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Reliability And Combustion Tests in A Ci Engine Using Biodiesel Using Jatropha Curcas Seed OIL

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Abstract - *This project aims on the use of biodiesel as fuel for CI engine and its performance. Biodiesel is an alternate energy source and could be a substitute for petroleum based diesel fuel. To be a variable alternative a biodiesel should provide net energy gain, have environmental benefits, be economically competitive and be producible in large quantities without reducing food supplies.*

In this project we have used diesel and biodiesel of different blends as fuel and made comparison of both with respect to their advantages and disadvantages. We have used Jatropha seed oil as a biodiesel and blends of B10, B20, B25, and B30. Studies have shown that Jatropha seed oil can be used in diesel engines as they are found to have properties closer to diesel fuel. Jatropha seed oil is renewable in nature and may generate opportunities for rural employment when used on large scale.

Key Words: Biodiesel, Jatropha curcas, fuel properties, Transesterification, Vegetable oil.

1. INTRODUCTION

1.1Background, motivation and Energy overview in India

Biodiesel is an alternative fuel made from renewable biological sources such as vegetable oils both (edible and non-edible oil) and animal fats. Vegetable oils are usually esters of glycol with different chain length and degree of saturation. It may be seen that vegetable contains a substantial amount of oxygen in their molecules.

Practically the high viscosity of vegetable oils as compared to that to Diesel leads to unfavorable pumping; inefficient mixing of fuel with air contributes to incomplete combustion, high flash point result in increased carbon deposit formation and inferior coking. Due to these problems, vegetable oil needs to be modified to bring the combustion related properties closer to those of Diesel oil. The fuel modification is mainly aimed at reducing the viscosity and increasing the volatility.

One of the most promising processes to convert vegetable oil into methyl ester is the 1angalore1ized1tion, in which alcohol reacts with triglycerides of fatty acids (vegetable oil) in the presence of catalyst. Jatropha vegetable oil is one of the prime non edible sources available in India. The vegetable oil used for biodiesel production might contain free fatty acids which will enhance saponification reaction as side reaction during the process.

The gases emitted by petrol, diesel driven vehicles have an adverse effect on the environment and human health.

1.2 Biofuels and sustainable developments in India

India is currently the fourth largest greenhouse gas (GHG) emitter, the fifth largest energy consumer and the second most populous country in the world. Naturally, there is an increase in energy demand every year. India will need to import huge amounts of energy from other countries in order to meet its energy demands. Although India's per capita emissions are less than half the world's average, in 2010, its transport sector accounted for 13 percent of the country's energy-related carbon dioxide emissions. Hence, India needs to find sustainable energy generation sources to meet its demands thereby providing a good market for biofuels. India's 3angalor production accounted for only 1 percent of global production in 2012. Bio- ethanol and bio-diesel are the two biofuels that are commercially produced. Currently, first generation feed stocks such as sugarcane, maize; sugar beet and cassava are commonly exploited for bio-ethanol along with palm oil, jatropha oil and other edible oils from various oilseed crops for the production of bio-diesel. But since the production of these fuels compete with food crops, questions regarding food security and sustainability issues arise. Thus, there is tremendous potential for second generation biofuels in India, especially for cellulosic and agricultural crop residues.

Biofuels development and use is a complex issue because there are many 3angalor options which are available. Biofuels, such as ethanol and biodiesel, are currently produced from the products of conventional food crops such as the starch, sugar and oil feed stocks from crops that include wheat, maize, sugar cane, palm oil and oilseed rape.

2. LITERATURE SURVEY

1. Toxicoses are reported in the medical literature and ingesting four seeds can be toxic to a child, with symptoms resembling organophosphate insecticide intoxication, yet with no antidote for the lethal mixture (**Abdu-Aguye et al., 1986)**

2.The proximate analysis of Jatropha seeds revealed that the percentage of crude protein, crude fat and moisture were 24.60, 47.25 and 5.54% respectively (**Akintayo,2004**). The seeds can be transported without deterioration and at low cost due to its high specific weight. The seeds of the Jatropha contain 30 - 40% oil that can be easily expressed for processing (Transesterification) and refinement to produce biodiesel (**Akintayo, 2004; Gubitzet al., 1999; Mahanta et al., 2008**).

