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Experimental Investigation of Performance and Emission Effects of Honge Oil-Blended Biodiesel Combustion in an Internal Combustion Engine

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Abstract

Current energy regulations address environmental concerns, climate change, and the promotion of greener energy. Because of the use of fossil fuels, air pollution has become a severe hazard to human survival. In terms of fossil fuel usage, India ranks third in the world, posing challenges to social and economic growth. The simplest way is to use vegetable oil in a CI engine, but due to their high viscosity and low volatility, direct injection of vegetable oils into a CI engine causes several operating and durability issues. This issue is solved by preheating the oil using exhaust gas in a shell and tube heat exchanger, which reduces chemical processing costs. Present experimental research on the performance, emission, and combustion characteristics of diesel and hone oil blends (D100, B20, and B40) with preheating at various loads. The above blends are compared unheated and preheated by analysing various parameters such as break thermal fuel consumption BSFC,ISFC, thermal efficacies, powers, mass emission of various gaseous pollutants species such as CO,HC,CO2 and NOx, combustion parameters such as indicated mean effective pressure IMEP,BIMEP and FMEP, and so on. A thorough investigation found that all performance criteria are greatly improved, and in the event of blending, preheating delivers comparable results to diesel injection while producing lower emissions. Preheating reduces CO, CO2, and HC emissions by 20-25

percent due to enhanced combustion, while NOx emissions increase as combustion temperature rises.

Keywords: *Biodiesel, NOx emission, IC Engine, Preheated Honge Oil*

INTRODUCTION

It is known fact that transport is totally dependent on fossil fuels like petroleum based fuels such as gasoline, diesel fuel, LPG and CNG. These resources are depleting day by day so there is need for alternate technology to introduce a liquid fuels that can help for energy requirement for transportation [1a]. We all known that air is a ‘’nectar in life and without air life is not sustainable. But it is polluting due to ‘noxious ‘gases and particulate matter of highly toxic substances that are hazardous to health. ‘It is very much necessary to maintain air quality by reducing these emissions. Globally average energy consumptions are increased by 1.1% due to transportation. It is a largest share of 63% of the total growth in ‘world consumption of petroleum and other fuels. Therefore by analyzing above factors it is very urgent need to go for alternative fuels for these sectors.

Transportation sector is emitting higher GHG (Greenhouse gases) emission and it is reason for rapid oil demand all over the world. Every day an adult man normally breathes 10.8m3 of air. In that mainly comprises of 78% nitrogen and 21% oxygen and also some suspended particle in air causes dangerous effect on human health.

Due to rapid development of vehicle industry resulted in increased exhaust emission to environment such as’’ particulate matter (PM), Hydrocarbon (HC), Carbon dioxide (CO2), Carbon monoxide (CO) and nitrogen oxide (NOx) which highly responsible for air pollution. Therefore biofuels are cleaner fuels for IC engines and their renewable properties and reducing fossil CO2 discharge which ‘significantly contribute to changing climate issues.

Table 1 shows the properties of honge oil with baseline diesel.

Density (Kg/m3)	830	820	842
Specific gravity	0.83	0.82	0.842
Flash point(0C)	63	83	89
Fire point(0C)	66	95	100
Calorific Value(KJ/Kg)	42000	41618	39380

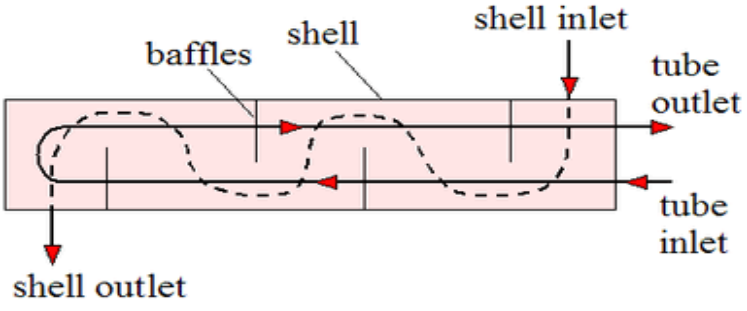
LITERATURE REVIEW

Alternative fuels, Waste heat recovery of an IC engine and use of biofuels with baseline diesel. It is proved that adoption of new methods will enhance the engine performance and emission characteristics. This ultimately helps to minimize the social and economic problems. To utilize waste heat from exhaust gas of an IC engine .It is known fact that in case of internal combustion engine only 30 to 35 % of supplied input energy is converted into useful work and remaining 70 to 65 % of energy goes as waste. Present work is in direction to utilize this waste energy to boost engine performance and good emission characteristics.

