PERFORMANCE CHARACTERISTICS OF MULTI CYLINDER DIESEL ENGINE RUNNING ON JOME BIODIESEL AND DIESEL

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Abstract
The rapidly exhaustion of fossil fuels due to the soaring industrialization and vehicles of the world.The journey for alternative fills has been able to be unavoidable, looking enthusiasm of diesel for transportation segment. Biodiesel has turned into a key source as utilization fuels for diesel engines. Biodiesel gotten from vegetable oils are entirely encouraging option fills for diesel engine. Utilization of vegetable oils in diesel. In the present work, experimentation is carried out to study the performance, emission and combustion characteristics of JOME biodiesel and diesel. In this experiment a multi cylinder, four stroke, naturally aspired, direct injection, water cooled, eddy current dynamometer, TATA Indica V2 diesel engine is used at very low load condition. Crude oil is converted into biodiesel and characterization has been done. The experiment is conducted at low load condition. The engine performance parameters studied were brake power, brake specific fuel consumption, brake thermal efficiency.

Keywords: Alternative fuel, Biodiesel, JOME biodiesel, Performance, Transesterification.

I. INTRODUCTION

For more than two centuries, the world's energy supply has relied heavily on nonrenewable crude oil derived liquid fuels. Out of which 90% is estimated as to be consumed for energy generation and transportation. It is also known that emissions from the combustion of these fuels such as CO2, CO, NOx and sulfur containing residues are the principal causes of global warming. On the other hand, known crude oil reserves could be depleted in less than 50 years at the present rate of consumption. Thus, increased environmental concerns, tougher clean air act standards necessitates the search for a viable alternative fuels, which are environmentally friendly. Oil seed crops such as palm, soyabean, sunflower, peanut, olive etc are by far the largest
group of exploitable renewable biomass resource for liquid
fuel and energy generation.[1] The attractive features of bio-diesel fuel are:

- It is a plant derived, not petroleum derived, and such its combustion does not increase current net atmospheric levels of CO2, greenhouse'gas.
- It can be domestically produced, offering the possibility of reducing petroleum imports.
- It is biodegradable.
- Relative to conventional diesel fuel, its combustion products have reduced level of particulates, carbon monoxide, sulfur oxides, hydrocarbons etc.
- Vegetable oils can be used in diesel engines as they have high octane number and calorific value very close to diesel.

The present work aims to investigate the possibilities of the application of mixtures of biodiesel with diesel as a fuel for diesel engines. The present investigations are planned after a thorough review of literature in this field. The combinations of Jome biodiesel, along with diesel are taken for the experimental analysis.

II. EXPERIMENTAION

A. Transesterification

It is most commonly used and important method to reduce the viscosity of vegetable oils. In this process triglyceride reacts with three molecules of alcohol in the presence of a catalyst producing a mixture of fatty acids, alkyl ester and glycerol. The process of removal of all the glycerol and the fatty acids from the vegetable oil in the presence of a catalystis called esterification. This esterifies vegetable oil is called bio-diesel. Biodiesel properties are similar to diesel fuel. It is renewable, non-toxic, bio-degradable and environment friendly transportation fuel. After esterification of the vegetable oil its density, viscosity, cetane number, calorific value, atomization and vaporization rate, molecular weight, and fuel spray penetration distance are improved more. So these improved properties give good performance in CI engine.

B. Separation of glycerol from bio- diesel

Fig-1 Separation of glycerin

The Fig -1 shows the separation of glycerin from the bio- diesel. After reaction the oil is kept in a settling funnel for the process of separation. In which biodiesel, glycerin and catalyst are separated.

C. Properties of fuels used

- Density

  Fig 2 shows the hydrometer setup. Density is defined as the ratio of the mass of fluid to its volume. It is denoted by the symbol (rho). The SI unit is given by kg/m3. Density of diesel is 828 kJ/kg and density of JOME biodiesel is 864 kJ/kg.

Fig-2 hydrometer

- Calorific value

  The total quantity of heat liberated by complete burning of unit mass of fuel. The calorific value of a substance is the amount of energy released when the substance is burned completely to a final state and has released all of its energy. It is determined by bomb calorimeter as shown in fig 3 and its SI unit in kJ/kg. The calorific value of diesel is found that 42,600 kJ/kg and JOME biodiesel is 40,800 kJ/kg.

Fig-3 Bomb Calorimeter

- Flash and fire point

  Flash point of the fuel is defined as the temperature at which fuel gives off vapor to just ignite in air. Fire point of the fuel is defined as the temperature at which fuel will ignite continuously when exposed to a flame or spark. The flash point of biodiesel is higher than the petroleum based fuel. Flash point of biodiesel blends is dependent on the flash point of the base diesel fuel used and increase with percentage of biodiesel in the blend. Thus in storage, biodiesel and its blends are safer than conventional diesel. Determined by the instrument called Ables flash and fire point apparatus as shown in fig 4 The value of flash and fire point of diesel found that 51 oC and 57 oC respectively and JOME biodiesel is 160 oC and 175 oC respectively.

Fig-4 Ables flash and fire point apparatus

III. EXPERIMENTAL SET-UP

Experiments were performed in the internal combustion engine laboratory, Department of mechanical engineering, PDA College of engineering, Gulbarga. The experimental setup consists of multi (four) cylinder, four stroke, vertical, water cooled, computerised TATA make Indica V2 diesel engine. Fig 5 photograph taken from the IC engine laboratory connected to eddy current dynamometer for variable loading. The set as stand- alone type independent panel box consisting of air box, fuel tank, manometer etc. The set up enables study of engine for brake power, BMEP, brake thermal efficiency, mechanical efficiency, specific fuel consumption, volumetric efficiency.

