INVESTIGATION AND PISTON TO PISTON COMPARISON OF TWIN CYLINDER DIESEL ENGINE FUELED WITH PONGAMIA OIL AND DIESEL OIL

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Abstract- All over the world the use of petroleum products has increased day by day. The vehicle population is also increasing day by day. The vehicle population has tremendous increased in the recent year with the explosion of vehicle population in the world wide. As the vehicle population increases the use of fossil fuel like petrol and diesel has increased tremendous. . Thus the implication of vegetable oil offers the advantage of being used readily in existing diesel engines. Hence to meet these requirements humans have to look towards alternatives to the petroleum based fuels like petrol and diesel. This paper focused only on non-edible oils like pongamia 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 pongamia 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 pongamia oil.

Keywords- Diesel, Pongamia oil, Performance, Exhaust Emissions, Alternative Fuels.

I. INTRODUCTION

Energy consumption is increasing globally in various forms for various purposes. The intensity of consumption is directly proportional to a society's development. Today, more developing countries are prospering through economic reforms and are becoming industrially advanced. Fuel is critical to any strategic plan for economic development and national security. In developing countries like India, the fuel has assumed serious economic consequences in the forms of budget deficits caused by oil imports and ecological degradation caused pollution. The possibility of substituting cleaner-burning alternatives for gasoline and diesel has drawn the attention of the automobile industry over the past decade. 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

S.D.Rahul Bharadwaj et.al [1] had conducted experiments on the utilization of pongamia oil on a single cylinder four-stroke, water-cooled compression ignition engine connected to an eddy current dynamometer with different percentage ethanol and methanol in honge bio-diesel blended with diesel. The results showed that Acceptable gives increased Indicated thermal efficiency and Mechanical Efficiency with blends containing up to 80% pongamia oil.

Jagadeesh Alku et.al [2] had conducted experiments on the utilization of pongamia oil on a single cylinder, four stroke, water cooled diesel engine at a rated speed of 1500 rpm. From investigation it was stated that up to 25% blend of pongamia biodiesel can be substituted for diesel engine without any modification and with modification we can blend up to 25% we can get better performance and combustion characteristics than normal engine. It was observe that 25% blend of pongamia biodiesel in diesel fuel has almost same mechanical efficiency; same specific fuel consumption and same indicated thermal efficiency .we can also see that there is slight increase in brake thermal efficiency which is a positive sign with this blend.

Ganapathi. P [3] et.al described an experimental study of using pongamia pinnata oil as a fuel in diesel engine. In this study the effect of using pongamia pinnata oil-diesel fuel blends (B10 B20) on the engine performance, exhaust emission have been experimentally investigated. Pongamia biodiesel shows lower heat release rate during premixed burning phase compared to diesel. The experimental result showed that the carbon monoxide, hydrocarbons and decrease in specific fuel consumption, volumetric efficiency and fuel consumption.

Gaurav Dwivedi (4) et.al conducted a test with the aim to focus on the work done in the area of production of biodiesel from Pongamia and the characterization of properties of various blends of Pongamia biodiesel.

The fuel properties like density, flash point, viscosity and calorific value of B10, B20 are very similar to diesel and therefore diesel may be well replaced by biodiesel in near future. The performance evaluation of engine has found that BSFC for B100 in case of Pongamia biodiesel was 30.4 % higher than diesel at full load, thereby indicating that more amount of B100 produce power similar to diesel.

III. OBJECTIVE OF THE PROJECT

- To study the performance and emissions characteristics of a conventional diesel engine with Pongamia oil as fuel and it is compared with diesel fuel.
- To study the performance and emissions characteristics of modified piston diesel engine with Pongamia oil as fuel and it is compared with diesel fuel.
- It is use to run 100% of Pongamia oil on engine
- To measure the emission level of CO, HC and smoke in the exhaust gases in the above said engine.
- To reduce the emission level of CO, HC and smoke level in the exhaust gases 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 Pongamia 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 Pongamia oil along with diesel fuel makes the engine run under dual fuel Mode.

- Conducting same trail for Pongamia oil and diesel fuel from zero to full load condition for modified engine and diesel engine.

Compare the performance and emission parameters for diesel and Pongamia oil for both base engine and modified piston diesel engine.