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3.Jatropha has important implications formatting the demand for rural energy services and also exploring practical substitutes for fossil fuels to counter greenhouse gas accumulation in the atmosphere. These characteristics along with its versatility make it of vital importance to developing countries (**Foidland Kashyap, 1999**).

4.The raw materials being exploited commercially by the biodiesel countries constitute the edible fatty oils derived from rapeseed, soybean, sunflower, etc. (**Li et al., 2006; Xie and Huang, 2006; Antolin etal., 2002**).

5.Obviously, the use of non-edible vegetable oils compared to edible oils is very significant. Jatropha curcas L. oil, due to the presence of toxic phorbol esters is considered non-edible oil. Jatropha curcas is a drought resistant shrub or tree belonging to the family Euphorbiaceae, which is cultivated in South America, Southeast Asia, India, Africa and China (**Schmook et al., 1997; Gubitz et al., 1999;Martinez-Herrera et al., 2006**)

6.Yaakob, et. Al.(2009) investigated that one way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids such as inedible oils, animal fats, waste food oil and by products of the refining vegetables oils The fact that Jatropha oil cannot be used for nutritional purposes without detoxification makes its use as energy/fuel source very attractive.

3. MATERIAL AND METHODOLOGY

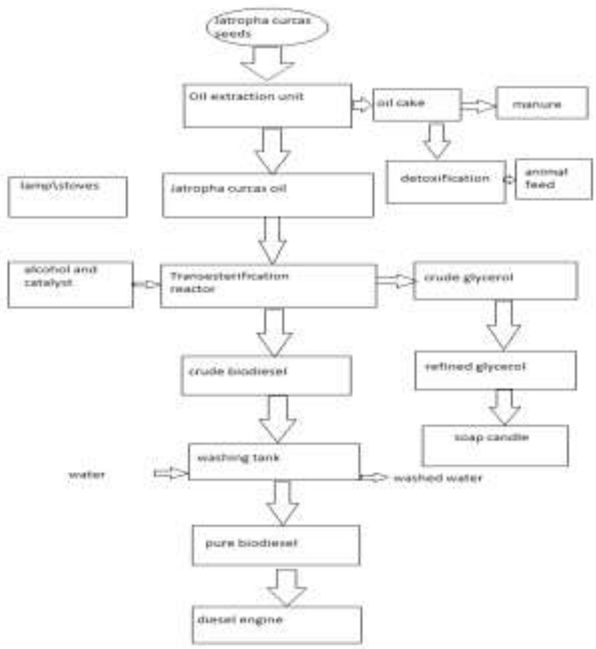

Fig.1 Processing Steps of Bio Diesel Production

4. PROPERTIES OF BIODIESEL AND BIODIESEL BLENDS

Table -1: Properties of jatropha seed oil

Jatropha seed Oil bio-diesel properties					
JOME	**Diesel**	**B10**	**B20**	**B25**	**B30**
Flash point(⁰C)	57	61	60	62	64
Fire point(⁰C)	63	66	64	64	67
Density (Kg/m³)	830	833.7	837.4	841.1	867
Viscosity(40ºc)	2.9	3.09	3.28	3.47	4.8
CV(KJ/Kg)	42500	42230	41960	41690	39800

5. EXPERIMENTAL SETUP

Place	RTE's Society's Rural Engineering College- Hulkoti.
Product	VCR Engine test setup 1 cylinder, 4 stroke, Diesel (Comp.)
Engine	Make Kirloskar, Type 1 cycle ., 4 stroke Diesel, water cooled, power 3.5kW at 1500rpm, stroke 110mm, bore 87.5mm. 661cc, CR17.5, Modified to VCR engine CR 12 to 18. with electric start arrangement, battery and charger
Dynamometer	Type eddy current, water cooled,
Load sensor	Load cell, type strain gauge, range 0-50 Kg
Compression ratio	17.5:1

