Performance Analysis of an I.C Engine Operating With Different Honge Oil Blends

R.Girimurugan[1], A.Jayachandhru[2], G.Magudeshwaran[3], M.Prakash[4], M.Sasikumar[5]
Assistant Professor[1], UG Scholars[2,3,4,5], Department of Mechanical Engineering, Nandha College of Technology, Erode, Tamilnadu, India-638052.
Email: giri2621988@gmail.com[1], chandhrumechnct@gmail.com[2], gmagudesh@gmail.com[3], prakashm022@gmail.com[4], sasi93mech@gmail.com[5]

Abstract- In this paper presents the performance analysis of an unmodified diesel engine fuelled with Honge oil and its blends with diesel. Engine tests have been conducted to get the comparative measures of Specific Fuel Consumption (SFC), Total Fuel Consumption (TFC), Heat Supply (QS), Brake Thermal Efficiency (BTE) and Indicate Thermal Efficiency (ITE). Results were compared with each other and finally best blend ratios are optimized. The present work presents the performance of diesel/Honge fuel blends in a diesel engine. Four blends were obtained by mixing diesel and Honge oil in the following proportions by volume: 95% diesel 5% Honge oil; 90% diesel 10%Honge oil; and 80% diesel 20% Honge oil. For comparison purposes, test runs were carried out for the pure diesel fuel. Experimental results show that the performance of the engine which is fuelled with honge oil blends is comparatively higher than Diesel fuel.

Index Terms- Single cylinder Diesel engine, performance analysis, honge oil blends.

1. INTRODUCTION

Fuels derived from renewable biological resources for use in diesel engines are known as biodiesel. Biodiesel is environmentally friendly liquid fuel similar to petrol-diesel in combustion properties. Increasing environmental concern, diminishing petroleum reserves and agriculture based economy of our country are the driving forces to promote biodiesel as an alternate fuel [1]. Oil content in the Jatropha and Pongamia seed is around 30- 40 %. India has about 80-100 million hectares of wasteland, which can be used for Jatropha and Pongamia plantation. India is one of the largest producer Neem oil and its seed contains 30% oil content. It is an untapped source in India [2].Experimental investigations have been carried out to examine properties, performance and emissions of different blends (B10, B20, and B40) of PME, JME and NME in comparison to diesel. Results indicated that B20 have closer performance to diesel and B100 had lower brake thermal efficiency mainly due to its high viscosity compared to diesel. However, its diesel blends showed reasonable efficiencies, lower smoke, CO and HC. Pongamia methyl ester gives better performance compared to Jatropha and Neem methyl esters [3].

2. ABOUT HONGE OIL

Honge oil is extracted from the seeds of the Honge tree. This tree is found all over India. In many places the leaves are used as green manure and the seed cake is used as fertilizer. Honge oil has fungicidal properties and is also traded as a non-edible vegetable oil. The inventor of the diesel engine, Rudolph Diesel, had used peanut oil in his engines. A lot of work was sub sequently done on vegetable oils before and during the Second World War in a world driven by political uncertainties and shortage of fossil fuels. In India, at least eleven vegetable oils were tried as diesel substitutes in Calcutta in the 1930s.Most of the physical and chemical properties of Honge oil were similar to those of diesel, though the 'Conrad son carbon residue' is higher in the case of Honge. This may call for frequent maintenance of the fuel injector. Considering that diesel fuel is often adulterated with other fuels and oils such as kerosene, the use of Honge oil may not cause problems that are worse than those being experienced already. Honge oil has to be preheated since the viscosity of the oil is much larger than that of diesel at room temperature. The power output of the diesel engine remains almost the same, though the calorific value of Honge is slightly lower. Honge oil will be less expensive than diesel in rural areas if the value of the cake, which is a good fertilizer, is taken into account. One hectare of Honge plantation could yield 10 tones of seeds which can yield gross revenue of Rs 40,000 (which is good revenue for dry land), provided high yielding plants are selected. Planting seedlings a hundred times more densely than is normally required (which is about a hundred trees per hectare). Though the yield per plant may be less in the earlier years, this is compensated for by the higher density. However, as the plants grow, weaker ones have to be selectively culled. The initial problems encountered in using Honge oil such as choking of filters and high viscosities. The suppliers of diesel engines had some reservations about the use of Honge oil earlier, but are now convinced that Honge oil can be used without any adverse impact on the engines.

