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Performance Analysis of Multi-Cylinder C.I. Engine by using Various Alternate Fules

N. BalajiGanesh[1],Dr. B Chandra Mohan Reddy[2]

[1]Assistant Professor, Mechanical Department, Aditya College of Engineering, Madanapalle, Andra Pradesh

[2]Assistant Professor, Mechanical Department, JNTUA Anantapur, Andra Pradesh

E-mail- balajiganeshn@gmail.com

Abstract: Modernization and increase in the number of automobiles worldwide, the consumption of diesel and gasoline has enormously increased. As petroleum is non renewable source of energy and the petroleum reserves are scarce nowadays, there is a need to search for alternative fuels for automobiles. The intensive search for alternative fuels for compression ignition engines has been focused attention on fuels which can be derived from bio mass in this regard cashew nut oil and cottonseed oil is found to be a potential fuel for C.I Engines. The properties of cashew nut oil and sunflower oil are determined by using standard methods. The experiment is to be conduct when the engine fuelled with mixing of cashew nut oil, cottonseed oil and its blends in various proportions like 10%, 20%, 30% and 40% by volume and then investigate the performance and emission characteristics of C.I Engine at different load conditions

Keywords: Alternate Fuels, Diesel engine, Cashew nut oil, Cottonseed oil

1. INTRODUCTION

In recent years, a lot of effort has been taken all over the world to reduce the dependency on petroleum products for power generation and transportation. Vegetable oils and biomass-derived fuels have received much attention in the last few decades. These fuels have been found to be potential fuels for an agriculture-based country like India. Biomass is a source of fuel, which is renewable, eco-friendly and largely available. Ethanol as a bio-fuel, derived from sugarcane, has been used in gasoline engines for many years. However, bio-fuels are, in general, 3–5 times more expensive than fossil fuel.

Vegetable oils have been found to be a potential alternative to diesel. They have properties comparable to diesel and can be used to run a compression ignition engine with minor modifications. The use of vegetable oils will also reduce the net CO2 emissions. Altin Recep et al. studied the effect of vegetable oil fuels and their methyl esters injected in a diesel engine. They observed that vegetable oils lead to problems such as gum formation, flow, atomization and high smoke and particulate emissions. Due to its complex structure and composition, gas phase emissions are higher. In order to use these fuels in diesel engines, high compression ratio and ignition assistance devices are required.

In the light of above, it becomes essential to search for alternative fuel, which can replace the petroleum products. The production of Cashew nut shell liquid is very simple and its auto-ignition properties are almost same as that of diesel fuels hence can be used in diesel engines with little or no engine modifications. Based on these facts, cashew nut shell liquid can be used as a substitute of diesel fuel.

India is the fifth largest cotton producing country in the World today, the first-four being the US, China, Russia, and Brazil. Our country produces about 8% of the World cotton. Cotton is a tropical plant.

It is a vegetable oil extracted from the seed of cotton, after the cotton lint has been removed after being freed from the linters, the seeds are shelled and then crushed and pressed are treated with solvent to obtain the crude cotton seed oil. Cotton seed oil is one of the most widely used oil and it is relatively in-expensive and also readily available.

An objective of the present work aims to find out suitability of cashew nut oil, cottonseed oil and its blends with diesel. In this project cashew nut oil and cottonseed oil - diesel blends are taken up for study on 10HP, Multi cylinder, four stroke, water cooled

AMBASSADOR diesel engine and performance for different blends is tested and performance curves are drawn. Gasoline either partially in the form of a blend or as a total replacement

2. EXPERIMENTAL INVESTIGATION

The experiments were conducted by considering various parameters. The tests were conducted for cashew nut oil, cottonseed oil and its blends at different proportions (10%, 20%, 30% and 40%) for conventional engine. The tests were conducted from no load to maximum load conditions. The readings such as time taken to consume 20cc of fuel consumption, speed of the engine, temperatures, etc, were noted. The observations were recorded in tabular column and calculations are made using appropriate equations.

The experiments were conducted on a Multi cylinder Hindustan four stroke diesel engine. The general specifications of the engine are given in Table-1. By taking the engine performance and plot the graphs

"Hindustan" engines for generating sets are fuel efficient, with the lube oil consumption less than 1% of S.C.F. lowest among the comparable brands. They are equipped with heavy flywheels incorporating 4% governing on the fuel injection equipment. This complete avoids voltage functions. In case of emergency, the unique overload stop feature safeguards equipments by shutting down the engine automatically

Table-1. Engine specifications.