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6. RESULTS

6.1 Performance Characteristics (Jome)

6.1.1 Load Vs Brake Thermal Efficiency

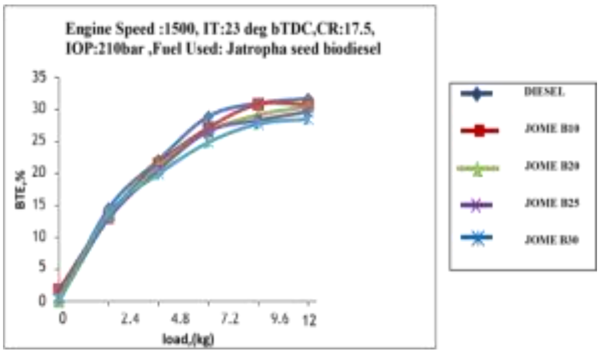


Fig.3 LOAD VS BTE

6.1.2 Load Vs Specific Fuel Consumption

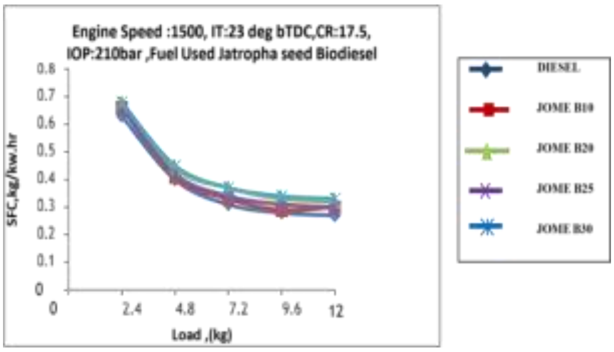
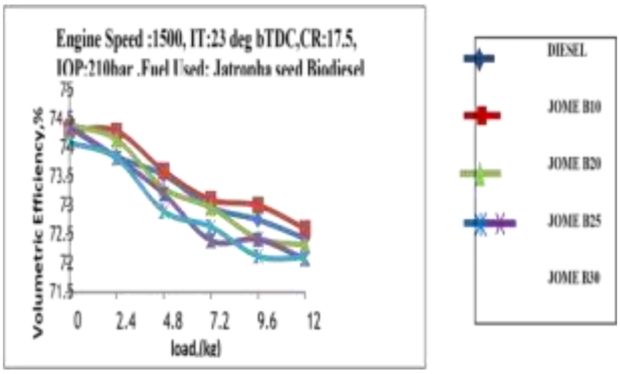


Fig.4 LOAD VS SFC

6.1.3 Load Vs Volumetric Efficiency



5 LOAD VS VOL EFF

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6.1.4 Load Vs Gas Exhaust Temperature