V. PROPERTIES OF DIESEL AND PONGAMIA OIL

Table-1 Properties

Sl. No	Properties	Diesel	Pongamia oil
1	Density(kg/m^3)	832	924
2	Calorific value (kJ/kg)	43200	38892
3	Kinematic viscosity @ 40^{0}C (mm^2/s)	2.78	4.8
4	Cetane number	56	42
5	Flash point ºC	50	225
6	Specific gravity	0.86	0.925

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: Test engine

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	17.5:1

ratio	
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



Fig- 2: Water loading

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.
- The engine was started on duel fuel mode, when engine became sufficiently heated; the supply of diesel was slowly substituted by 100 % Pongamia 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

Carbon Monoxide

Figures 3(a) and (b), shows the variation CO level with respect to Pongamia oil and diesel fuel at different loads. From the graph it is clear that the CO level decreases in modified piston Pongamia fuels as shown in figure 3(a) but CO level increases in modified piston engine diesel fuel as shown in figure 3(b). It is recommended to use 100 % Pongamia oil in a modified piston engine and emission level also decreases as compared to conventional engine.

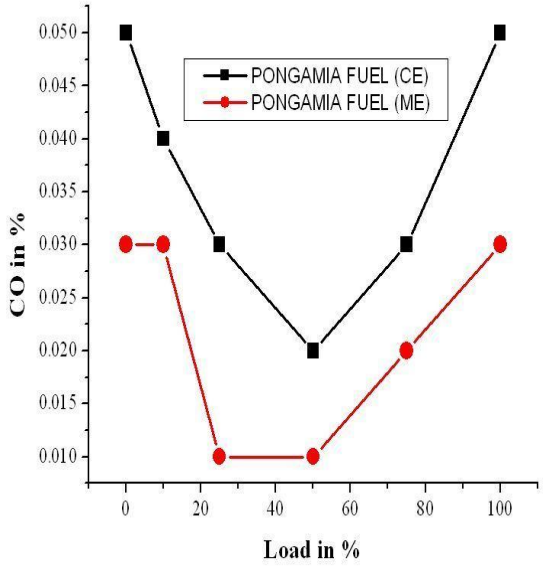


Figure- 3(a): Comparison of Carbon monoxide vs Load

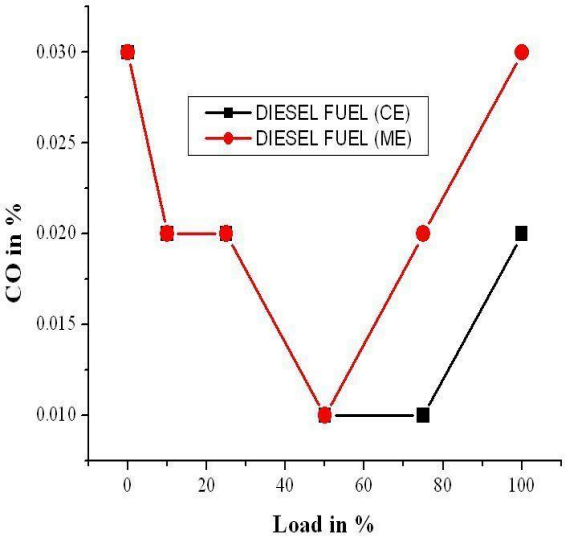


Figure- 3(b): Comparison of Carbon monoxide vs Load

Brake thermal efficiency

Figure 4(a) and (b), shows the variation of brake thermal efficiency with respect to Pongamia oil & diesel at different loads. From the graph it is observed that as load increases brake thermal efficiency is also increases for both the piston engine up to 75% of load for both diesel as well as Pongamia oil and it is observed that for both piston engine efficiency is increases in modified piston engine as compared to conventional piston engine.

