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Experimental Investigation of Multi Cylinder Diesel Engine Using Rubber seed oil and Diesel

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***Abstract*— Petroleum based fuels play an important role in rapid depletion of conventional energy sources along with increasing demand and also major contribution to air pollution. Major portion of today's energy demand in India is being met with fossil fuels. Therefore it is the right time for searching alternative fuels in the engines. As India is an agricultural country, there is a wide scope for the production of vegetable oils (both edible and non-edible) from different oil seeds. This paper focused only on non-edible oils like rubber seed oil as fuel for C.I engine.**

The main objective of this paper is to study the performance and emission characteristics of a multi cylinder, constant speed diesel engine using rubber seed oil & compared with the diesel fuel. Brief studies about the experimental setup and components have been done before the experiment started. Calculations have been done for the taken readings.

A four stroke multi cylinder diesel engine was used to study the brake thermal efficiency, brake specific fuel consumption and emissions from zero loads to full load for both diesel and rubber seed oil.

***Keywords*— Diesel, Rubber seed oil, Performance, Exhaust emissions, Alternative fuels.**

I. INTRODUCTION

Many experts have surveyed and said that by the year 2070, the world will be exhausted of fossil fuels. India is one of the fastest developing countries with a stable economic growth, which multiplies the demand for transportation in many fields. Fuel consumption is directly proportionate to the demand. India depends on fossil fuels in all the fields due to limited fossil fuel reserves available in India and it has been importing fossil fuels from other countries it is great impact on economy so, there is an urgent need of replacing these fossil fuels with alternative fuels. Basically the major part of energy consumed worldwide comes from the fossil fuels like petroleum, coal, natural gas etc. these fossil fuels not only non-renewable but also major cause pollution to the atmospheric. Meanwhile alternative fuels are renewable and also addresses many issues like global warming and air pollution.

Previously vegetable oils were not acceptable because they were more expensive than petroleum fuels but due to the recent increase in petroleum prices and uncertainties concerning petroleum availability renewed the interest in non edible vegetable oil fuels for diesel engines. There are about 340 oil-bearing crops like cotton seeds, sunflower, soybean, rapeseed, jatropha; Pongamia, rubber seed, pine oils etc are identified as potential replacement for diesel fuel.

II. LITERATURE SURVEY

A.S. Ramadhas et.al [1] had conducted experiments on the utilization of rubber seed oil on a single cylinder four stroke water cooled constant speed direct injection Diesel engine. The results showed that Acceptable brake thermal efficiency and specific fuel consumption with blends containing up to 80% rubber seed oil.

Kulachate Pianthong et.al [2] had conducted experiments on the utilization of rubber seed oil on naturally aspirated single cylinder direct injection CI engine. It was found that the torque and brake horse power of the engine using B100 were 5% lower compared to diesel. The specific fuel consumption of B100 engine was about 10% higher than that of diesel engine depending on engine speeds. At low engine speed, the brake thermal efficiency of the engine using B100 was higher than that using diesel by 5%. Also it was found that the emission from B100 engine is lower than those of the diesel engine.

S.N. Harikrishnan et.al [3] paper presents performance and emission characteristics on single cylinder, four stroke, constant speed, water cooled, direct injection diesel engine using rubber seed oil (RSO) as a fuel. The experimental data for various parameters such as thermal efficiency, brake specific fuel consumptions are analyzed and acceptable thermal efficiencies of the engine were obtained with blends containing up to 75% of rubber seed oil biodiesel blend compared to 25%, 50% and 100%.

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S. Mahalingam et.al [4] paper presents A single cylinder constant speed DI engine was used to evaluate the engine performance and emission characteristics of biodiesel (rubber seed and jatropha oil) and conducted the experiment by using rubber seed and jatropha seed oil blended diesel fuel from 20 %(B20) to 40 % (B40) with an increment of 10%. They had concluded that the CO of blended fuel at B20 gives the better performance compared to the B40.

III. Objective Of The Project

- To study the performance and emissions characteristics of a diesel engine with Rubber seed oil as fuel and it is compared with the base engine.
- To study the performance and emissions characteristics of modified piston diesel engine with Rubber seed oil as fuel and it is compared with the base engine.
- To measure the level of CO, HC and smoke in the exhaust emissions in the above said engine.
- To reduce the CO, HC and smoke level in the exhaust emissions by modifying the piston.
- To analyze the exhaust emission.

IV. Methodology

- The engine used for the experiment is started using diesel fuel and then its performance and emission readings are observed under various load condition.
- Selecting suitable rubber seed oil for double cylinder diesel engine and development of an experimental set-up with necessary instruments to study the performance and emission characteristics.
- The admission of rubber seed oil along with diesel fuel makes the engine run under dual fuel Mode.
- Conducting same trail for rubber seed oil and diesel fuel from zero to full load condition for modified piston diesel engine.
- Compare the performance and emission parameters for diesel and rubber seed oil for both base engine and modified piston diesel engine.

