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REVIEW PAPER ON PERFORMANCE MEASUREMENT OF 4-STROKE DIESEL ENGINE USING PREHEATED OIL BASED BIO-DIESEL WASTE

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ABSTRACT

Bio-diesel is widely accepted as comparable fuel to diesel in compression ignition engine. It offers advantages like higher cetane number, reduced emissions of particulates. Moreover, transportation and agriculture sector depends on diesel fuel therefore, it is essential that alternatives to diesel fuels must be developed. In the view of these, vegetable oils like palm oil, cotton seed oil, Neem oil, pongamia oil are considered as alternative fuels to diesel which are promising alternatives. Natural gas is a mixture of hydrocarbons-mainly methane and is produced either from gas wells or in conjunction with crude oil production.

Bio-diesel fatty acid methyl or ethyl ester made from vegetable oils (both edible & non-edible) and animal fats. The main commodity sources for bio- diesel in India can be non-edible oils obtained from plant species such as Jatropha, Curcas, Karanj, Neem, Mahua etc. Bio-diesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a bio-diesel blend or can be used in its pure form just like petroleum diesel, bio-diesel operates in compression ignition

KEYWORDS: Preheated Biodiesel, Diesel, Viscosity, Mixture Formation, Performance, Emissions.

I. INTRODUCTION

An enormous increase in the number of automobiles in recent years has resulted in greater demand for petroleum products. With crude oil reserves estimated to last only for a few decades, therefore efforts are made on way to research on alternative to diesel. Depletion of crude oil would cause a major impact on the transport sector. Fossil fuels play the significant role in development of country. Continuous supply of fuel with increasing rate should be ensured to sustain and further development of country. Recently, significant problems associated with fossil fuel like short supply, drastically increasing price, non renewability, contamination of environment, adverse effect on bio systems compiles researcher to search for an alternative fuel, which promises a harmonious correlation with sustainable development, energy conservation, management, efficiency, and environmental preservation has become highly pronounced in the present context. Energy conservation is important for most of the developing countries, including rest of world. The rapid depletion in petroleum reserves and uncertainty in petroleum supply due to political and economical reasons, as well as, the sharp escalations in the petroleum prices have stimulated in search for alternatives to petroleum fuels. The situation is very grave in developing countries like India which import 70% of the required fuel, spending 30% of her total foreign exchange on oil imports.[1] In view of this, researcher found and analyze many energy sources like CNG, LNG, LPG, ethanol, methanol, hydrogen, bio-diesel and many more. Among these alternative fuels, India is having significant scope for development of bio fuel. Diesel engines are major source of transportation, power generation, marine application, agriculture vehicles etc. Bio-diesel is widely accepted as comparable fuel to diesel in compression ignition engine. It offers advantages like higher cetane number, reduced emissions of particulates. Moreover, transportation and agriculture sector depends on diesel fuel therefore, it is essential that alternatives to diesel fuels must be developed. In the view of these, vegetable oils like palm oil, cotton seed oil, Neem oil, pongamia oil are considered as alternative fuels to diesel which are promising alternatives.

II. METHODOLOGY

1. Experimental Setup

Experimental setup used Engine specification and other details are discussed in following section. Also, cooling of hydraulic dynamometer is done with water circulation.