ABOUT HEAT EXCHANGER AND EXPIREMENTAL SETUP

As shown in Fig.1 it is a tabular type of heat exchanger which is generally built with circular tubes, Rectangular or round flat twisted. These are flexible in design because core geometry can be altering easily by changing tube diameters, length and arrangement.

Shell and tube heat exchangers are bundle of round tubes mounted in a cylindrical shell with the tube "axis parallel to that axis. In this one fluid flows inside the tubes and another flows across and along the tubes. In this type various type constructions are used based on required heat transfer and pressure drop performance. There are various methods are used to control thermal stresses by Preventing leakage, providing ease of cleaning, controlling corrosion ,contain operating pressure and temperature, and to accommodate asymmetric flows etc. Heat exchanger material should have 1. Low specific heat capacity, 2. Low thermal expansion coefficient, 3.Inert chemical property. Major components are: - 1. Tubes (Tube bundle), 2. Shell, 3. Front end head and Rear end head, 4.Buffels and 5.Tube sheets. Fig.3.2 shows model of shell and tube heat exchanger.



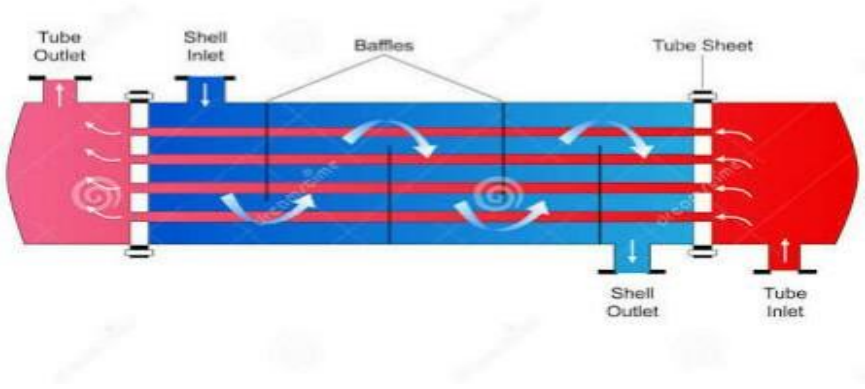


Fig.1 Schematic diagram of Shell and tube heat exchanger

Fig. 2 Shell and Tube Heat Exchanger

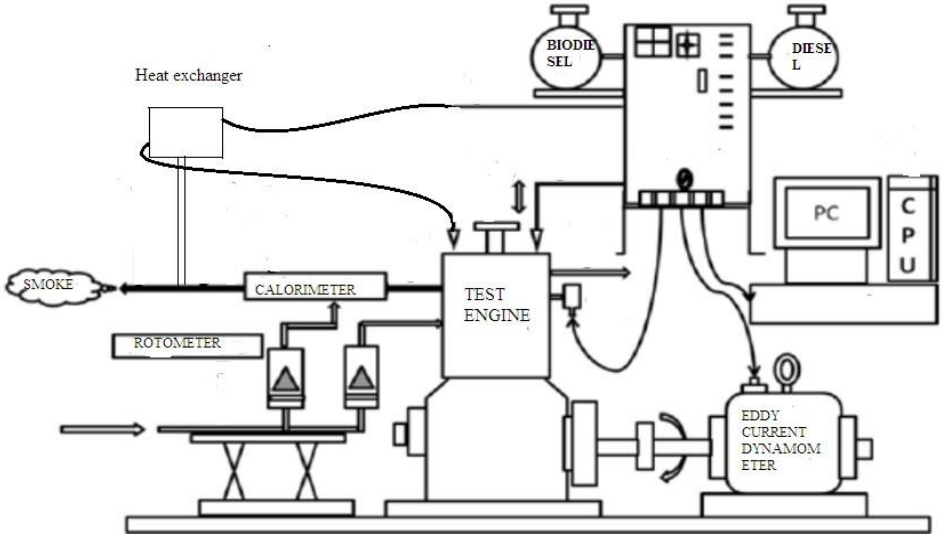


Fig. 2 Layout of VCR Engine Setup with Heat Exchanger

RESULT AND DISCUSSION

Fig.3 shows with preheating .It is observed that with preheating of fuel gives the improved in brake and indicated mean effective pressure .As honge has greater viscous compared to diesel it offers greater lubrication which ultimately reduce frictional mean effective pressure. With help of preheating there will be reduction in viscosity but due to complete combustion indicated and break mean effective pressure are increasing manner.

