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# INDIGENOUS CASTOR OIL BIODIESEL AN ALTERNATIVE FUEL FOR DIESEL ENGINE

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**Abstract:-** Rising petroleum prices, increasing threat to the environment from exhaust emissions and global warming have generated intense international interest in developing alternative non-petroleum fuels for engines. The present work aims to find out the prospects and opportunities of using methyl esters of castor as fuels in an automobile. The suitability of such fuels in transportation vehicles helps in saving foreign exchange and use can be made of locally available resources. Tests were conducted on a four stroke, four cylinder, D.I. diesel engine with Diesel and Biodiesel. The results of the emission tests on smoke meter are compared for 100% castor biodiesel (BC100) with that of neat diesel. No modifications were done on the engine. The results indicate that there is a reduction of 30% -35% in smoke density while using Biodiesel. It can be thus be concluded that methyl esters of castor oil can be used as a substitute for diesel fuel in automobiles.

**Keywords:** *smoke density, eddy current dynamometer, transesterification, methyl ester, foreign exchange etc.*

## 1. INTRODUCTION

Diesel engines dominate the field of commercial transportation and agricultural machinery due to its superior part load efficiency and lower cost of fuel. Due to increasing cost of petroleum in the international market and increased demand of fuel due to increasing number of vehicles, an alternative source for diesel is the need of the day. 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 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, [1] 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. 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'. These esters have much lower viscosity than parent oils. The process of producing methyl esters of oil is known as 'esterification'. Esterification is a simple process in which the oil is mixed with methyl alcohol and heated in presence of a catalyst. The products of the reaction are methyl ester (biodiesel) and glycerin. Glycerin being heavier,

settles down and oil which is lighter is removed from the top and used after washing and removal of moisture. 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 20% biodiesel with petroleum diesel is designated as B20 fuel and when neat biodiesel is used it is denoted as B100. No engine modifications are required to be done when biodiesel is used. Engine emissions are reduced except the oxides of nitrogen which increase.

Many researchers have reported the use of methyl esters of *karanja*, olive, rapeseed, mahua (*madhuca indica* oil), neem, coconut, *jatropha*, and waste vegetable oil in compression ignition engines. Raheman and Phadtare [2] have blended 20% (B20) to 80% (B80) of methyl ester of *karanja* oil in diesel and have reported that with B20 and B40 the emissions are reduced. Dorado et al [3] have tested a 3-cylinder, 4 stroke D.I. diesel engine for emissions using methyl ester of waste olive and have concluded that there is a significant decrease in most of the emissions except  $\text{NO}_x$  which increased by 81%. They have further stated that long duration tests are necessary to prove the quality of the fuel. Deccan hemp oil has been used by Hebbal et al [4] in a single cylinder engine. This oil is blended in diesel in different proportions and the results show that the emissions are increased. In this paper they have also compared the results with *jatropha* and *karanja* oil and report that with deccan hemp oil the thermal efficiency is higher, hydrocarbon emissions are reduced and exhaust gas temperatures are comparable to that of diesel. Mahua oil [6], soybean oil [7], waste vegetable oil methyl ester [8] and rapeseed biodiesel [9] have also tested in diesel engine for their performance and emissions.

N.L. Panwar and Hemant Y. Shrirame [11] studied the emission characteristics of a compression ignition engine operating on castor oil methyl ester. The test was carried out at a constant speed of 1500 rpm at different loads. The results show that with an increasing biodiesel percentage, there is decrease in CO and CO<sub>2</sub>. To find out the performance and emission of biodiesel prepared from castor seed oil, testing was undertaken with single cylinder compression ignition engine at variable loads. In present study the biodiesel derived from castor seed oil has been used.

The properties of castor oil biodiesel are given in Table 1.

