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Castor oil Biodiesel an alternative fuel for Diesel in Compression Ignition Engine

S. S. Ingle [1], V. M. Nandedkar[2]
(Dept. of Production Engg., SGGS Institute of Engineering & Technology, Nanded, India)

ABSTRACT : *World's petroleum supply are getting constrained, attention has been directed to find out alternative sources of fuels for engines Biodiesel is receiving increasing attention each passing day because fuel properties and compatibility with petroleum- based diesel fuel. Therefore, in this research work, the prospects and opportunities of methyl esters of castor oil as fuel in an automobile is studied. Tests were conducted on a four stroke, single cylinder, D.I. diesel engine with Diesel and various blends of Biodiesel. The results of performance tests are compared with various blends of castor oil biodiesel with that of neat diesel. The result indicates that at blend B80, highest Brake thermal efficiency and lowest BSFC (Brake Specific Fuel Consumption) ,while for blend B 60, the Lowest fuel consumption is obtained.*

Keywords - *Brake Specific Fuel Consumption, eddy current dynamometer, Brake thermal efficiency etc*.

I. INTRODUCTION

The resources of petroleum as fuel are dwindling day by day and increasing demand of fuels, as well as increasingly stringent emission regulations, pose a challenge to science and technology. This aspect has drawn the attention to conserve and stretch the oil reserves by conducting research on alternative fuels. Therefore, research on biodiesel derived from vegetable oils and animal fats lead to the study of alternative to petroleum based diesel fuels. Vegetable oils, edible and non-edible, hold special promise in this regard, as they are locally produced and can be grown on barren land also. Vegetable oils such as soybean, coconut, sunflower, groundnut, castor oil etc. have been used and their performance reported by many researchers. These oils pose some problems when they are used without any treatment. Due to their long chain hydrocarbon structure, [8, 5] they have good ignition characteristics but have higher viscosity and have problem of carbon deposits, gum formation and poor thermal efficiency. Hence use of neat vegetable oils is not encouraging in the long run. Another drawback of edible oils is their high cost and shortage. Hence use of non-edible oils such as Jatropha curcas (Jatropha), Pongamia Pinnata (Karanja), Deccan hemp, castor oil etc. can be made upon by improving their properties [2,4]. To improve the properties of fuel such as viscosity and breaking down of higher hydrocarbons, the oil is esterified with low molecular weight alcohols. Generally methyl alcohol is used for esterification and hence these fuels are known as methyl esters. These oils (methyl esters) have properties similar to that of petroleum diesel and hence are also known as 'biodiesel' Biodiesel is a clean burning, renewable, non-toxic, biodegradable, environment friendly, transportation fuel. Biodiesel can be blended with petroleum diesel in different proportions and used or it can be used as a neat fuel (100%). A blend of 60% (by volume) biodiesel with petroleum diesel is designated as B60 fuel and when neat biodiesel is used it is denoted as B100. No engine modifications are required to be done when biodiesel is used [6,7]. Though castor biodiesel is costly, it is used in diesel engine for research purpose. The various blends of castor biodiesel are tested for performance characteristics. The properties of Castor oil biodiesel are given in Table 1.

II. EXPERIMENTATION

The performance characteristics of the engine were studied at different engine loads (6 Nm, 12 Nm, 18 Nm and 24 Nm at an average engine speed of 1500 rpm). At each load, the engine was stabilized for 20 minutes and then measurement parameters were recorded. The engine was loaded using the eddy current dynamometer. Experiments were carried out on a single cylinder, vertical, 4-stroke cycle, single acting, totally enclosed, water-cooled, compression ignition engine. Diesel, biodiesel (B100) and its blends B20, B40, B60, and B80 were used to test the engine of the specifications mentioned in Table.2. According to the results obtained, the graphs between BTE and Load, BSFC and Load and, mf and load are plotted [2].