Item	**Specifications**
Engine power	10 H.P
Cylinder bore	84 mm
Stroke length	110 mm
Arrangement of cylinder	Vertical
Engine speed	1500 rpm
Compression ratio	15:1

Table 2: Properties of Diesel, cashew nut oil and cottonseed oil

Properties	Diesel	Cashew nut oil	Cottonseed oil
Calorific value (kJ/kg)	42000	37300	38000
Density at 30 ^{0}C (kg/l)	0.85	0.902	0.912
Viscosity at 40	2.7	49.62	55.61

^{0}C,			
Flash point	52	167	207
Fire point	65	180	230
Cetane number	50	49	52

Table 3: Proportions of Diesel, cashew nut oil and cottonseed oil Blends

S.NO	BLENDS	DIESEL,% Vol	CASHW NUT OIL,% Vol	COTTON SEED OIL,% Vol
1	Diesel fuel	100	0	0
2	B10	90	5	5
3	B20	80	10	10
4	B30	70	15	15
5	B40	60	20	20

Fig 1:- Test rig engine

COMPONENTS OF EXPERIMENTAL SETUP

Manometer

Fig 2: Manometer

Loading System

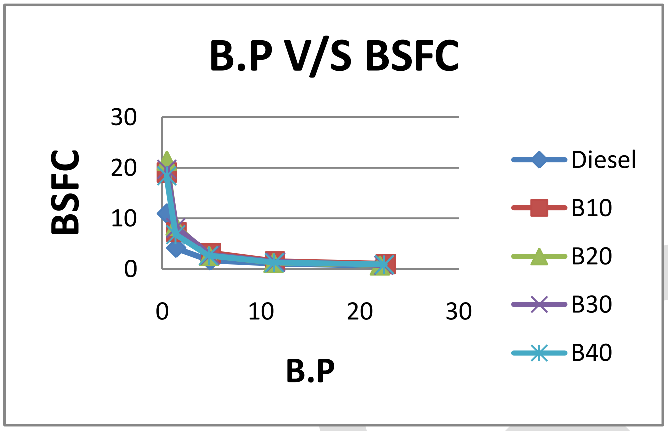
Fig 3: Dynamometer

Air box system

Fig 4:- Load indicator

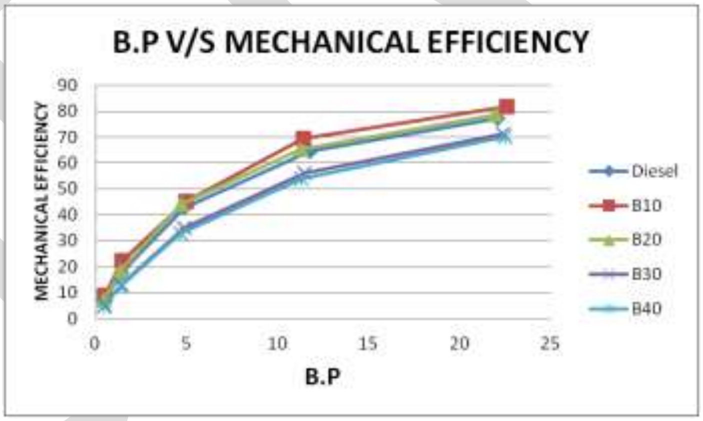
3. Results and Discussions

Graph No.1: Brake power Vs Specific fuel consumption



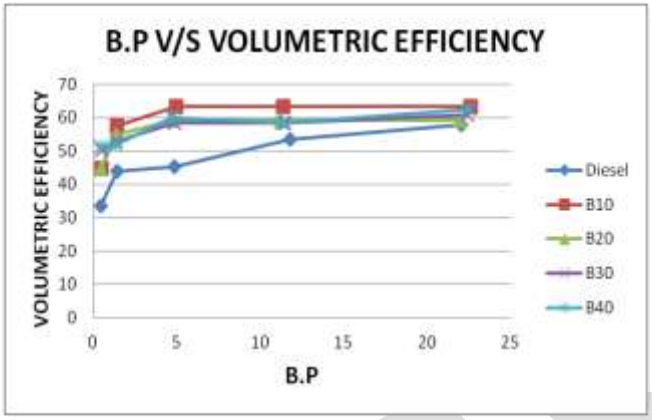
In the above graph Brake power is taken in x-axis and is taken BSFC in y-axis. The BSFC of the blends has been compared with diesel fuel at various loads and it is shown in figure. It is observed that the BSFC is less for the B20 Over the entire range of load.