Table 1. Properties of castor oil biodiesel

Density @ 15°C	: 0.9268 g/cm <sup>3</sup>
Viscosity at 40°C	: 15.98 mm <sup>2</sup> /s
Flash Point	: 190.7°C
Pour Point	: -45°C
Cloud Point	: -23°C
Specific gravity @ 15°C	: 0.9268 g/ml
Calorific Value	: 37900.8 kJ/kg
Visual appearance	: Viscous pale yellow
Ash content	: 0.02%
Cetane number	: 50

Table 2. Specifications of engine used

Make	Kirloskar
Type	Single-cylinder, four-stroke, compression ignition diesel engine
Stroke	110 mm
Bore	80 mm
Compression ratio range	16.5:1
Rated output	3.7 kW
Rated speed	1500 rpm
Dynamometer	Eddy current, water-cooled with loading unit

## 2. EXPERIMENTS

The experiments were conducted on a 4-cylinder, 4 stroke D.I. diesel engine. No engine modifications were done. The details of the engine specification are given below in Table 2. The speed of the engine was kept constant 1500 rpm while the load of the engine was varied from 0 to 24 Nm. The smoke density is measured by using smoke meter.

## 3. RESULTS AND DISCUSSION

The results of the emission tests from smoke meter are compared for 100% castor biodiesel

(BC100) and with that of neat diesel and graphs plotted.

### 3.1 Smoke density: for B0 and B100

The smoke density vs load is shown in Fig. 1 for Diesel (B0) and Castor Methyl Ester (CME) Biodiesel (B100), initially the smoke density increases but as load increases the smoke density decreases for castor biodiesel while for diesel smoke density increases with increase in Load of the engine. The reason attributed is due to complete combustion of the biodiesel fuel.

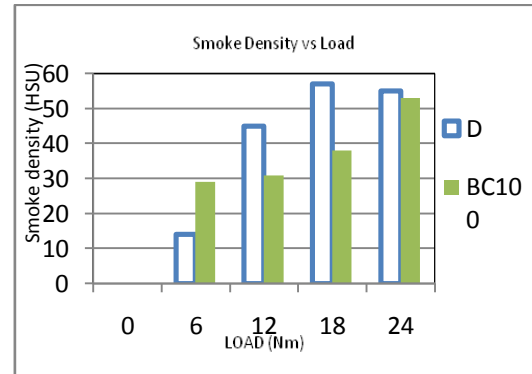


Fig. 1. Smoke Density vs Load

### 3.2 Fuel consumption

It is found that the average fuel consumption is 0.0001484 kg/s when working on diesel and 0.0001696 kg/s for castor biodiesel. The fuel consumption for biodiesel is approximately same for neat diesel and castor biodiesel. This indicates that biodiesel is a better alternative fuel to diesel. Fig. 2. shows the fuel consumption for Diesel and castor Biodiesel.

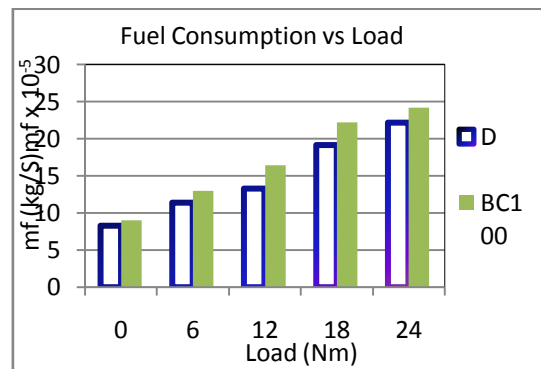


Fig. 2. Mass of fuel consumption vs Load

## 4. CONCLUSION

Based on the experimental work on a 4 stroke, 4 cylinder engine the following conclusions can be drawn:

- The engine run successfully on neat (100%) castor biodiesel.
- No engine modifications are required.

- Fuel consumption in both cases is nearly equal
- smoke density decreases by upto 30-35% with use of castor biodiesel.

The results of the tests prove that methyl esters of castor have a good potential of being used as a diesel engine fuel. CME can be alternately used as fuel for diesel engines. There is an urgent need to encourage the use of currently available biofuels as an intermediate step to prepare the world economy for more efficient alternatives in the transport sector.

#### **Abbreviation (for figures)**

D - Diesel

BC100- castor Biodiesel 100%

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