oil is separated by sucking it from beaker to a bottle with help of pipe. Then the blends of diesel and Linseed oil are prepared. We made four blends B15, B30, B45 and B60 of 1.25 litres each.

- B15 means 15% Linseed biodiesel and 85% diesel
- B30 means 30% Linseed biodiesel and 70% diesel
- B45 means 45% Linseed biodiesel and 55% diesel
- B60 means 60% Linseed biodiesel and 40% diesel

Figure 11: Blending of Linseed Oil with diesel with help of keep and measuring cup

V. TESTING OF BIODIESEL ON FOUR STROKE ENGINE

After preparation of various blends of biodiesel it is tested in engine to check the performance of engine. The Four Stroke Vertical single cylinder diesel engine was used for experimentation. The filter of the diesel engine was disconnected from its diesel tank and connected directly to fuel measuring unit [5]. The Diesel Engine is coupled to a Hydraulic dynamometer that acts as a loading device. The reaction torque of the dynamometer measured either using a spring balance and dead weight or a load cell. The engine and hydraulic dynamometer are directly coupled on a substantial base plate. The Engine has the following specifications

Table 1: Technical Specifications

Make	Greaves-Model1510
Engine Type	Four Stroke, Single Cylinder, Vertical
Bore	85mm
Stroke	90mm
Displacement	510cc
RPM	3000
BHP	10
Compression Ratio	17.5:1
Mode of Injection	Compression ignition
Cooling System	Air Cooled
Dynamometer	Hydraulic Dynamometer

VI. PERFORMANCE OF LINSEED BIO-DIESEL

A. Brake Specific Fuel Consumption

Brake specific fuel consumption (BSFC) is the ratio between mass fuel consumption and brake effective power, the loss of heating value of biodiesel must be compensated with higher fuel consumption. Fig. 12. compares the BSFC of pure diesel and its blends with Linseed oil biodiesel fuel. There was about higher specific fuel consumption when running on B15, B30, B45 and B60 than diesel fuel.

Table 2: BSFC of Blended Linseed oil in Kg/Kw.h

Load	B15	B30	B45	B60	B0
10	0.291024	0.330507	0.321051	0.324690	0.3608
15	0.201087	0.222366	0.217783	0.235178	0.2408
20	0.157763	0.168894	0.166247	0.181992	0.1822