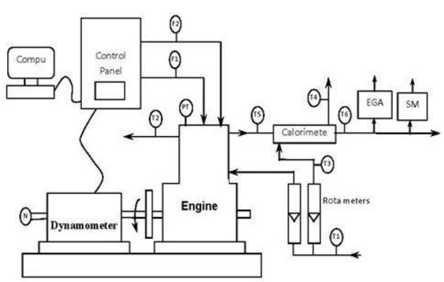

Fig. 2 Experimental Setup

IV. EXPERIMENTAL PROCEDURE

For getting the base line data of engine first the experimentation is performed with diesel and then with biodiesel.

- Fill the diesel in fuel tank
- Start the water supply. Set cooling water for engine at 650 LPH and calorimeter flow at 150 LPH.
- Also ensure adequate water flow rate for dynamometer cooling and piezo sensor cooling.
- Check for all electrical connections. Start electric supply to the computer through the UPS.
- Open the lab view based engine performance analysis software package “engine soft” for on screen performance evaluation.
- Supply the diesel to engine by opening the valve provided at the burette.
- Set the value of calorific value and specific gravity of the fuel through the configure option in the software.
- Select run option of the software. Start the engine and let it run for few minutes under no load condition.
- Choose log option of the software. Turn on fuel supply knob. After one minute the display changes to input mode then enter the value of water flows in cooling jacket and calorimeter and then the file name (applicable only for the first reading) for the software. The first reading for the engine gets logged for the no load condition. Turn the fuel knob back to regular position.
- Repeat the experiment for different load and speed.
- All the performance readings will be displayed on the monitor.

V. RESULTS & DISCUSSION

A. Performance characteristics of multi cylinder diesel engine.

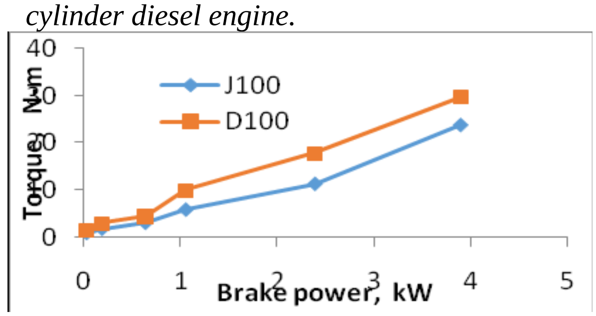

Fig 4.2.1 Variation of torque with brake power

Variation of torque with brake power is shown in fig 4.2.1 at low load condition. Torque obtained for the biodiesel is less as compare to the diesel. The maximum torque recorded for biodiesel is 23.6 N-m and diesel is 27.9 N-m at 3.9 kW brake power. Torque generation for biodiesel is low mainly due to higher viscosity.

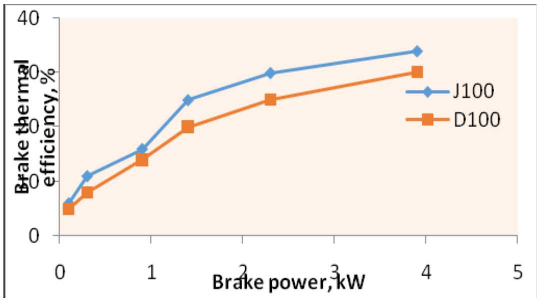

Fig 4.2.2 Variation of brake thermal efficiency with brake power

Variation of brake thermal efficiency with brake power shown in fig 4.2.2. Brake thermal efficiency increases with increase in brake power for both biodiesel and diesel. Maximum brake thermal efficiency of 46% for biodiesel and 83.31% for diesel is obtained. Biodiesel yields lower brake thermal efficiency compare to diesel because of higher viscosity and lower mean gas temperature.

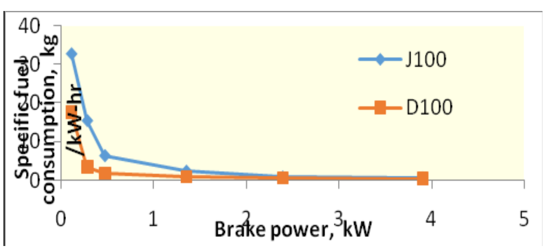

Fig 4.2.3 Variation of specific fuel consumption with brake power

Variation of specific fuel consumption with brake power is shown in fig 4.2.3. At the beginning specific fuel consumption is more and becomes constant with increase in brake power. In the idling condition specific fuel consumption of biodiesel is 32.76 kg/kW-hr at 0.11 kW and of diesel is 17.58 kg/kW-hr at 0.11 kW. Biodiesel consumption is more because of higher viscosity which produces improper air fuel mixture and hence poor combustion. Higher viscosity of biodiesel lowers the maximum temperature. So consumption of biodiesel is more for same power output.

VI. CONCLUSION

The purpose of this chapter is to summarize the preparation; characterization of biodiesel and the results of experiment have been carried out. The following section contains specific conclusions that have been drawn from the project work.
The conclusions of the project are as follows.
Neat JOME oil is converted into biodiesel using transesterification process.

- Characterization of JOME biodiesel is carried out, the specific gravity and calorific value of biodiesel is less than that of diesel.
- Viscosity of the neat JOME oil is at higher values. However viscosity of biodiesel is well comparable with diesel.
- Engine is producing the desired brake power at different speed compared with that of diesel.
- Brake thermal efficiency of biodiesel is lower than diesel.
- In the load range of 0 to 2.2 kW specific fuel consumption of biodiesel is higher, as load increases biodiesel comparable with that of diesel.

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