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PERFORMANCE AND EMISSION TESTS USING BIODIESEL FROM DECCAN HEMP OIL IN CI ENGINE

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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 Deccan Hemp seed oil as a biodiesel and blends of B10, B20. Studies have shown that Deccan Hemp seed oil can be used in diesel engines as they are found to have properties closer to diesel fuel. Deccan Hemp seed oil is renewable in nature and may generate opportunities for rural employment when used on large scale.

Key Words: Transesterification, Cetane Number, Kinematic Viscosity

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. Deccan Hemp 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.

Among the alternatives being considered are methanol, ethanol, biogas and vegetable oils. Vegetable oils have certain features that make them attractive as substitute for Diesel fuels. Vegetable oil has the characteristics compatible with the CI engine systems.

Vegetable oils are also miscible with diesel fuel in any proportion and can be used as extenders. India highly depends on import of petroleum crude and nearly two third of its requirement is met through imports. More over the gases emitted by petrol, diesel driven vehicles have an adverse effect on the environment and human health.

2. LITERATURE SURVEY

1. Md. Hasan Ali, Mohammad Mashud, Md. Rowsonozzaman Rubel, Rakibul Hussain Ahmed They analysed properties of biodiesel obtained from neem oil. 3:1 molar ratio of methanol and oil at temperature range of 55 to 61°C in presence of 1 atmospheric pressure has been found as condition for equilibrium. Kinematic viscosity was found to be 5.96 which is higher than diesel but met ASTM D 6751 specifications.

2. Ihsanullah, Sumaira Shah, Muhammad Ayaz, Iftikar Ahmed, Murad Ali, Naveed Ahmed and Irshad Ahmed They synthesised biodiesel from algae. They made use of transesterification process in order to produce biodiesel. Maximum amount of oil was extracted from algal biomass using combination of n-hexane and diethylene. Maximum extracted oil was 0.09 fraction of biomass by using blend of both solvent, solvent to biomass ratio of 3:5, algal biomass size of 0.4mm and contact time of 24 hours.

3. Lay L. Mint, Mahmoud M. El-Halwangi They analysed and optimized production of biodiesel from soya bean oil. They emphasized on recycling of by products in order to optimise biodiesel production process and reduce cost of biodiesel production. Mass and energy integration studies were performed to reduce consumption of heating and cooling utilities, to conserve fresh water and to reduce waste water recharge.

4. A. Gnanapraksham, V.M. Siva Kumar, A. Surendhar, M. Thirumarimurugan, T. Kannadasan They described biodiesel production from waste cooking oil and various parameters which influences biodiesel production process. They made use of waste cooking oil, generally left after frying, as a raw material. They used base catalyzed transesterification process in order to synthesize biodiesel.

5. A Arun Shankar, Prudhvi Raj Pentapati, R. Krishna Prasad they synthesized biodiesel from cotton seed oil using homogeneous alkali catalyst and heterogeneous muiti walled carbon tubes. They analysed effects of various parameters on yield of biodiesel and biodiesel yield was founded highest at 110°C for alkali concentration of 0.75g NaOH/l of oil at an alcohol to oil ratio of 7:1. Maximum biodiesel yield was 95%.

3. MATERIAL AND METHODOLOGY

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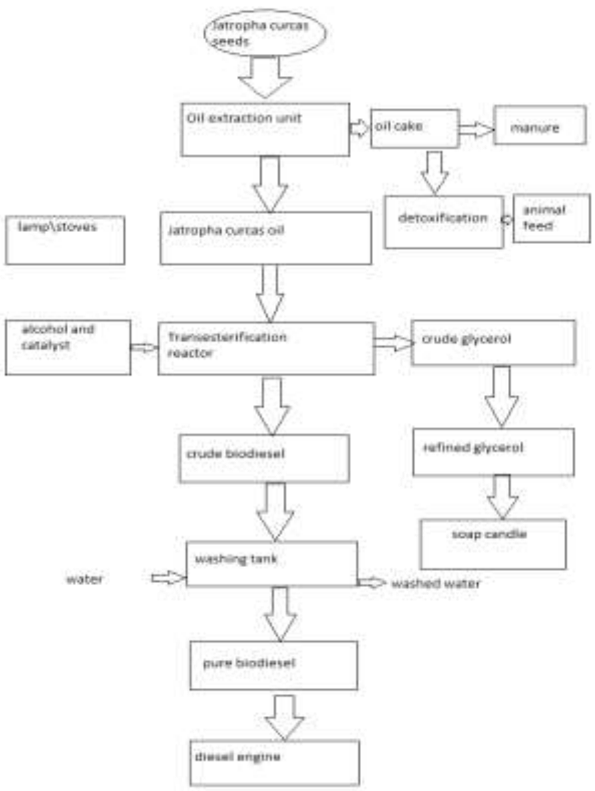

