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Experimental Investigation Of Multi Cylinder Diesel Engine Using Diesel, Jatropha Oil &Apricot Oil

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Abstract: *Due to modernization, increase the number of industries and automobiles sector the consumption of petroleum products has increased which leads to fuel crises. It was estimated consumption of diesel fuels in India was 28.30 million tones, which is 43.2% of the consumption of petroleum products. This requirement was met by importing crude petroleum as well as petroleum products, with the expected growth rate of diesel consumption of more than 14% per annum, for this shrinking crude oil reserves and limited refining capacity, as per the research survey petroleum products may available another 30 to 50 years, it has made us to think and focus on search alternate fuels for diesel fuel. Our main objective for this work is to use and run diesel engine by 100% vegetable fuels and decreases the dependency of fossil fuels. The main objective of this work is investigates the performance and emission characteristics of a twin cylinder diesel engine is fuelled with non-edible vegetable oil such as jatropha oil and Apricot oil and compared with diesel fuel. The experimental setup consists of double cylinder, oil cooled, four stroke constant speed diesel engine. The experimental engine started with diesel fuel and its performance and emission readings are taken and observed at various load condition, later the admission of jatropha oil or apricot oil make the engine run under dual fuel mode and conducting the same trail from zero load to full load condition. Based on the performance and emission characteristics of jatropha oil and Apricot oil it is concluded that the jatropha oil and Apricot oil is a good alternative fuel with closer performance and good emission characteristic to that of diesel. From the results it is concluded that jatropha oil and Apricot oil shows better performance hence the jatropha oil and Apricot oils suitable alternatives for diesel.*

Keywords*: Diesel, Jatropha oil, Apricot oil, Performance, Exhaust emissions*

I. Introduction

Nowadays due to limited resources, rapid depletion of fossil fuels and as pollutant resulting from these categories are massively expelled to ruin the healthy climate is demanding an urgent need of alternative fuels for meeting sustainable energy demand with minimum environmental impact. Diesel engines are playing a more and more dominant role due to its superior thermal efficiency and fuel economy. However, its exhaust emissions have become the major concerns due to their environmental impacts. As such, emission regulations have been made more and more stringent during the past few years, and this has posed serious challenges to the researchers and engine manufacturers. As advance technologies becoming available, researchers are looking into new strategies such as common rail fuel injection, multiple injections and low temperature combustions to reduce the harmful emissions and increase the engine efficiency. However, the rising oil prices and concerns on the depletion of fossil fuel reserves have forced researchers to not only look into engine optimization, but also find alternative resources to tackle the energy crisis. Biodiesel has gained a growing interest as one of the most promising solutions. Its primary advantages are biodegradable, renewable, carbon neutral and do not produce hazardous toxic [1]. The high energy demand in the industrialized world as well as in the domestic sector and pollution problems caused due to the widespread use of fossil fuels make it necessary to develop renewable energy sources. From the point of view of protecting the global environment and concerns for long-term energy security, it becomes necessary to develop alternative fuels with properties comparable to those that are petroleum based. The rapid depletion of petroleum reserves and fluctuating oil prices leads to the search for

Alternative fuels. This was the basic motivation behind the research in this paper. Non edible oils are promising fuels for agricultural applications. Vegetable oils have properties which similar to diesel and can be used to run compression ignition engines with little or no modifications. For diesel engines, a significant research effort has been directed towards using vegetable oils and their derivatives as fuels [2]. In country like India, majority of population lives in rural areas and they depend on agriculture. The diesel engines are popular in rural areas where it is not possible to have uninterrupted electric supply to run electric motor for water pump sets. If fuel for these diesel engines is prepared locally, it makes the farmers self-sufficient with regard to their energy needs. There are many vegetable oils which can be used as fuel for diesel engines. But the edible oils like sunflower oil, peanut oils, soya oil, are costly and are for human consumption. The non edible oils obtained from plant species such as Jatropha curcas (Ratanjyot), mahua, Pongamia pinnata (Karanj), honge, honne (Nagchampa), Hevca brasiliensis, and rubber etc. can be used as fuel for diesel engine. These non edible vegetable oil plant species can be grown on the land which is not suitable for agricultural purpose. The oil seeds upon crushing and extraction; oil can be obtained, which can be used as fuel for diesel engine. The vegetable oils offer many benefits including sustainability, regional development, reduction in green house gases and reduction on dependency on mineral diesel. Scientists around the world have explored several alternative energy resources, which have the potential to quench the ever-increasing energy thirst of today's population. The projected petroleum production in the country as given in eleventh five year plan is showing. The production of crude oil in India is estimated to have a decreasing trend after the year 2010. But there will be an Performance and Emission Characteristics of CI Engine fuelled with crude oil (petrol and diesel) CO Carbon monoxide, CO2 Carbon dioxide, HC Hydro Carbon, NOx, Oxides of nitrogen all these emissions are polluting the environment. An increase in the vehicle population every year which will demand an increase in crude oil imports. With this scenario the need for an alternate fuel arises to maintain the economy of the country and also to reduce the environmental pollution. Non edible vegetable oil have received significant attention both as a possible renewable alternative fuel and as an additive to the existing petroleum-based fuels