Graph No 2: Brake power Vs Mechanical Efficiency



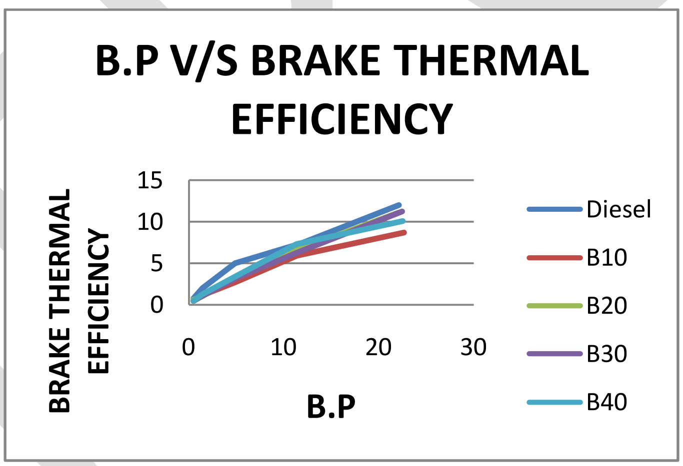
In the above graph Brake power is taken in x-axis and Mechanical Efficiency should be taken in y-axis. The Mechanical efficiency of the blends has been compared with diesel fuel at various loads and it is shown in figure. It is observed that the Mechanical Efficiency for B20 blend was considering Higher over entire load range

Graph No 3: Brake power Vs Volumetric efficiency



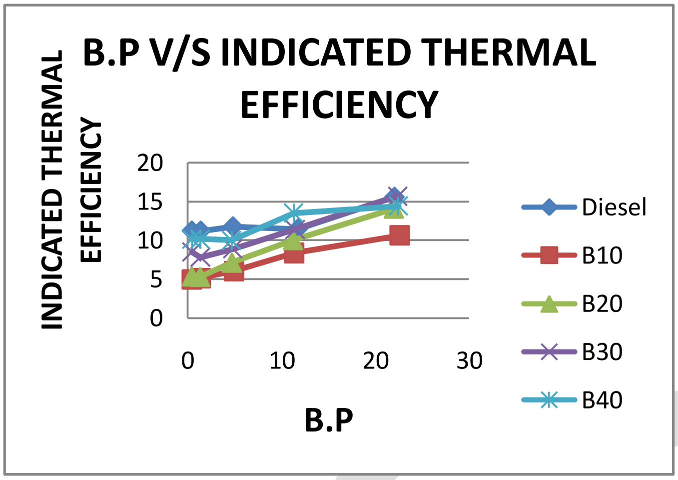
In the above graph Brake power is taken in x-axis and Volumetric Efficiency should be taken in y-axis. The volumetric efficiency of the blends has been compared with diesel fuel at various loads and it is shown in figure. It is observed that the Volumetric Efficiency for B40 blend was considering Higher over entire load range.

Graph No 4: Brake power vs Brake thermal efficiency



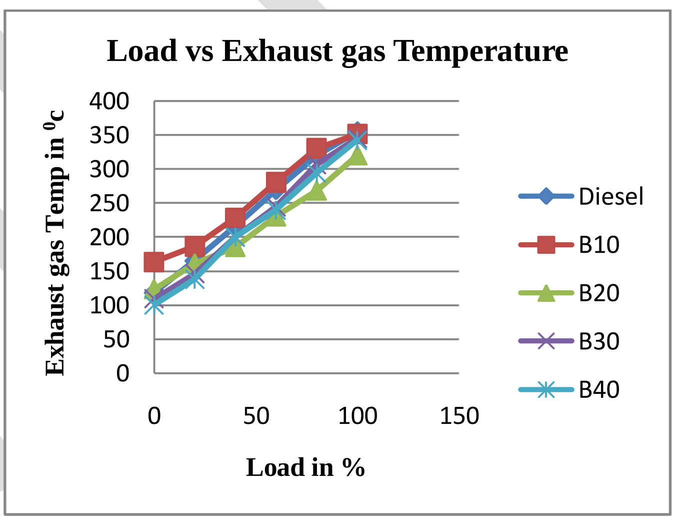
In the above graph Brake power is taken in x-axis and Brake Thermal Efficiency should be taken in y-axis. The Brake Thermal efficiency of the blends has been compared with diesel fuel at various loads and it is shown in figure. It is observed that the Brake Thermal Efficiency for B40 blend was considering higher for first three loads remaining B20 is higher over the other blends operation over entire load range.