Table 1. Properties of Castor oil biodiesel

Viscosity at 40°C	15.98 mm^2/s
Density @ 15^0C	0.9268 g/cm^3
Calorific Value	37908 kJ/kg
Cetane number	50
Ash content	0.02 %
Pour Point	-45°C
Visual appearance	Viscous pale yellow
Flash Point	190.7°C

Table 2. Properties of Castor oil biodiesel

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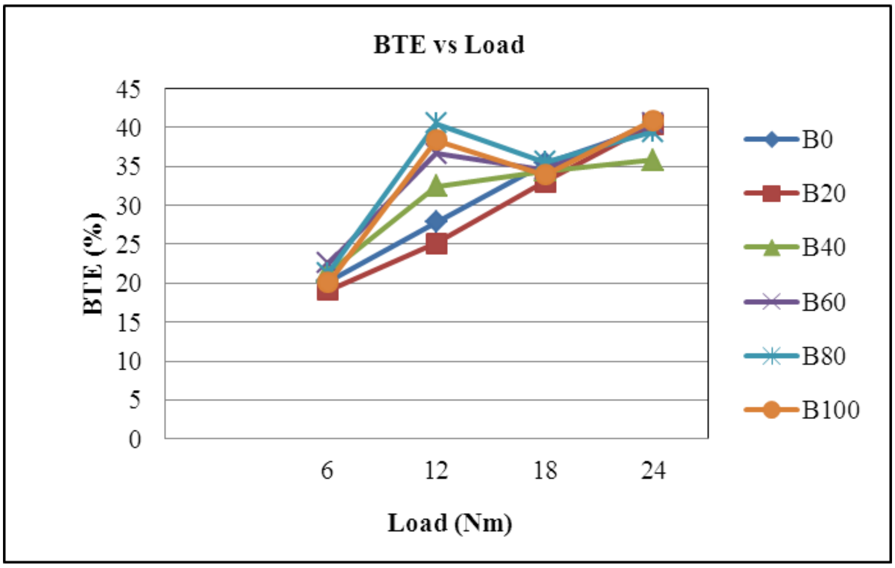

Fig.1 Graph of BTE vs Load.

III. RESULTS AND DISCUSSION

Fig. 1 indicates variation of brake thermal efficiency with respect to load for different blends . In all cases, brake thermal efficiency was having tendency to increase with increase in applied load. This was due to the reduction in heat loss and increase in power developed with increase in load. At atmospheric temperature all blends shows nearly 40% efficiency for full load. Thermal efficiency of the engine was improved with increase in concentration of the biodiesel in the blend. The possible reason for this is the additional lubricity provided by the biodiesel. The molecules of biodiesel (i.e. methyl esters of the oil) contain some amount of oxygen, which takes active part in combustion process. It is noticed that after a certain limit with respect to diesel ester blend, the thermal efficiency trend was reverted and it started decreasing as a function of the concentration of blend, this lowered brake thermal efficiency was obtained for B20 which could be due to the reduction in calorific value. The variation of brake specific fuel consumption with respect to BMEP is shown in Fig. 2. Brake specific consumption is found to decrease with increase in load. This is due to the higher percentage increase in brake power with load as compared to the increase in fuel consumption. But at no load conditions the developed brake power is less and hence the BSFC is more on that load for all blends. Using different blends at atmospheric temperature B80 shows lowest BSFC among all blends. The variation of fuel consumption with respect to load is shown in Fig.3. For all blends, m_f increases with increase in load. At B60 and B80, the fuel consumption is less as compared to other blends.