2. Engine Specification

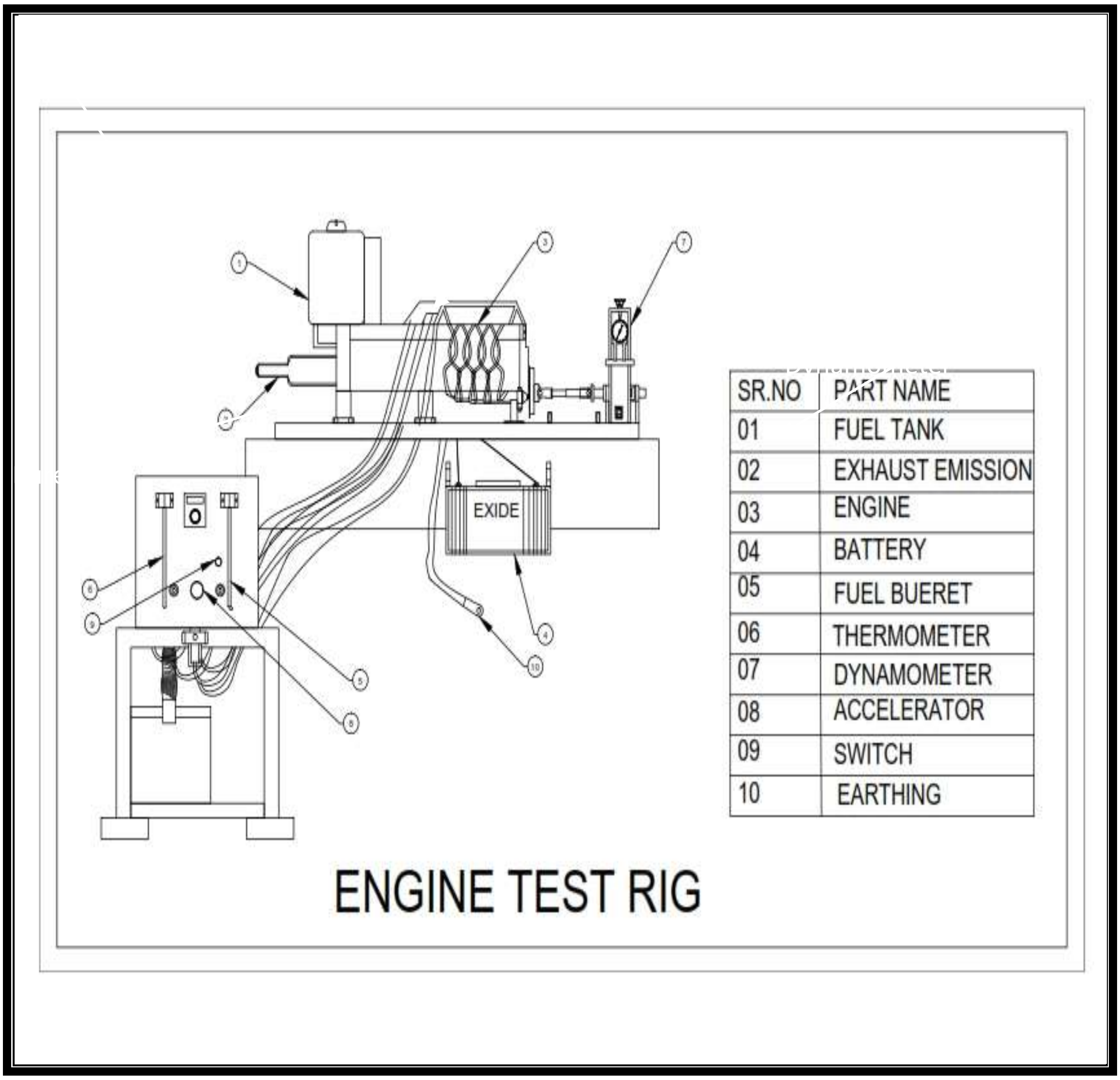

Figure.3.1. Line diagram of engine test rig

Experiments to be carried out at constant engine speed of 1500 RPM. Load is varied by changing excitation of hydraulic dynamometer. Starting from no load observations to be having for each fuel at six different loads. Observations are taken at time when exhaust gas temperature remains steady. Various performance parameters to be measured at each load and test fuel are mentioned below. Using measured data, brake power, brake thermal efficiency, brake specific energy consumption to be calculated for each test fuel including diesel.

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Fig3.2.Photo of engine test rig

Multi cylinder, four stroke, water cooled, direct injection CI engine is used for experimental purpose. Figure 3.1 shows the position of engine in experimental setup. Table 3.1 shows details of engine specification and other details of engine. Cooling water is circulated at constant flow rate.

Engine performance with diesel is measured first followed by B20, B40. Again engine performance is measured with B20, B40, B100, at different preheated temperature 18ºC, 20ºC with preheating in manner mentioned above. Data measured and calculated thus used for comparison with mineral diesel.

3. Specifications of testing engine

Table 3.1 Engine Specification

Make & Model	Tata Engine
General Details	Four stroke, Four cylinder, Vertical, Compression Ignition, Water cooled, Direct injection.
Bore	75 mm
Stroke	79.5 mm
Bhp	10 hp
Orifice	30 mm
Make	Tata

4. Experimental Procedure

Experiments to be carried out at constant engine speed of 1500 RPM. Load is varied by changing excitation of hydraulic dynamometer. Starting from no load observations to be having for each fuel at six different loads.