II. Objective Of The Project

- It is proposed to use 100% vegetable oils in the diesel engine
- To decrease the dependency of fossil fuel.
- To study the performance and emissions characteristics of a diesel engine with Jatropha oil and Apricot oil as fuel and it is compared with diesel fuel.
- 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.
- To analyze the exhaust emission.
- To improve the performance and emission characteristics of diesel engine using Jatropha and apricot oil as a fuel in diesel engine

III. Properties Of Diesel, Jatropha Oil And Apricot Oil

Table-1 Properties

Sl. No	Properties	Diesel	Jatropha oil	Apricot oil
1	Density(kg/m^3)	832	914	921.432
2	Calorific value (kJ/kg)	43200	39340	41427.04
3	Kinematic viscosity @ 40^{0}C (mm^2/s)	2.78	31.2	4.26
4	Cetane number	56	58.4	---
5	Flash point ºC	50	174	105
6	Specific gravity	0.86	0.9186	0.87

IV. Experimental Setup And Engine Specification

The experimental test set as shown in fig.1 consists of four strokes, constant speed, oil cooled and twin cylinder diesel engine. The injection timing given by the manufacturer is 27º BTDC, the opening pressure of the nozzle was set at 1800 bar and the engine speed is 1500rpm.There are a number of transducers used in the engine such as piezoelectric pressure transducer flush with the cylinder head surface to measure cylinder pressure. Specifications of engine are shown in Table 2.

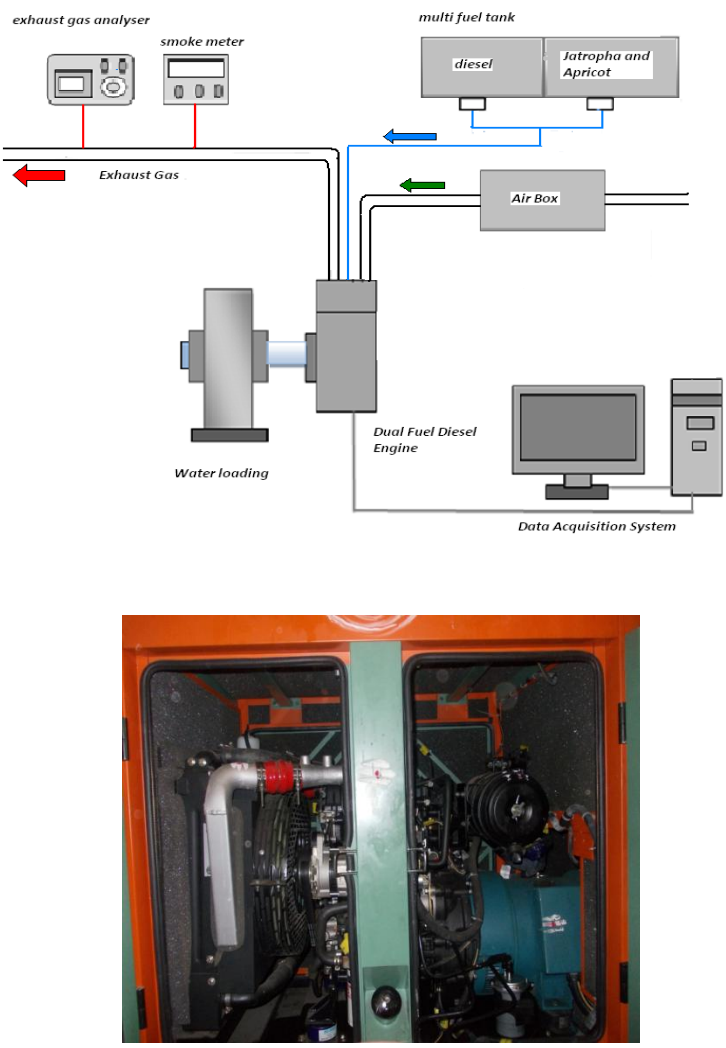

Fig.1: Schematic arrangement of Experimental Set-up

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 water load bank specification

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

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

VI. Results And Discussion

Carbon Monoxide:

Figures 2, shows the variation CO level with respect to diesel, Jatropha oil and Apricot oil at different loads. From the graph it is clear that at zero loads jatropha oil and apricot oil CO emission level is higher than that of diesel fuel, as the load increases from zero load to full load CO emission is also decreases and at full load condition jatropha oil CO emission level is lower than diesel fuel whereas apricot CO emission level is same as that of diesel fuel at full load condition.