Fig.1 Processing steps of biodiesel production

Table -1: Properties of Deccan Hemp seed oil

Deccan Hemp seed Oil bio-diesel properties					
DHOME	Diesel	B10	B20	B30	B40
Flash point(^{0}C)	62	61	60	70	72
Fire point(^{0}C)	65	66	64	90	95
Density (Kg/m^3)	830	850.5	851.7	862.6	860.6
Viscosity(60^{o}c)	0.04214	0.04959	0.07657	0.06125	0.09006
CV(KJ/Kg)	42500	42230	41960	43600	43200

4.Engine Setup

Table 2: Engine Specification


Fig.2 Engine 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

5. RESULTS AND DISCUSSIONS

5.1 Performance Characteristics (DHOME)

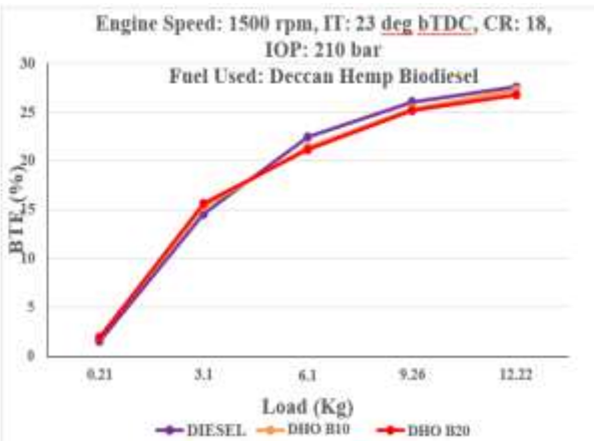

Fig.3 LOAD VS BTE

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5.1.2 Load Vs Specific Fuel Consumption

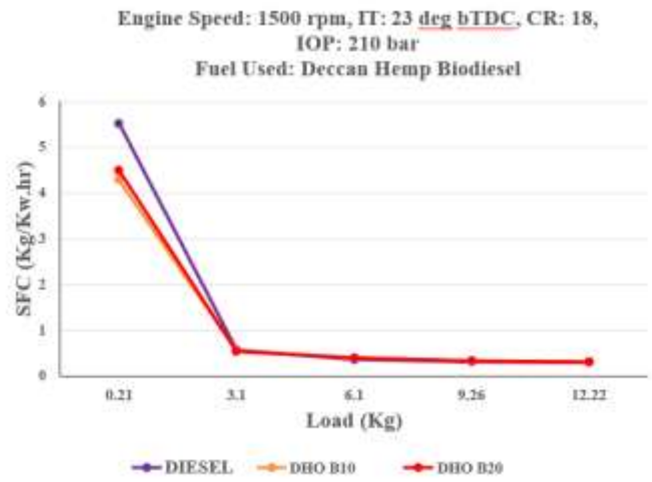

Fig.4 LOAD VS SFC

5.1.3 Load Vs Volumetric Efficiency

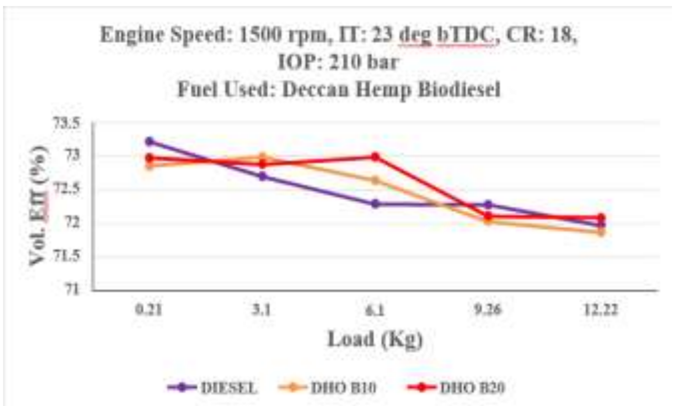

Fig.5 LOAD VS Vol efficiency

5.1.4 Load Vs Gas Exhaust Temperature

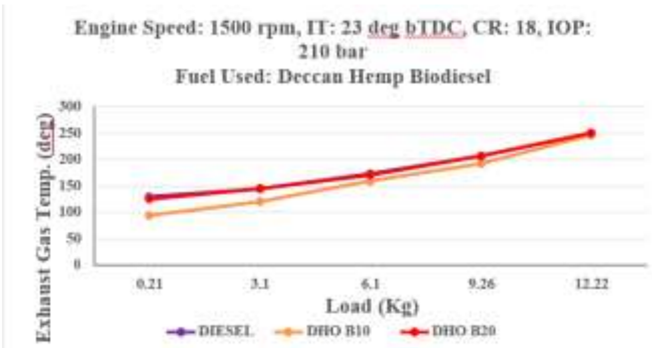

Fig.7 LOAD VS EGT

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5.2 Emission Characteristics (DHOME)

