

Testing of Mixed Biodiesel on VCR Engine formed with Neem Oil and Sesame Oil

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KEY WORDS -

B10 (10% blend and 90% diesel), B20 (20% blend and 80% diesel), B30(30% blend and 70% diesel), FFA (Free fatty acid), Neem Oil Methyl Ester (NOME), Sesame Oil Methyl Ester (SOME), VCR (Variable compression ratio)

1. ABSTRACT

Stringent emission norms, Energy Crisis and environment degradation due to pollutants from automotive vehicles lead us to find the suitable alternative for petro-diesel. Non edible and edible grade vegetable oils are predominant feedstock for biodiesel production. Obviously biodiesel production from edible oil results in the high price of biodiesel. In some countries, non-edible oils such as *Jatropha curcas* or waste cooking oil are preferred due to their low price. Realistically, non-edible oils only cannot meet the demand of energy consumption therefore; it has to be supplemented from some edible oils. Operationally, biodiesel blends perform very similar to conventional diesel in terms of performance without major modifications of engine because the properties of biodiesel and conventional diesel are similar. The performance of blends of biodiesel is compared with diesel.

2. INTRODUCTION

Accordingly, in the recent years logical efforts have been made to persuade investigation in technique and use of vegetable oils as alternative to diesel in the CI engines. 'Azardiratchi' is the main biochemical component of the Neem that is used for medicinal purposes. Neem oil can be used for transesterification after the extraction of 'Azardiratchi'. The seed oil yield is 30–60% of the weight of the kernel. However this oil suffers from the problem of high FFA therefore transesterification process cannot be used to proficiently convert it to biodiesel.

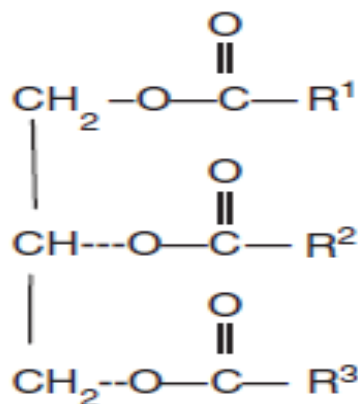


Fig. 1 Chemical Structure of Vegetable oil

These are cocking of injector nozzles, carbon accumulation on the parts of cylinder, dilution of crank case lubricating oil, glut wear on the rings, piston and cylinder and breakdown of the engine lubricating oil due to corrosion and polymerization. These problems have been linked gums, high thickness acidic composition, FFA content and low cetane ratings. It is crucial to understand and look forward to these evils before an exertion is made to use vegetable oils.

3. REVIEW OF LITRATURE

The diesel fuel molecules are saturated non-branched molecules with carbon atoms which range between 12 and 18, whereas vegetable oils are the combination of organic compounds which range from simple straight chain compound to complex arrangement of proteins and fat-soluble vitamins. Fats and oils are mainly water-insoluble, hydrophobic substances in the plant and animal kingdom that are made up of solitary mole of glycerol and triple moles of fatty acids and are commonly referred to as triglycerides. (Pryde, 1982).

2.1 Transesterification of Vegetable Oil

Vegetable oils have to go through the procedure of transesterification to be utilizable in IC engines. Biodiesel is the item for use after the process of transesterification. Biodiesel is recyclable, harmless and effectively liberated from sulfur; it is recyclable and can be formed from farming and plant assets. Biodiesel is

an substitute fuel, which has a connection with sustainable progress, energy preservation, supervision, competence and ecological perpetuation.

2.2 Use of edible vegetable oil as engine fuel

Worgetter(1981) approved out a series of experiments using a tractor fuelled with a blend of 50 % food grade quality rapeseed oil and diesel prepared on volume basis. The test showed a power thrashing after 100 hours. After 350 hours of test, the injection nozzle was found to have carbon residues which however, were deemed suitable for continued use of the manufactures.

2.3 Use of non-edible vegetable oils as engine fuel

A short term engine performance test of a direct injection, naturally aspirated, three cylinders, CI engine on pure Chinese tallow and stillingia oil and their blends with diesel in 25, 50, and 75 proportions (mass basis) was carried out. It was observed that the cetane rating and heat of combustion of blends were lower. Based on engine performance, 50 percent replacement of diesel with Chinese tallow and stillingia oil was recommended. However, fuel flow restriction problem in the filters requiring the use of a fuel pump was reported with pure oil or their blends having concentration more than 50 percent.