V. Properties Of Diesel And Rubber Seed Oil

Table-1 Properties

Sl. No	Properties	Diesel	Rubber seed oil
1	Density(kg/m^3)	832	864
2	Calorific value (kJ/kg)	43200	39867
3	Kinematic viscosity @ 40^{0}C (mm^2/s)	2.78	3.78
4	Cetane number	56	182
5	Flash point ºC	50	198
6	Specific gravity	0.86	0.93

VI. Experimental Setup And Engine Specification

The experimental test set up as shown in fig 1 and 2 consists of four stroke, constant speed and multi cylinder diesel engine. The engine is oil cooled. The injection timing given by the manufacturer is 27º BTDC, the operating pressure of the fuel injector was set at 1800 bar and the engine speed is 1500rpm.There are number of sensor are used in the engine to measure the fuel and engine parameter and the engine is loaded with water loading as shown in fig 3. Engine specifications as shown in table 2 and table 3 show load bank specification.

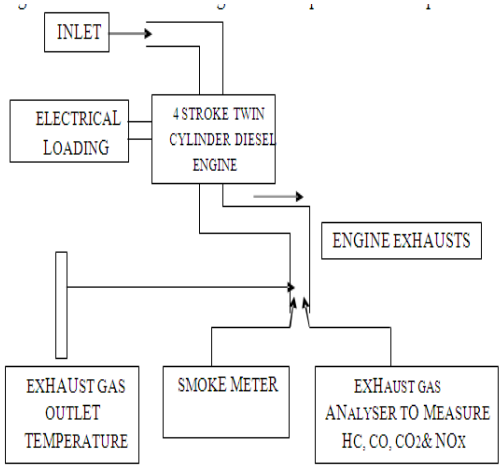

Fig- 1: Schematic arrangement of Experimental Set-up

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Fig -2: Test engine

Fig- 3: Water loading

Table-2
Test Engine specification

Engine type	Four stroke Twin cylinder diesel engine
No. of cylinders	02
Stroke	100 mm
Bore Diameter	87 mm
Engine power	15 KV
Compression ratio	17.5:1
RPM	1500
Type of starting	Crank starting
Load type	Water loading

Table-3
Load bank specification

Max. Output	15 KV
Generator type	1 Phase
Amps	63
RPM	1500
PF	0.8
Volts	240

VII. EXPERIMENTAL PROCEDURE

- Experiments were initially carried out on the engine using diesel as fuel in order to provide base line data.
- Initially the engine was started using diesel fuel and allowed to run for few minutes until to reach steady state; the base line data were taken. Load was varied from zero loads to full load condition using the water loading and Emissions, smoke and fuel consumption reading were recorded.

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- The engine was started on duel fuel mode, when engine became sufficiently heated; the supply of diesel was slowly substituted by 100 % rubber seed oil for which a two way valve was used. Once the engine reaches steady state, the emission, fuel consumption and smoke reading were taken. The same procedure is carried from zero to full load condition.
- Similarly same procedures were carried for modified piston diesel engine.

VIII. Results And Discussion

a) Carbon Monoxide

Figures 4, shows the variation CO level with respect to diesel and rubber seed oil at different loads. From the graph it is clear that the CO level decreases when rubber seed oil as a fuel for conventional and modified engine.

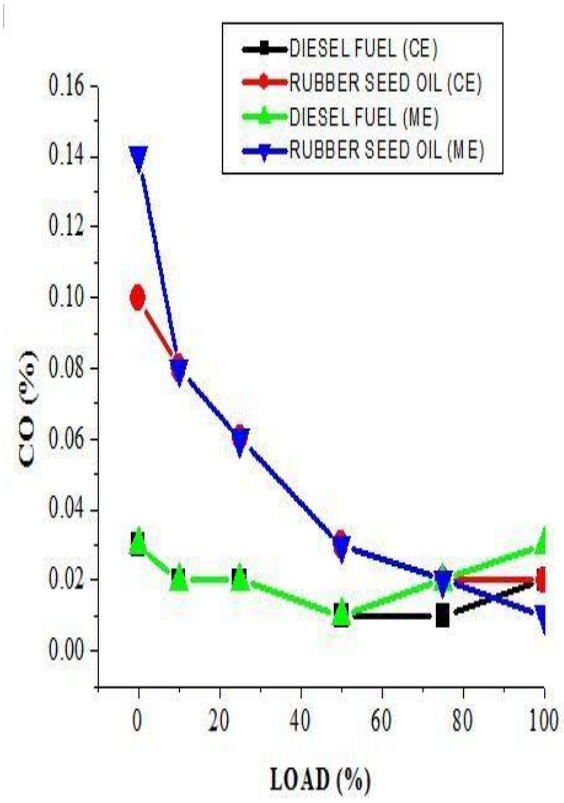

Figure- 4: Comparison of Carbon monoxide vs Load

b) Brake thermal efficiency

Figure 5, shows the variation of brake thermal efficiency with respect to rubber seed oil & diesel at different loads. From the graph it is observed that as load increases brake thermal efficiency is also increases for diesel as well as rubber seed oil.