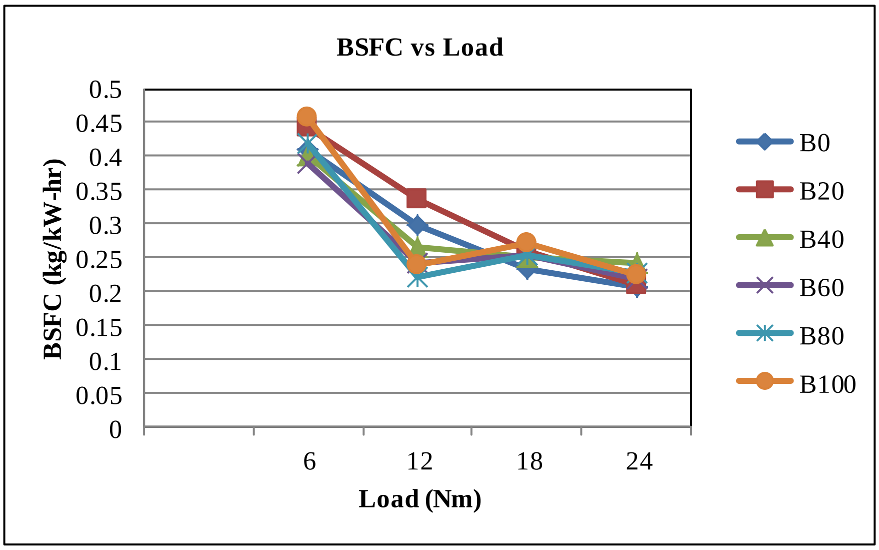

Fig. 2 Graph of BSFC vs Load.

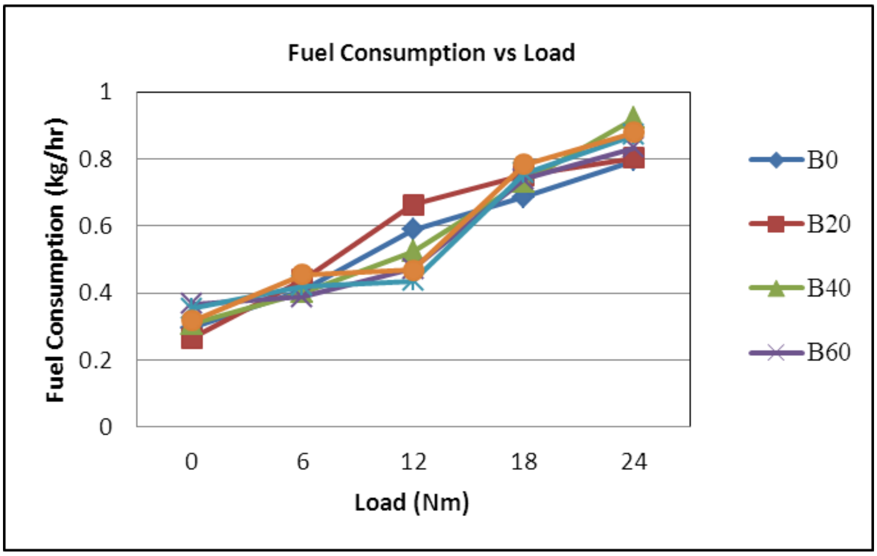

Fig.3 Graph of m_f vs Load

IV. CONCLUSION

The research aims to study the performance of castor biodiesel and its different blends with diesel and find the optimum blend to be used in diesel engine. B80 shows the overall optimum performance when used in Compression ignition engine. Also it is found that overall performance characteristics of castor oil biodiesel and diesel are similar. Hence, Use of castor biodiesel will increase the use of waste land and will generate rural employment. The Local production of biodiesel will save a huge amount of foreign exchange. This capital when invested in country will improve its financial structure.

Abbreviation:

BSFC - Brake Specific Fuel Consumption (kg/kW-hr)
BTE – Brake Thermal Efficiency (%)
m_f – fuel consumption (kg/hr)
B0 – Diesel
B20 - castor Biodiesel 20% +Diesel 80%
B40 - castor Biodiesel 40% +Diesel 60%
B60 - castor Biodiesel 60% +Diesel 40%
B80 - castor Biodiesel 80%+Diesel 20%
B100- castor Biodiesel 100%

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