4. MATERIAL AND METHODS

4.1 Selection of Fuel Constituents

In this project, diesel oil is used as a reference fuel. Apart from diesel fuel, mixture of bio-diesels of Neem Oil Methyl Ester (NOME) and Sesame Oil Methyl Ester (SOME) and their blends are taken with diesel. Mixtures of all these fuels are taken in different proportion as an engine fuel to perform different experiments.

4.2 Preparation of Neem oil methyl ester (NOME)



Figure-4.1 A flask filled with mixture of methanol and sulphuric acid



Figure-4.2 Heating of Neem oil by Magnetic Stirrer Heater



Figure-4.3 Washing of NOME in a separating funnel



Figure-4.4 separation of NOME and glycerol

4.3 Preparation of sesame oil biodiesel or sesame oil methyl ester (SOME)



Figure-4.5 Separation of biodiesel from glycerol and excess methanol



Figure-4.6 Separation of water and biodiesel after Water washing of biodiesel

4.4 Mixing of NOME (NEEM OIL METHYLE ESTER) and SOME (SESAME OIL METHYLE ESTER)

After obtaining the two bio-diesel named NOME (Neem Oil Methylene Ester) and SOME (Sesame Oil Methyl Ester) by transesterification process as explained above in detail. The mixing of these two bio-diesels NOME (Neem Oil Methylene Ester) and SOME (Sesame Oil Methyl Ester) are carried out in the ratio of 50:50 to obtain blends of fuel. This mixture is then heated for 15 minutes at the maximum temperature of 60°C and atmospheric pressure.

4.5 Preparation of Fuel Blends

The viscosity of this mixture of Neem oil and sesame oil makes it unsuitable as a complete replacement of diesel for combustion engine. NOME and SOME and diesel blends were prepared by mixing all these oils. So this mixture is mixed with diesel in the ratio of 10:90, 20:80 and 30:70. These blends of mixed biodiesel and diesel are tested in engine for testing of performance characteristics. If this ratio of replacement of diesel gives the satisfactory results, there would be a saving

of diesel on the large scale. Moreover it many blends with different ratio can be formed to achieve more appropriate consequences. The description of the blends used in this experiment is given in the table 4.1.

S.No.	Fuel Types	Nomenclature
1.	Diesel	-
2.	Neem oil + Sesame oil	-
3.	10% (Neem oil + Sesame oil) + 90% Diesel	B10
4.	20% (Neem oil + Sesame oil) + 80% Diesel	B20
5.	30% (Neem oil + Sesame oil) + 70% Diesel	B30

Table 4.1: NOME + SOME+ Diesel Blends for Experiments

4.6 Test Engine

The setup consists of single cylinder, four strokes, VCR Diesel engine linked to eddy current dynamometer for loading.

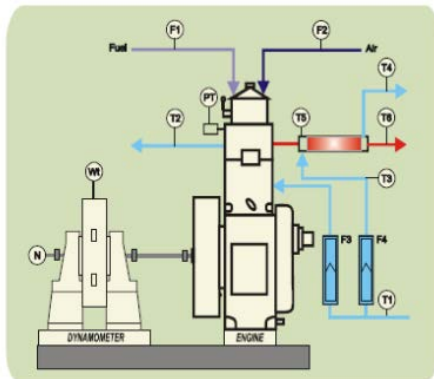


Figure-4.7 Block diagram of Engine Setup



Figure-4.8 A VCR Engine connected with computer system

4.7 Experimental Procedure

An eddy current dynamometer with electronic controller.

- i. A kirloskar make, 3.5 kW, steady speed of engine
- ii. A Software to estimate engine performance parameters.

4.8 Engine Performance Test

The performance of the engine was evaluated by conducting fuel consumption and rating tests as per **IS:10000[P: 8]:1980**.

4.9 Fuel consumption test

The fuel consumption test was carried out on fuels shown in Table 3.3. The performance of the engine on selected fuels was evaluated at the following load condition.

- i. No load
- ii. 3 kg load
- iii. 6 kg load
- iv. 9 kg load
- v. 12 kg load

5. RESULT AND DISCUSSION

The fuel properties such as kinematic viscosity, relative density of raw Neem oil, raw sesame oil, NOME, SOME as well as their blends with diesel were compared. A 3.5 kW, stationary, steady speed, single cylinder diesel engine was tested on diesel and selected NOME-diesel blends. The fuel consumption tests of the engine were performed as per **IS: 10000 [P: 8]:1980** and break power, specific fuel consumption, brake thermal efficiency were calculated.