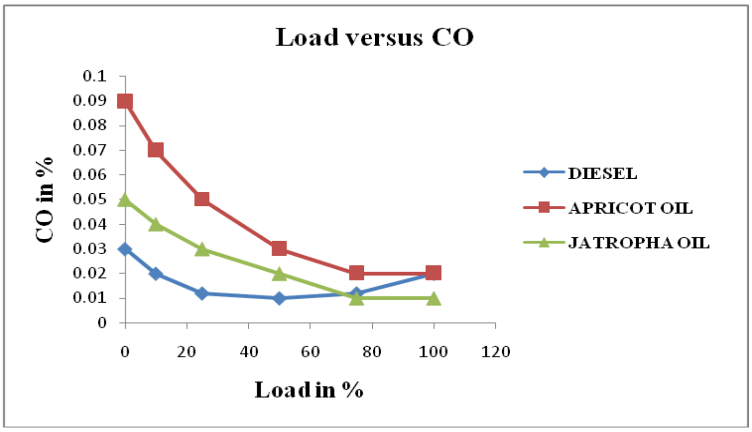

Fig.2: Comparison of Carbon monoxide versus Load

Brake thermal efficiency:

Fig.3 shows the variation of brake thermal efficiency of diesel, Apricot and Jatropha oil at different load at different loads. From the graph it is clearly observed that at zero load condition brake thermal efficiency of Apricot oil is higher than diesel and jatropha oil, as the load increases from zero loads to full load condition brake thermal efficiency increases up to 75% load and then decreases up to full load.at full condition brake thermal efficiency Jatropha oil is higher than diesel and apricot oil.

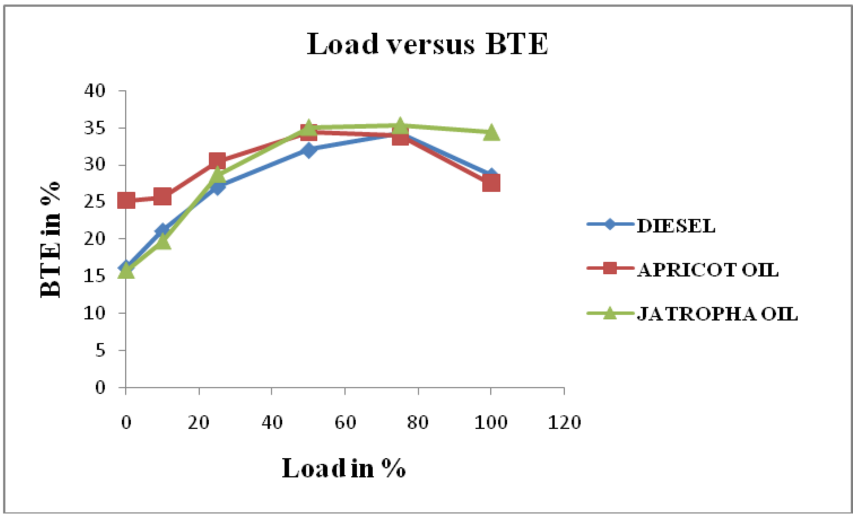

Fig.3: Comparison of Brake thermal efficiency versus Load

Brake specific Energy conversion:

From fig.4, it is clearly observed that at zero loads the BSEC of Diesel, Jatropha oil and apricot oil is higher, as the load increases BSEC decreases up to 75 % load and then increases after 75% load to full load. Jatropha oil BSEC is higher than diesel and apricot oil at zero load condition whereas at full load condition diesel fuel is higher than Jatropha and Apricot oil.