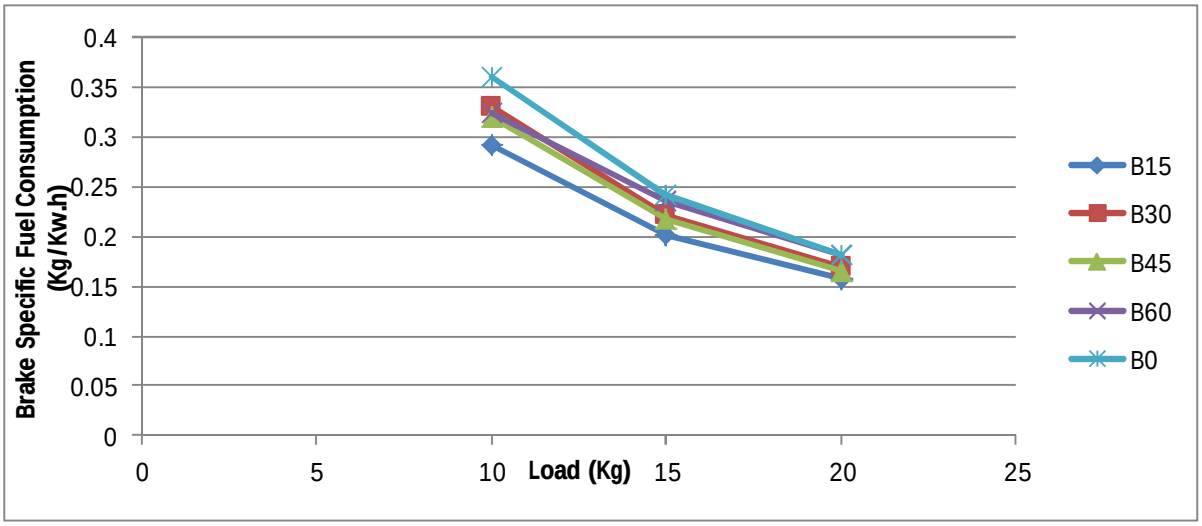

Figure 12: Variations of BSFC vs Load of Linseed oil blends with Diesel

B. Brake Thermal Efficiency

The variation of brake thermal efficiency with speed for different blends is presented in fig. 13. The brake thermal efficiencies were obtained to be 44% for B15, which was higher than that of all blends.

Table 3: Brake Thermal Efficiency of Blended Linseed oil

Load	B15	B30	B45	B60	B0
10	0.210027	0.184313	0.18432	0.18149	0.17
15	0.303990	0.27394	0.27172	0.25057	0.2537
20	0.387	0.36067	0.356126	0.3238	0.335

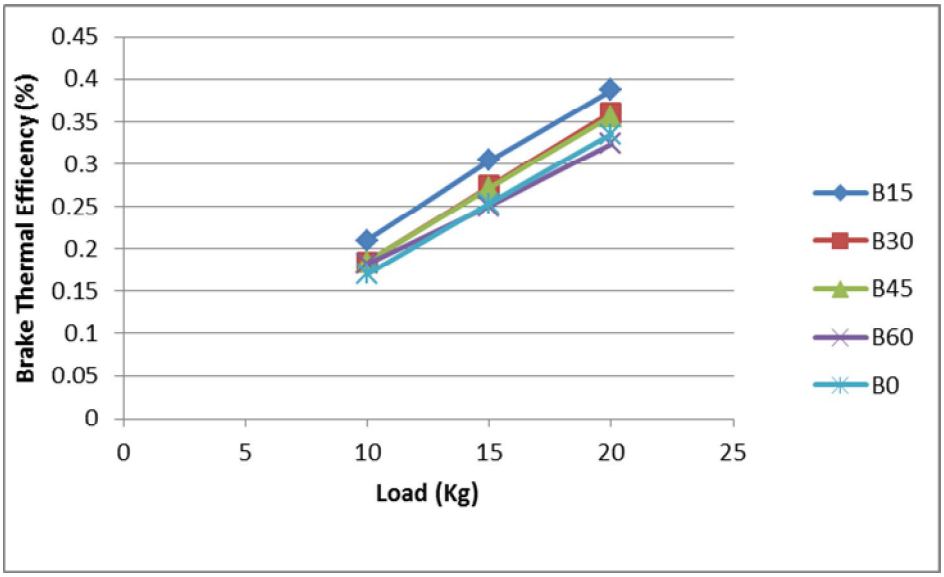

Figure 13: Variations of Brake thermal efficiency vs Load of Linseed oil blends with Diesel

VII. CONCLUSION

In the current investigation, it has confirmed that Linseed oil may be used as resource to obtain the bio diesel. The methyl esters of Linseed along with diesel may reduce the environmental impacts of transportation and also reduce the dependency on crude oil imports, and also provide employments in agricultural field. The conclusions are summarized as follows.

1) There was increase in Brake Thermal Efficiency of B15 as compared to Pure Diesel because of complete combustion.

2) Brake Specific Fuel Consumption has not much affected by the blending of oil with the diesel fuel.

From the study of Linseed oil, it has been found that the performance of biodiesel, mixture of 15% biodiesel & 85% diesel (B15) and compared with diesel and found that the brake power, brake thermal efficiency is greater than diesel. Linseed oil has potential as an alternative energy source. However, this oil alone will not solve our dependence on foreign oil within any practical time frame. Use of this and other alternative energy sources could contribute to a more stable supply of energy.

From the study of Linseed oil it has been found that the BSFC of B15 biodiesel blend was found to be higher than diesel fuel. As the proportion of biodiesel blend increased, the BSFC was observed to be increased. This is due to the higher density of biodiesel. As the percentage of blend increases the density also increases. Also, brake thermal efficiency is found to decrease with the increase in blend content B15, B30, B45 and B60. This is due to the higher viscosity of blends which led to the poorer atomization and poor combustion.