5.3 Engine Performance on Selected Fuels

5.3.1 INDICATED POWER AND BRAKE POWER

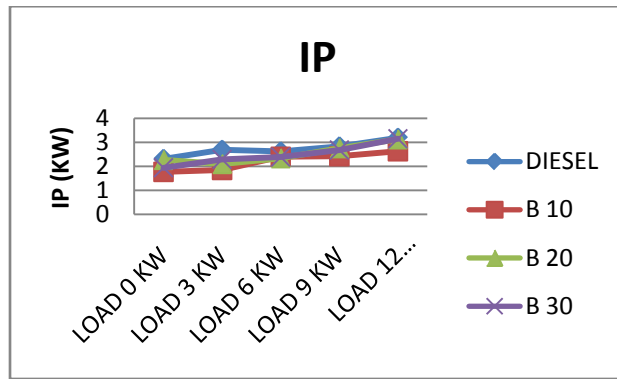


Figure-5.1 Indicated Power Produced by blends of diesel with NOME+SOME

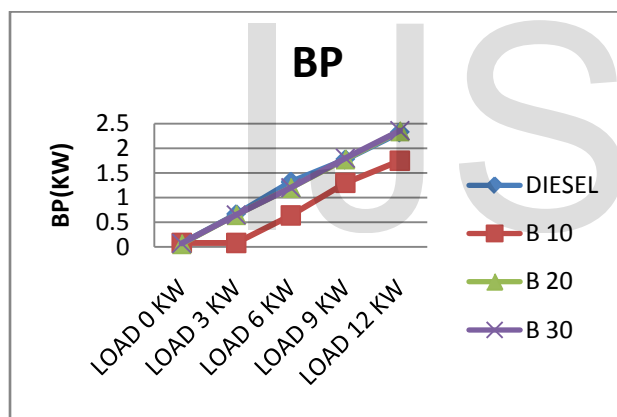


Figure-5.2 Brake Power Produced by blends of diesel with NOME+SOME

These figures indicate the Indicated power and Brake power. It is observed that blend B20 gives the result almost similar to that of diesel. IP and BP are increasing with increasing the load. This is favorable to our objective.

5.3.2 IMEP and BMEP

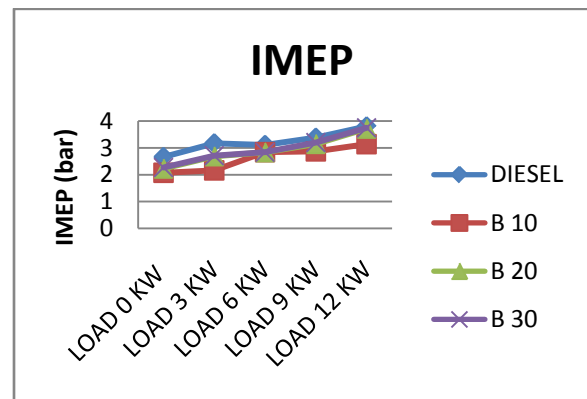


Figure 5.4 IMEP Produced by Diesel and its Blend with NOME+SOME

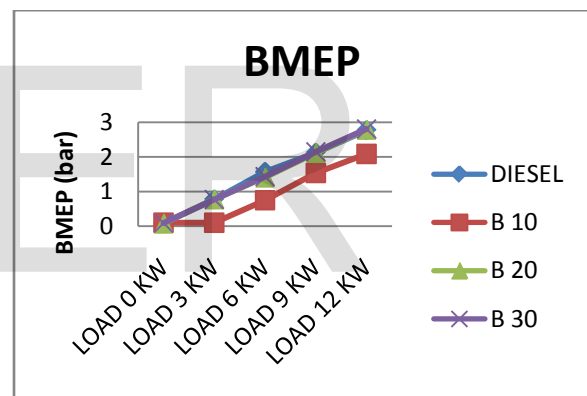


Figure 5.5 BMEP Produced by Diesel and its Blend with NOME+SOME

These figures indicate the Indicated mean effective power and Brake mean effective power. It is observed that blend B20 gives the result almost similar to that of diesel. IMEP, BMEP are increasing with increasing the load. This is favorable to our objective. Since we can say that till now the observation indicates that B20 blend is the suitable for replacement of pure diesel.