5.2.1 Load Vs Hydro Carbon

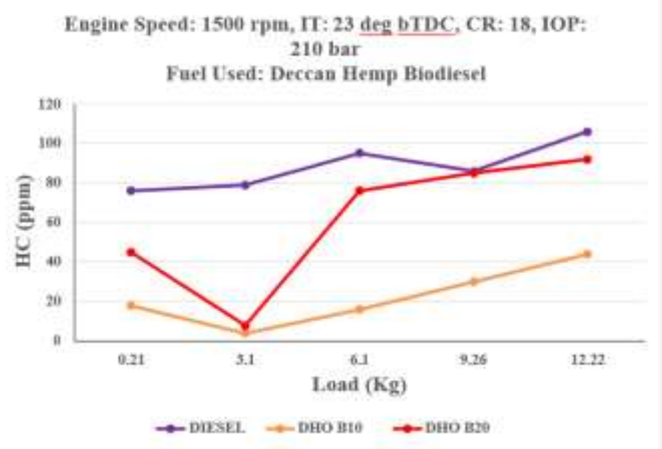

Fig.6 LOAD VS HC

5.2.2 Load Vs Nitrogen Oxide

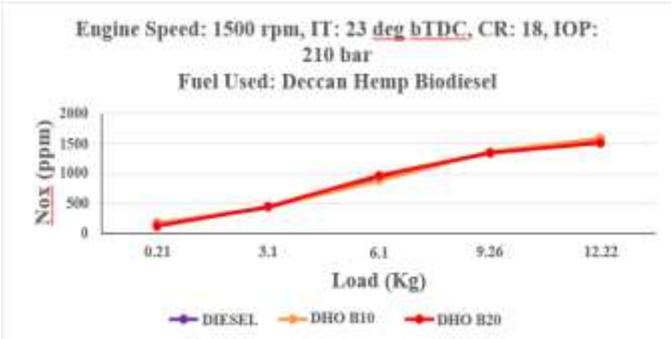

Fig.8 LOAD VS NO_X

5.2.3 Load Vs Carbon dioxide

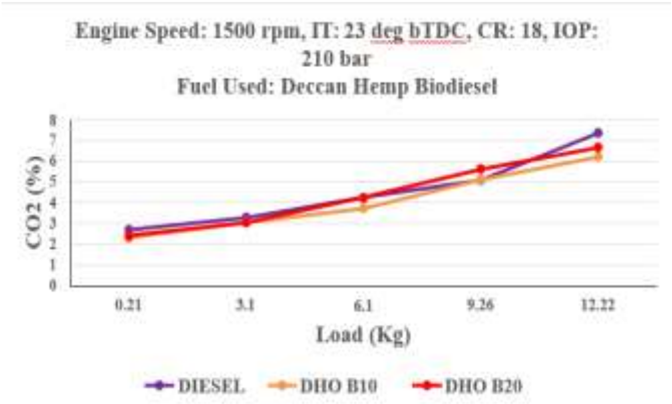

Fig.9 LOAD VS CO_2

5.2.4 LOAD VS O_2

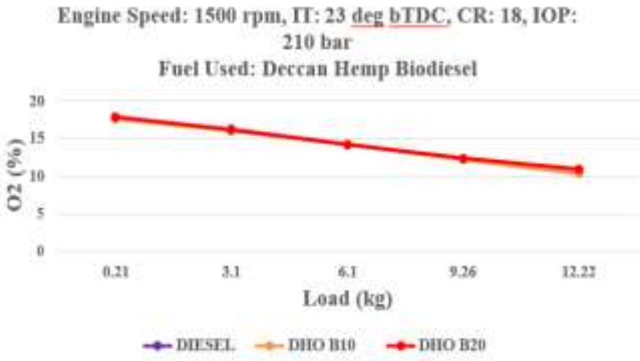

Fig.10 LOAD VS O_2

6. CONCLUSIONS

1. Performance, combustion and emission characteristics of DHOME B20 blend. The maximum brake thermal efficiency of DHOME B20 and DIESEL are respectively 26.74%, and 27.59%.
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, DHOME B20 is 0.32 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 3% of DHOME 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 DHOME 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 DHOME biodiesel than that of diesel. Higher CO2 emissions reduce harmful CO emissions. The percentage reduction in HC Deccan Hemp oil biodiesel is about 60% as compared to that of Diesel. Due to higher NOx emissions with pure DHOME 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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