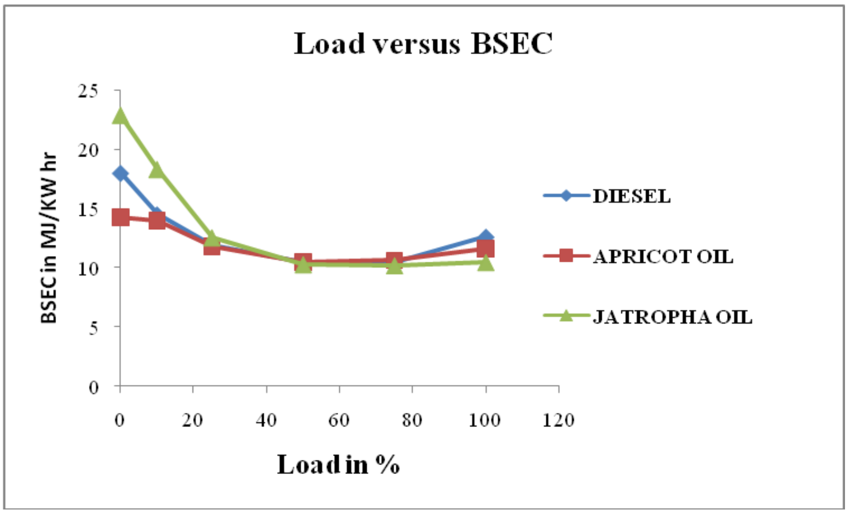

Fig.4: Comparison of Brake specific fuel consumption vs Load

Hydrocarbon:

The variation of Hydrocarbon emission of the engine with diesel, Jatropha and Apricot oil is shown in fig 5. It can be seen that at zero load condition Hydrocarbon emission of Jatropha oil and Apricot oil is higher than diesel fuel and HC emission decreases as the load increases up to full load condition whereas diesel fuel HC emission level is less at zero load and higher at full load condition. At full load condition HC emission level of Jatropha oil is lesser than diesel and apricot oils.

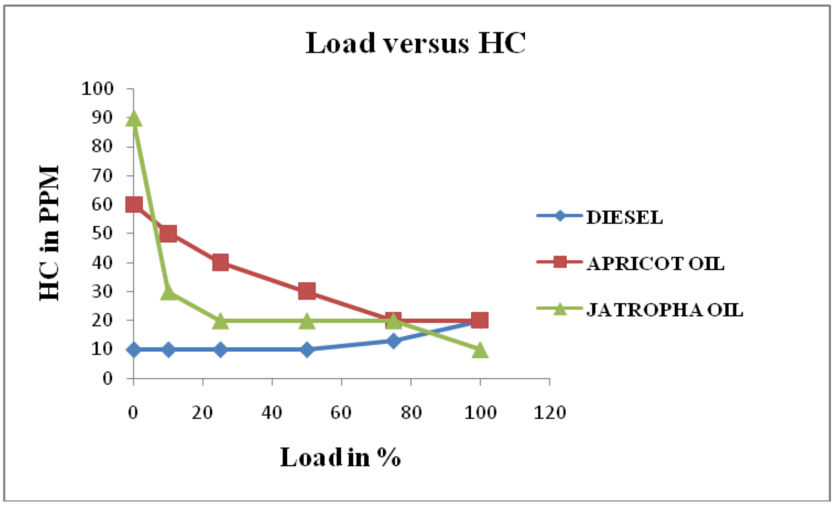

Fig.5: Comparison of Hydrocarbon versus Load

Smoke:

From fig.6, it is clearly shows that at full load condition smoke level apricot oil is lesser than diesel fuel where as Jatropha oil smoke level is higher than diesel fuels.

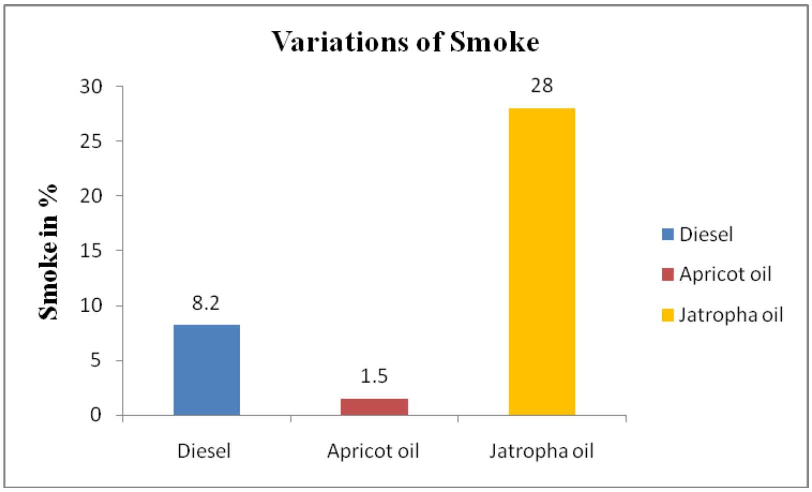

Fig.6: shows the variations of Smoke for different Vegetable oils at full load

VII. Conclusion And Future Scope

Based on the performance and emissions of Jatropha oil, Apricot oil, it is concluded that the Jatropha oil, Apricot 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 Jatropha oil, Apricot oil, shows better performance characteristics like Brake thermal efficiency, and the emission parameters like CO, HC. Hence the 100% Jatropha oil, Apricot oil can be used as a substitute for diesel. The future research directions for scientists or researcher can be done with different engine modification.

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