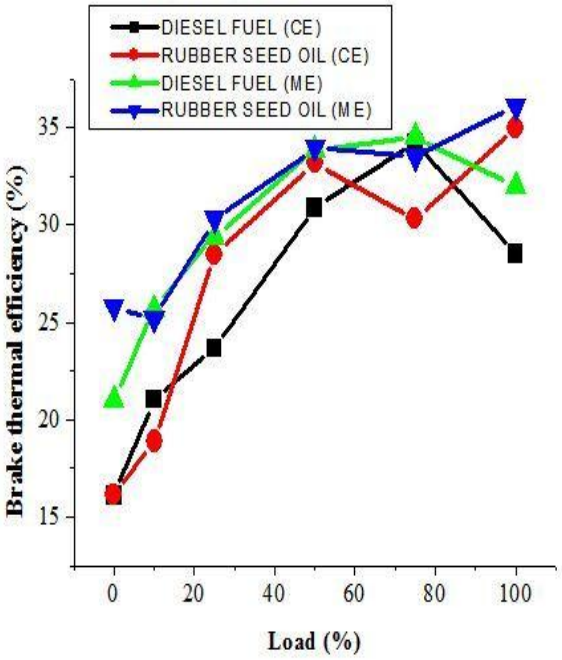

Figure- 5: Comparison of Brake thermal efficiency vs Load

c) Specific fuel consumption

From figure-6 it is clear that as the load increases specific fuel consumption decreases for different loads and the SFC of rubber seed oil is less than the diesel.

d) Hydrocarbon

The variation of Hydrocarbon of the engine with diesel & rubber seed oil is shown in figure 7. It can be seen that there is an increase in Hydrocarbon emission for diesel fuel and decreases for rubber seed oil in both conventional and modified engine.

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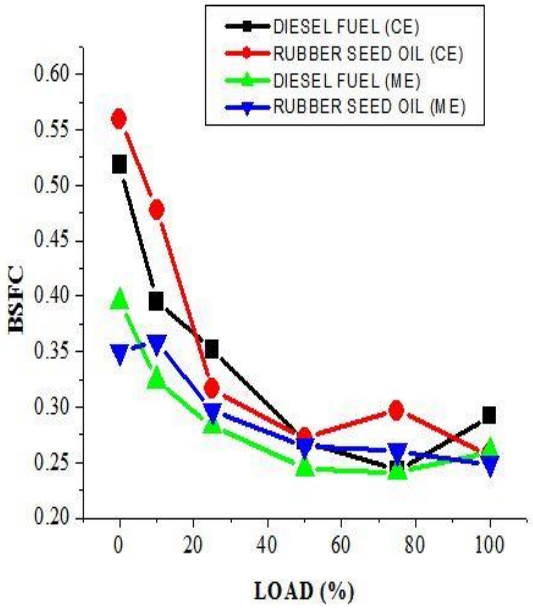

Figure- 6: Comparison of Brake specific fuel consumption vs Load

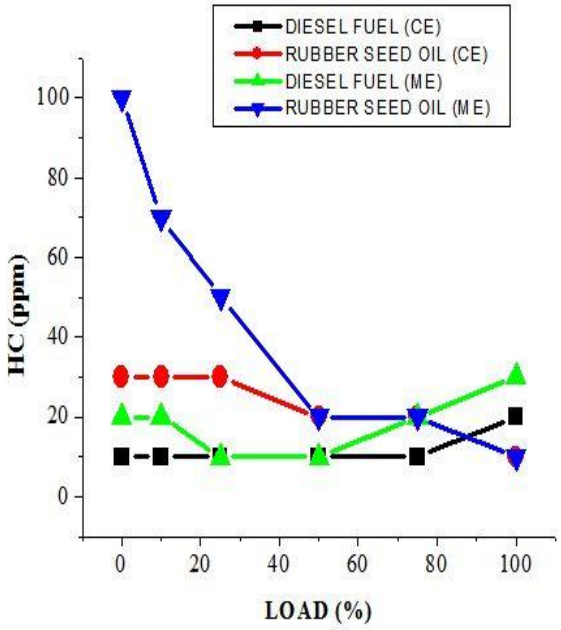

Figure- 7: Comparison of HC vs Load

IX. Conclusion And Future Scope

Based on the performance and emissions characteristics of rubber seed oil, it is concluded that the rubber seed oil shows a good alternative fuel with closer performance and better emission characteristics to that of a diesel. From the above results it is concluded that the rubber seed oil shows better performance characteristics like Brake thermal efficiency, and decrease in the emission parameters like CO, HC. Hence the 100% rubber seed oil can be substitute for diesel. The future research directions for scientists or researcher can be done with different engine modification.

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