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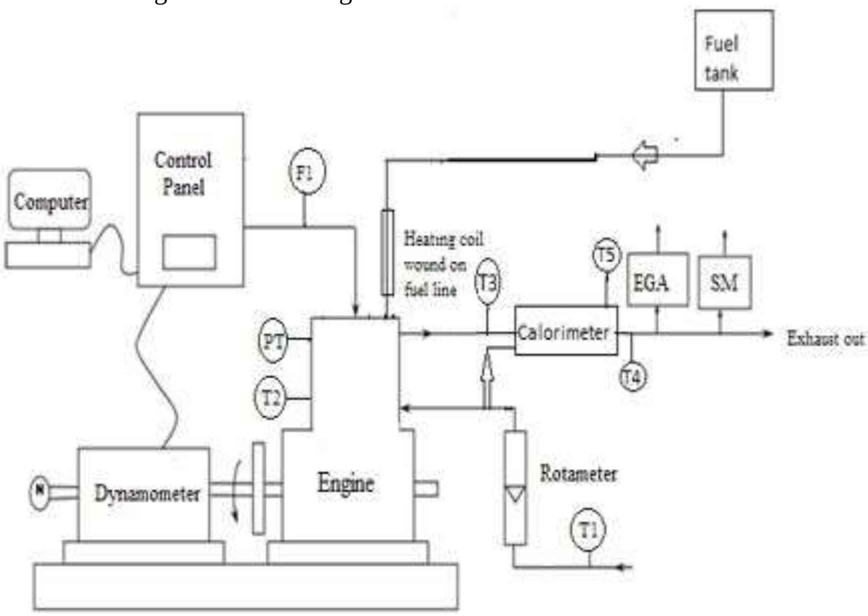
Observations are taken at time when exhaust gas temperature remains steady. Various performance parameters to be measured at each load and test fuel are mentioned below. Using measured data, brake power, brake thermal efficiency, brake specific energy consumption to be calculated for each test fuel including diesel.

- Time taken for 20ml fuel consumption.
- Exhaust Gas Temperature.
- Load on Dynamometer
- Temperature of outlet cooling water.
- Time taken for collecting 5 litre of cooling water.



T1- Inlet engine water temperature   PT- Pressure transducer

N- RPM decoder

T2- Outlet engine jacket water Temperature   EGA- Exhaust gas analyzer

F1- Fuel Flow (differential Pressure Unit)   SM- Smoke Meter

T3- Exhaust gas temperature   T4- Calorimeter exhaust temperature

T5- Calorimeter exhaust temperature

Figure 3.3. Schematic diagram of the experimental test rig

Engine performance with diesel is measured first followed by B20, B40 and B100. Again engine performance is measured with B20, B40, B100, at different preheated temperature 60ºC, 75ºC, 90ºC and 105ºC with preheating in manner mentioned above. Data measured and calculated thus used for comparison with mineral diesel.

Sample calculation to calculate brake power, brake thermal efficiency and brake specific energy consumption are described below:
N = 1500 RPM
W = Load on dynamometer (kg) = 10 kg

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T = Time required for 20 ml fuel consumption (sec) = 29.2042

Mass of test fuel (mf) = sample vol *Density = 0.20*0.820=0.164 kg

Calorific value of Diesel fuel (CV_{diesel}) = 41907.6 KJ/Kg

2950 Dynamometer constant

a. **Brake power**

BP = W * N /2950

BP = 10 * 1500 / 2950

BP = 5.0847 Kw

b. **Brake thermal efficiency**

BTE = BP * t / mf * CV

BTE =5.0847 * 29.2042 / 0.164 *41907.6

BTE =21.76542 %

c. **Brake Specific Energy Consumption.**

BSEC = mf * CV *3.6 / BP * t

BSEC = 0.164 *41907.6 *3.6 / 5.0847 *29.2042
BSEC=16.54000MJ/kWh

III. CONCLUSION

1. Exhaust gas temperature CO_2 and NO_x concentration have been increased when engine fueled with K20 and K30 as compared with pure diesel fule (D).
2. Brake thermal efficiency has been slightly increased with K20 and K30 blends as compared with pure diesel fule (D).
3. The bsfc has been reduced by 11.3%and 19.45% when engine fueled with K20 and K30 respectively at low load as compared with pure diesel.
4. The main objective of the present investigation was to reduce the viscosity of Jatropha oil close to that of conventional diesel in order to make it suitable for use in a C.I. engine and to evaluate the performance of the engine with new alternate fuels. In the present study, viscosity was reduced by preheating the Jatropha oil.
5. It was found that heating the Jatropha oil between at 100°C is reducing the viscosity of jatropha oil close to diesel.
6. It can be concluded from the experimental data that the BTE and BSFC of engine with PHJO fuel give optimum output at 20^0 BTDC fuel injection point and 150 kgf/ cm^2 injection pressure. Optimum fuel injection pressure and fuel injection point were evaluated for PHJO which was found to be 170 kgf/cm^2 and 20^0 BTDC for preheated jatropha oil.
7. For various blends and preheated biodiesel BSFC and exhaust gas temperature are found higher compared to Diesel at lower compression ratio

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