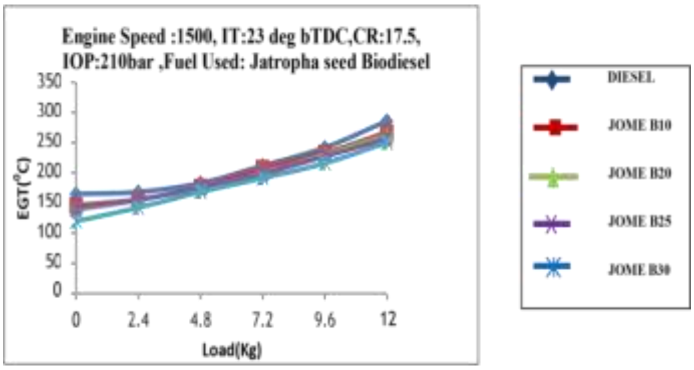

Fig.6 LOAD VS EGT

6.2 Emission Characteristics (Jome)

6.2.1 Load Vs Hydro bcarbons

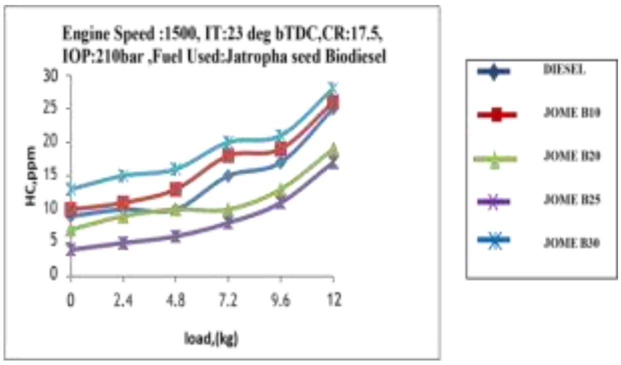

Fig.7 LOAD VS HC

6.2.2 Load Vs Nitrogen Oxide

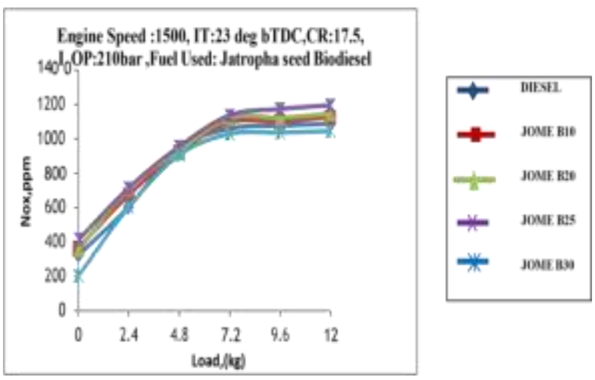

Fig.8 LOAD VS NO_X

6.2.3 Load Vs Carbon dioxide

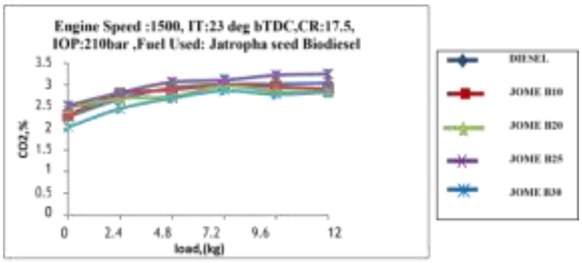

Fig 23. LOAD VS CO_2

6.2.4 LOAD VS O_2

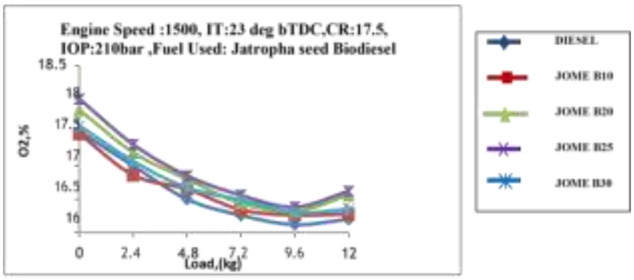

Fig 24.LOAD VS O_2

8. CONCLUSIONS

1. Performance, combustion and emission characteristics of JOME B20 blend. The maximum brake thermal efficiency of JOME B20 and DIESEL are respectively 31.67%, and 30%.
2. The BSFC decreased with an increase in engine load. For biodiesel and its blends the BSFC are higher than that of diesel fuel. The BSFC values for biodiesels, JOME B20 is 0.30 which is higher than diesel fuel.
3. The NOx emission is higher than diesel fuel for all modes of test fuels. This is due to higher oxygen content of biodiesel, which would result in better combustion and maximum cylinder temperature. The maximum value of NOx emission is 8% of JOME at full load conditions, which is higher than diesel fuel.
4. For biodiesel and its blends, it was found that CO and HC emissions were lower than that of pure diesel. The lowest CO and HC emissions were obtained for neat biodiesel (B100).The maximum reduction in CO and HC emission with neat biodiesel and at full load are 16% and 20% respectively which is lower than diesel fuel.
5. On the whole, the methyl esters of JO biodiesel and its blends can be used as an alternative fuel in diesel engines without any engine modifications. It gives lower HC, CO emission when compared

with the diesel fuel. But the addition of higher percentage of biodiesel blends with diesel fuel which decreases brake thermal efficiency and increases specific fuel consumption.

6. It is found that CO2 emissions are more for JO biodiesel than that of diesel. Higher CO2 emissions reduce harmful CO emissions. The percentage reduction in HC Jatropha oil biodiesel is about 60% as compared to that of Diesel. Due to higher NOx emissions with pure JO biodiesel, suitable blends can become a striking balance between NOx emissions on one end and all other emissions along with performance on the other hand.

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