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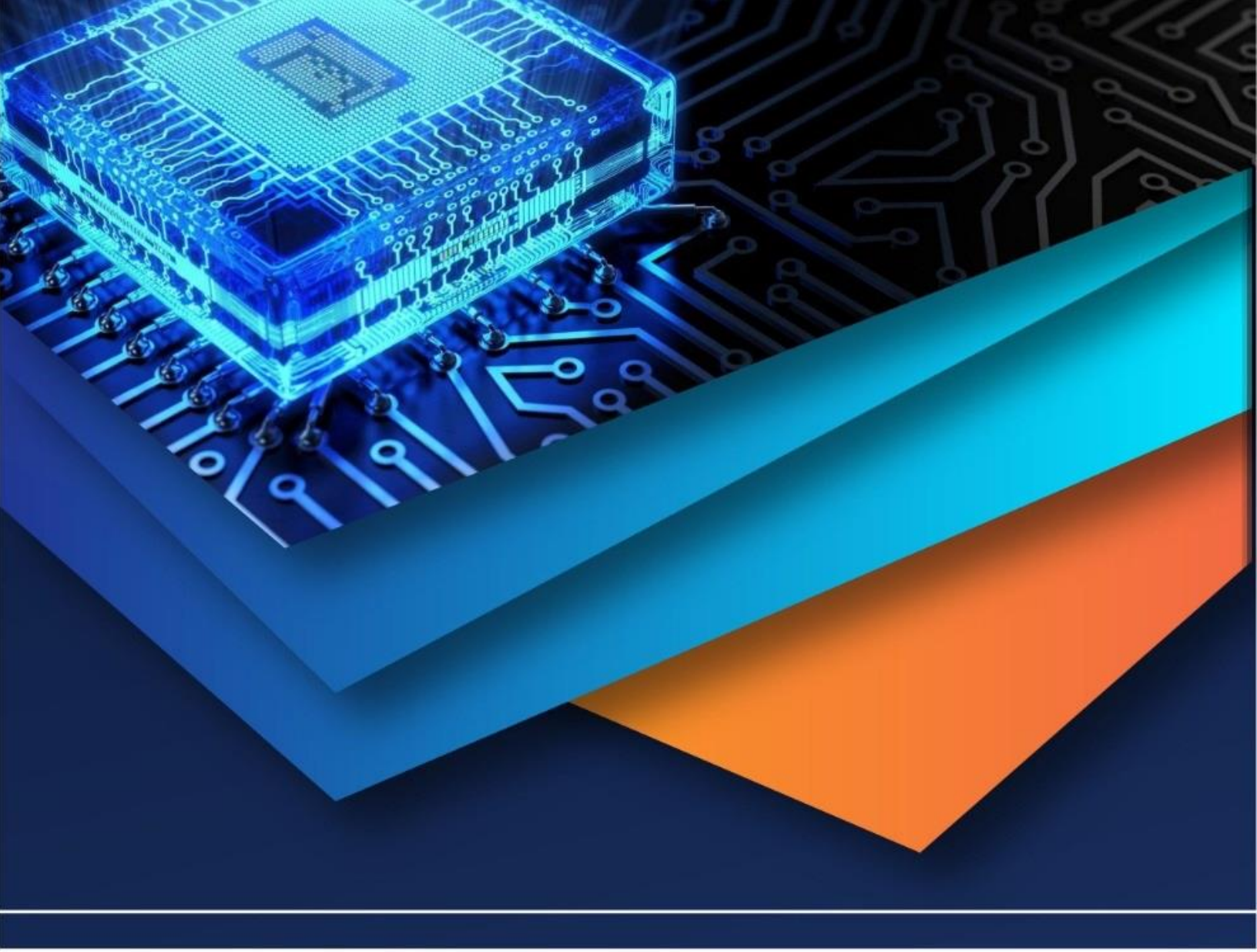

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