Fig.4. shows with preheating .It is observed that with preheating of fuel gives the stagnant values of IP, BP and FP but for higher loads these values will increase .For increased inlet temperature of fuel there will be complete combustion resulting the higher power production. Preheating will help to increase the power generation. Fig.5 shows with preheating .It is observed that with preheating break and indicated thermal efficiency are increasing at higher loads .As discussed above due to complete combustion the amount of power generation is also higher hence both indicated and break thermal efficiencies are increasing and it also evident that B20 provides better inner lubrication that may cause to increase break thermal efficiency.

Fig. 6 shows with preheating .It is observed that with preheating mechanical, volumetric and torque are increasing at higher loads .It is due to complete combustion and higher pressure rise will results in increased parameters. These results are more favorable for higher loads.

Fig.7 shows with preheating .By analyzing above graphs it shown that emissions like CO& CO2 are comparatively reducing .It is also known fact that CO emission of honge is less than diesel.CO2 is also reducing due to higher temperature and improved combustion.

Fig.8 shows with preheating .It is observed that with preheating HC and NOx are comparatively increasing manner. NOx increases with increase in temperature and degree of blending .NOx formation is sensitive to preheating .This is due to fuel is burnt at high temperature causing dissociation of N2, which leads formation of nitric acid and premixing of preheated fuel molecules takes place very rapidly. It is seen that HC remains stagnant.

Similarly the test is conducted on D100 and B40 blends.

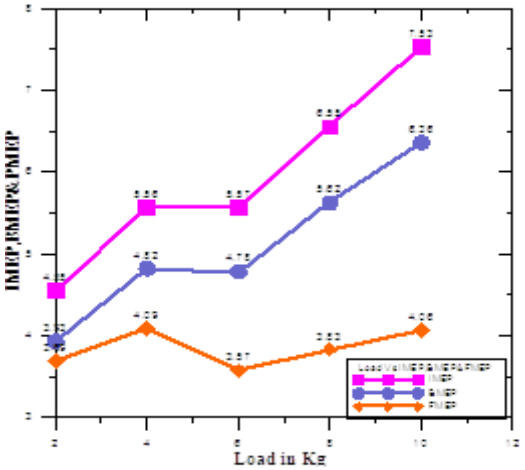


Fig.3 Load Vs IMEP, BMEP & FMEP

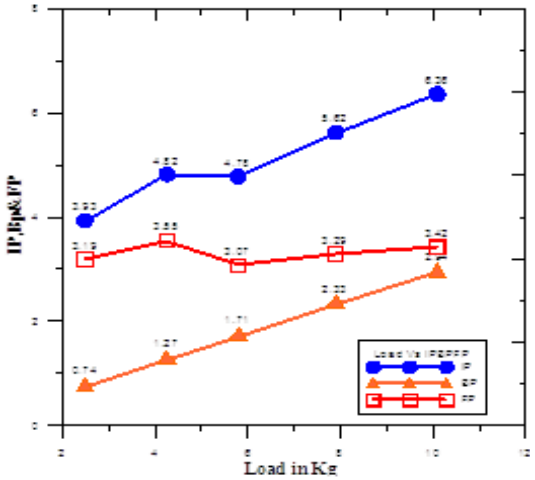


Fig.4. Load Vs IP, BP &FP

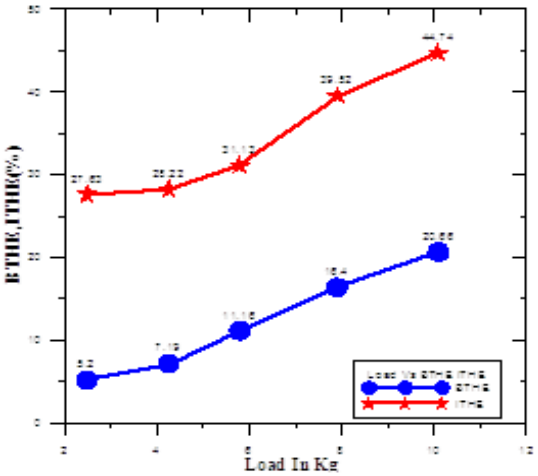


Fig.5 Load Vs BTHE and ITHE (%)