Graph No 5: Brake Power v/s Indicated thermal efficiency



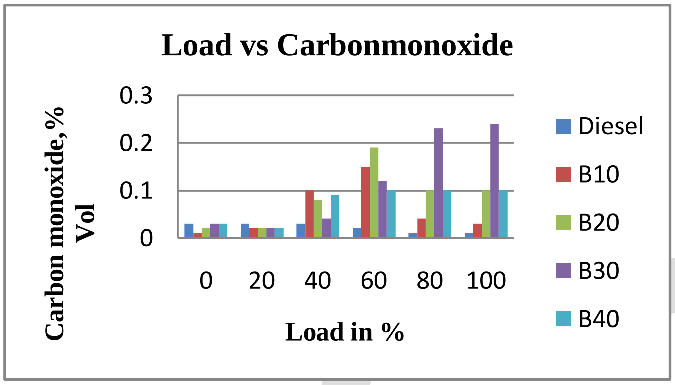
In the above graph Brake power is taken in x-axis and Indicated Thermal Efficiency should be taken in y-axis. The Indicated Thermal efficiency of the blends has been compared with diesel fuel at various loads and it is shown in figure. It is observed that the Indicated Thermal Efficiency for B40 blend was considering higher for first four loads remaining B30 is higher over the other blends operation over entire load range.

Graph No 6: Load vs Exhaust gas Temperature



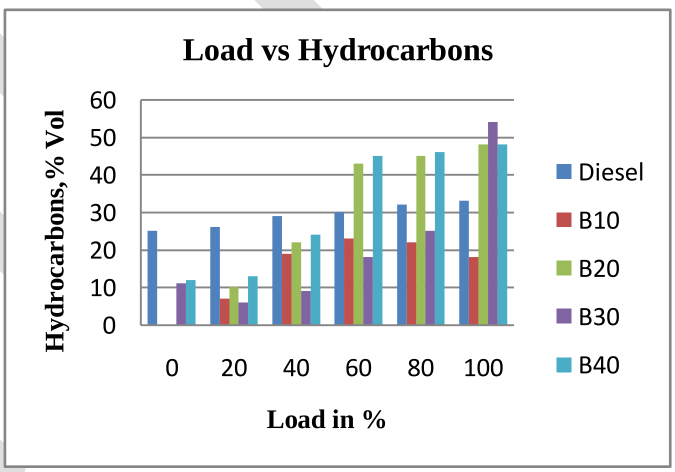
The variation of exhaust gas temperature with load at various load conditions is depicted in Fig. 6. It is observed that the exhaust gas temperature increases with load because more fuel is burnt to meet the power requirement. It can be seen that in the case of diesel fuel operation exhaust gas temperature ranges from 85 ^{0}C at low load to 275 ^{0}C at full load. For B10and B20, at full load the exhaust gas temperature marginally increases to 322 ^{0}C and 315 ^{0}C respectively. The exhaust gas temperature for B40 varies from 141^{0}C at low load to 353^{0}C at full load. Higher exhaust gas temperature in the case of cashew nut oil and cottonseed oil blends compared to Diesel is due to higher heat release rate.

Graph No 7: Load vs Carbonmonoxide



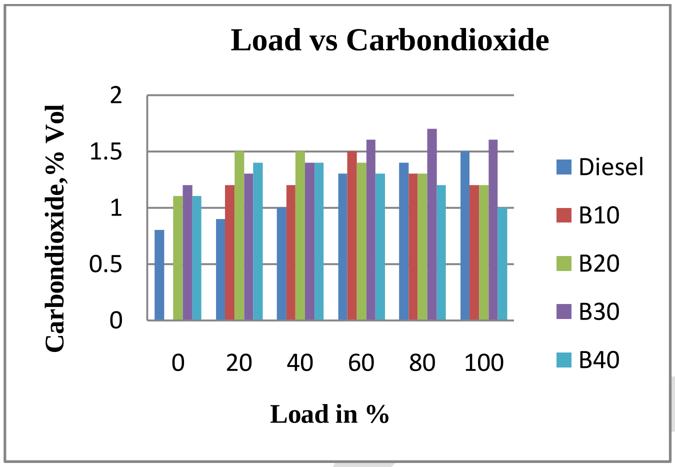
From Fig. 7, the variation of carbon monoxide with load can be observed for all the cashew nut oil and cottonseed oil blends –Diesel fuel blends. The results show that CO emission of cashew nut oil and cottonseed oil blends is lower than Diesel fuel. With increase in power output, the CO emission gradually reduces for cashew nut oil and cottonseed oil blends –Diesel fuel blends and the difference in the values for CO emission with Diesel fuel reduces significantly