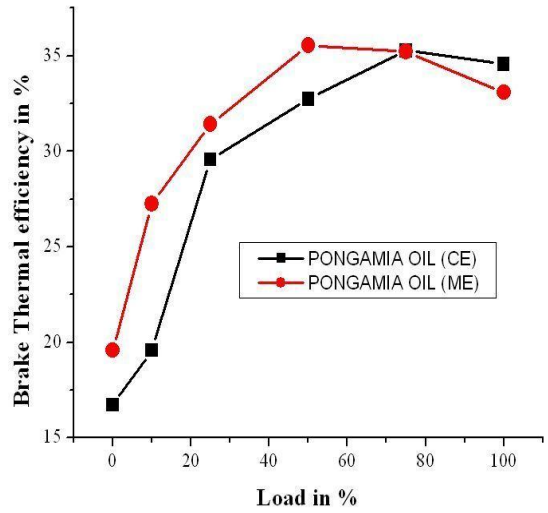


Figure- 4(a): Comparison of Brake thermal efficiency vs Load

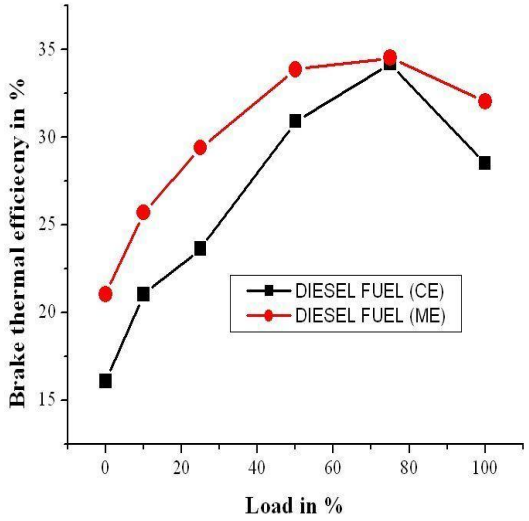


Figure- 4(b): Comparison of Brake thermal efficiency vs Load

Specific fuel consumption

Figure 5 (a) and (b), shows the variation of specific fuel consumption with respect to Pongamia oil & diesel at different loads. From the graph it is observed that as load increases specific fuel consumption is also decreases up to 75% of load for diesel as well as Pongamia oil. It is observed that specific fuel consumption is decreases in modified piston engine as compared to conventional piston engine.

Hydrocarbon

Figure 6 (a) and (b), show the variation of Hydrocarbon of the engine with Pongamia oil &diesel fuel at different load. It can be seen that there is a decrease in Hydrocarbon emission for Modified Pongamia oil as compared to conventional Pongamia oil but for diesel fuel emission level is increases in modified engine as compared to conventional engine. It is recommended to use 100% Pongamia oil and also decreases emission level by compared to conventional engine.

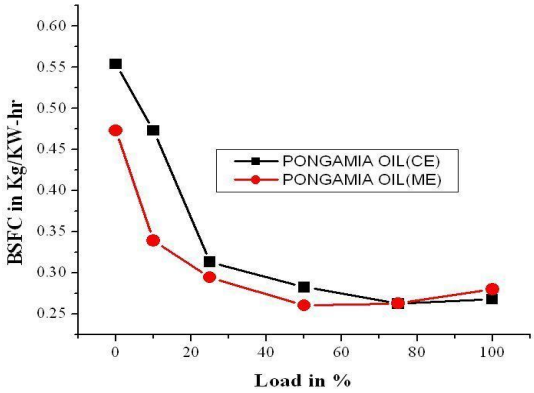


Figure- 5(a): Comparison of Brake specific fuel consumption vs Load

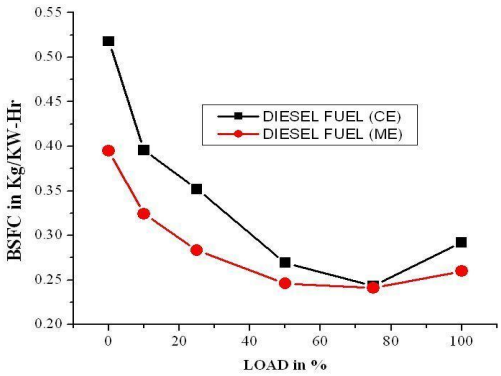


Figure- 5(b): Comparison of Brake specific fuel consumption vs Load

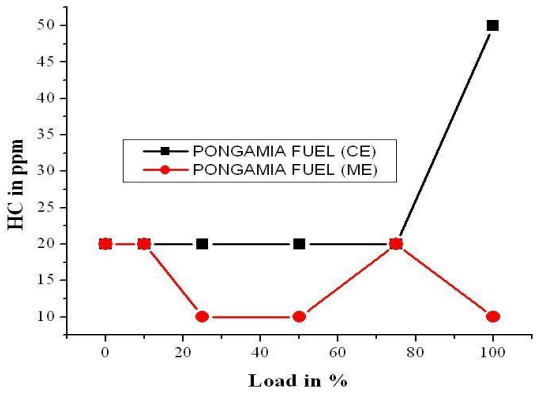


Figure- 6(a): Comparison of HC vs Load

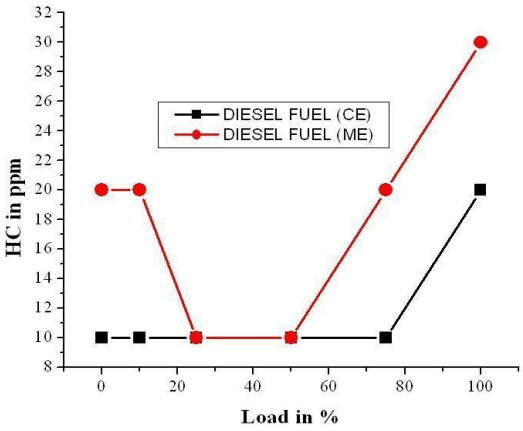


Figure- 6(b): Comparison of HC vs Load

CONCLUSION AND FUTURE SCOPE

Based on the performance and emissions characteristics of Pongamia oil, it is concluded that the Pongamia 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 Pongamia oil shows better performance characteristics like Brake thermal efficiency, and decrease in the emission parameters like CO, HC. Hence the 100% Pongamia 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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