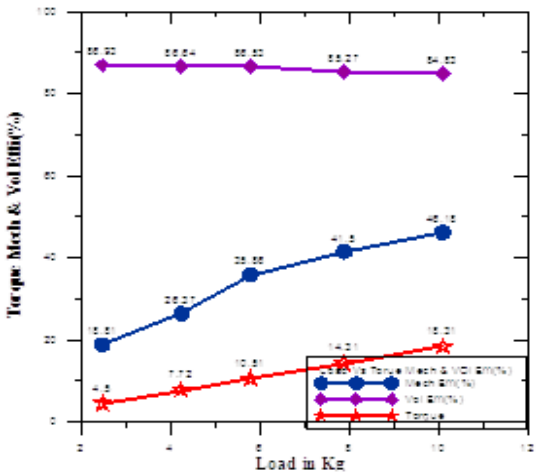


Fig.6 Load Vs Torque,Mech and Vol Effi(%)

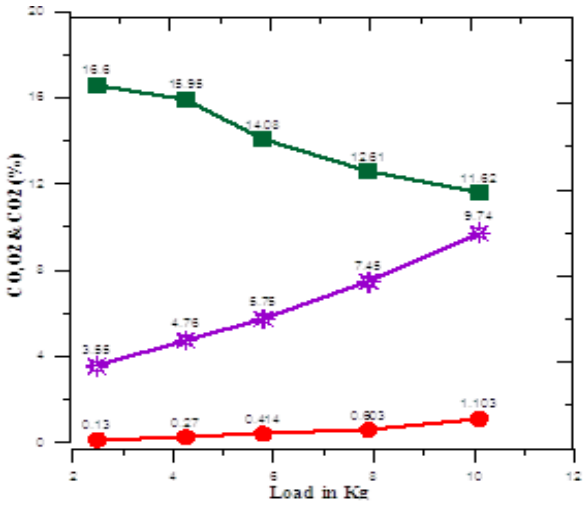


Fig.7 Load Vs CO,O2 & CO2(%)

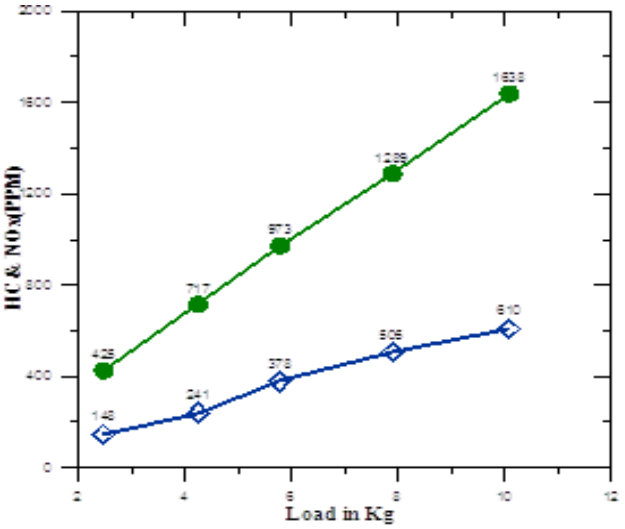


Fig.8 Load Vs HC & NOx (ppm)

CONCLUSION

World is facing three critical problems such as high fuel prices, climatic changes and air pollution. So it is a perfect time to go for alternative energy resources in that contrast biofuels play a very vital role in minimizing above mentioned problems.

Present work is by taking the honge oil as biodiesel in CI engine and blending with baseline diesel and preheating it by exhaust gas concludes the following points.

- Preheating of diesel with honge oil blending will significantly reduce the properties such as kinematic viscosity, density and surface tension which dominantly improve injection ultimately better fuel atomization.

- Preheating is also reduces the ignition problems by decreasing ignition delay period and it is helpful to knock tendencies.

- As it is evident that honge oil energy content less compared to diesel but by preheating the B20 blending it is clear that all performance parameters are equal to diesel.

- Preheating is effectively helpful to curb CO, CO2 emissions in D100 and B20 and in case of B40 CO2 slightly higher that also reduces for higher loads.

- In all three cases it is common that NOx is increasing with preheating it is due to increase in combustion temperature.
- HC remains unchanged and sometimes decreased by preheating

- Finally it is shown that preheating of B20 gives equivalent results compared to diesel without engine modification.

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