5.3.3 TORQUE, MECHANICAL EFFICIENCY AND VOLUMETRIC EFFICIENCY

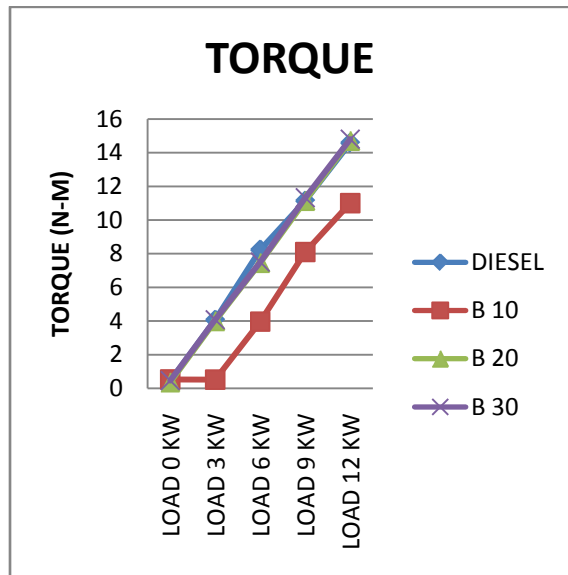


Figure 5.7 Torque produced by Diesel and its Blend with NOME+SOME

In these figure we can see that initially when engine is operating at no load, the torque is not produced. But as we increase the load the torque is increasing simultaneously. In the case of torque B30 blend gives the directly proportional graph and B20 behave like the diesel.

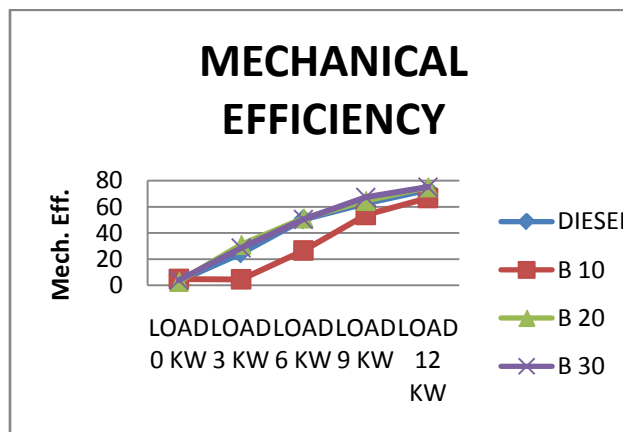


Figure 5.8 Mech. Eff. produced by Diesel and its Blend with NOME+SOME

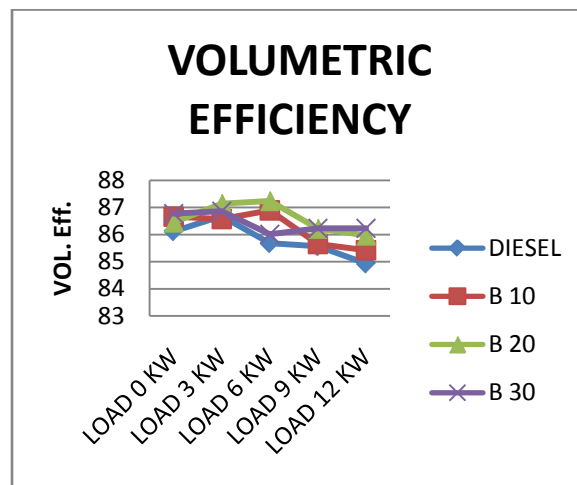


Figure 5.9 Vol. Eff. produced by Diesel and its Blend with NOME+SOME

Mechanical efficiency is increasing with load. But the volumetric efficiency initially increases and then decreases. The results for blend B20 is closer to the diesel.

1. SUMMARY AND CONCLUSION

A 3.5 kW, constant speed diesel engine was tested on diesel, NOME-diesel blends in 10:90, 20:80 and 30:70 ratios. The performance of the engine was found to be satisfactory on the blends. On the basis of the results obtained from the entire experiment the following conclusion can be drawn:

1. Two steps esterification is used to make the Neem oil biodiesel and Sesame oil biodiesel because FFA (free fatty acid) content in Neem oil and Sesame oil is very high.

2. The relative density of Neem oil and Sesame used in the experiment was higher than the diesel and NOME+SOME had the relative density higher than diesel.
3. The kinematic viscosity of Neem oil and Sesame oil used to make NOME and SOME was about 17 times higher than the diesel and NOME+SOME was about 3 times higher than the diesel.
4. The gross heat of combustion of Neem oil and Sesame oil is found to be higher than the diesel but NOME+SOME had the gross heat of combustion lesser than the diesel.
5. The performance evaluation of 3.5 kW diesel engine under the fuel consumption test on blends of NOME+SOME and diesel was found satisfactory on the basis of brake power, brake specific fuel consumption and brake thermal efficiency.
6. The engine performance was the best on B20 as the brake thermal efficiency was found to be highest.

The above discussion indicates that Neem oil methyl ester (NOME) + Sesame oil methyl ester (SOME) may be recommended as CI engine fuel. However for the better

performance of the engine B20 may also be recommended.

7. REFERENCES

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