Graph No 8: Load vs Hydrocarbons



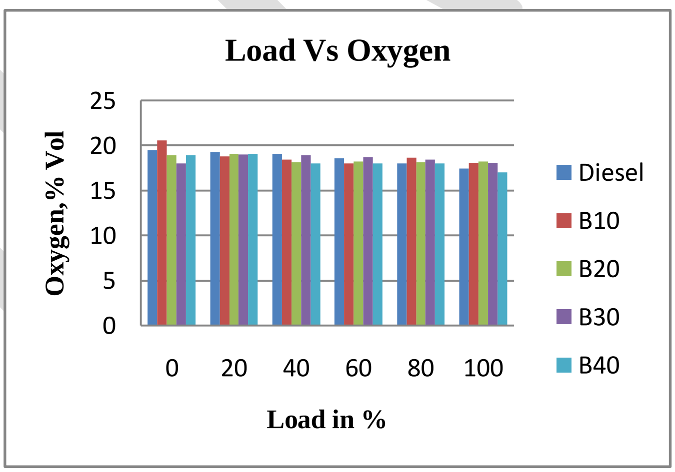
The variation of hydrocarbons with load for tested fuels is depicted in Fig. 8.. From the results, it can be noticed that the concentration of hydrocarbon of cashew nut oil and cottonseed oil blends –Diesel fuel blends is less than Diesel fuel. With increase in power output, the HC emission gradually increases for cashew nut oil and cottonseed oil blends –Diesel fuel blends.

Graph No 9: Load vs Carbon dioxide



As shown in fig.9, it can be observed that the variation of carbon dioxide emission with load for Diesel Fuel and cashew nut oil and cottonseed oil blends –Diesel fuel blends. From the results, it is observed that the amount of CO2 produced while using cashew nut oil and cottonseed oil blends –Diesel fuel blends is lower than Diesel fuel at all loads except full load. This may be due to late burning of fuel leading to incomplete oxidation of CO.

Graph No 10: Load vs Oxygen



The variation of brake thermal efficiency with load for and cashew nut oil and cottonseed oil blends –Diesel fuel blends is shown in Fig.4. It is clear that oxygen present in the exhaust gas is decreases as the load increases. It is Obvious that due to improved combustion, the temperature in the combustion chamber can be expected to be higher and higher amount of oxygen is also present, leading to formation of higher quantity of NOx, in and cashew nut oil and cottonseed oil blends –Diesel fuel blends.

4.CONCLUSIONS:

A Multi Cylinder Four Stroke Compressed Ignition Engine was operated successfully using the mixing of cashew nut oil and cottonseed oil and diesel blends as fuel. The following conclusions are made based on the experimental results.

a.The Specific fuel Consumption for Blend 20 is less when compared to diesel and all other blends over the entire load range.

b.The efficiencies such as Brake Thermal Efficiency, Indicated Thermal Efficiency and Mechanical Efficiency values for blend 20% is more than diesel and other blends over the entire load range.

c.The Volumetric Efficiency for diesel is more than all the blends over the entire load range.

e.Exhaust gas temperature of blends B 30 is less than that of the diesel, which indicates the effectiveness of input energy.

f.Carbon monoxide emission from the exhaust gas is reduced as the output power increases but this concentration is increased as the cashew nut oil and cottonseed oil blend increase with the diesel fuel.

g.Hydro carbon emission is found that lesser in concentration than the diesel at all load conditions. For the B20 and B40 hydrocarbon emission is slightly higher than the diesel.

h.Carbon dioxide emission is increased as the load variation increased but the concentration is less when compared to the diesel fuel operation.

I.Oxygen content is reduced from the exhaust gas as the load is increased. If the high content of oxygen is present in the exhaust it leads to the formation of oxygen.

So, it is preferred to use the B20 blend, as a best blend to the diesel due to the following reasons:

1. Lowest specific fuel consumption reduces the expenditure on fuel.

2. The power utilized is more from the developed power than other blends.

3. Low exhaust gas temperature results in decreasing the environmental pollution.

4. As the volumetric efficiency is good sufficient amount of air is available to the fuel, so the emission is due to incomplete combustion is lowered.

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