3. PROBLEMS WITH VEGETABLE OILS

From previous studies, it is evident that there are various problems associated with vegetable oils being used as fuel in compression ignition (C.I.) engines, mainly caused by their high viscosity. The high viscosity is due to the large molecular mass and chemical structure of vegetable oils, which in turn leads to problems in pumping, combustion and atomization in the injector systems of a diesel engine. Due to the high viscosity, in long-term operation, vegetable oils normally introduce the development of gumming, the formation of injector deposits, ring sticking, as well as incompatibility with conventional lubricating oils. Therefore, a reduction in viscosity is of prime importance to make vegetable oils a suitable alternative fuel for diesel engines. The problem of high viscosity of vegetable oils has been approached in several ways, such as preheating the oils, blending or dilution with other fuels, trans-etherification and thermal cracking/pyrolysis.

4. TECHNIQUES IN PREPARING – BIODIESEL

Generally the following techniques are used for preparing of Biodiesel.

(1) Micro emulsification
(2) Blending
(3) Cracking
(4) Pyrolysis
(5) Transesterification
(6) Super Critical Method

5. TRANSESTERIFICATION PROCESS

To reduce the viscosity of the raw Honge oil, transesterification method is adopted. The procedure involved in this method is as follows: Sodium hydroxide [4g] is added to methanol [130ml] and stirred until properly dissolved. The solution thus prepared is called meth oxide which is added to raw Honge oil [850ml] and stirred at a constant rate at 600C for one hour. After the reaction is over, the solution is allowed to settle for 4-5 hours in a separating flask. The glycerin settles at the bottom and the methyl ester floats at the top (coarse biodiesel).Coarse biodiesel is separated from the glycerin and it is heated above1000^0C and maintained for 10-15 minutes for removing the untreated methanol. Certain impurities like sodium hydroxide (NaOH) etc are still dissolved in the coarse biodiesel. These impurities are cleaned two or three times by washing with 50 ml of petroleum ether and 100 ml of water for 1000 ml of coarse biodiesel. This cleaned biodiesel is taken up for the study.

6. REASON TO USE HONGE OIL

(1) Physical and chemical properties of Honge oil are similar to those of diesel.
(2) Availability in India is more.
(3) Harmless engine performance.
(4) No need of major modifications in Engine.
(5) Less expensive.
(6) Cake can be used as fertilizer.
(7) Tree based oil seed so the yield is more.
(8) Planting seedling a more densely than is normally required.

7. CHEMICAL AND PHYSICAL PROPERTIES OF HONGE OIL

The following table.1 shows the chemical and physical properties of transesterified honge oil were measured by various equipment in our Physics and chemistry Laboratory.

Table 1 Chemical and Physical Properties of Honge Oil

Sl.No.	Property	Units	Value	Equipments Used
1	Specific Gravity	-	0.937	Electronic Weighing Balance
2	Density	kg/m^3	937	Electronic Weighing Balance
3	Flash Point	˚C	270	Cleveland Open cup Apparatus
4	Fire Point	˚C	290	Cleveland Open cup Apparatus
5	Calorific value	MJ/kg	34	Bomb Calorimeter

8. TECHNICAL SPECIFICATIONS

Table.2 shows the technical specifications of the tested engine.Table.3 shows the technical specifications of the loading rheostat.Table.4 shows the technical specifications of the AC Generator. Table.5 shows the different measuring ranges of the Gas Analyzer.

9. EXPERIMENTAL SETUP

A load test on an engine provides information regarding the performance characteristics of the engine. The performance characteristics of such engines are obtained by varying the load on the engine.

The experiments were carried out on a single cylinder 4 stroke diesel engine of a model manufactured by Kirloskar oil engines Ltd., the largest manufacturer of portable multi-fuel engines. The Kirloskar engine is a single cylinder, vertical and air cooled diesel engine. It is coupled to a 3 phase loading rheostat. A fuel tank with a measuring burette enables the engine fuel consumption to be measured. The loading rheostat is coupled by means of rigid coupling carefully without any misalignment between axes. The proper alignment helps to damp-out any vibration that may occur during transmission.Fig.1 shows the engine which is used for our testing. Fig.2 shows the loading rheostat which is used to gives the external load to the test engine. Fig.3 shows the gas analyzer which is used to measure the amount of exhaust emissions in test engine.

Table 2 Technical details of the Engine

Type	Four stroke, single cylinder, air cooled, vertical engine.
Made	Kirloskar oil engines Ltd, Pune, India.
Loading Device	Alternator with resistance load.
Speed	1500 RPM
Power	6 HP
KW	4.4

Table 3 Technical details of the Loading Rheostat

Sl.No.	Parameters	Range
1	Watts	5 KW
2	Phase	3 Phase
3	Volts	230 V

Table 4 Technical Details of the AC Generator

Sl.No.	Parameters	Range
1	Volts	230 V
2	Frequency	50 Hz
3	Speed	1500 rpm
4	Phase	Single
5	Amps	21.7 A

Table 5 Measuring Range of Gas Analyzer

Sl.No.	Parameters	Measuring Range
1	CO	0.00-20%
2	CO_2	0.00-20%
3	HC	0-15000 ppm
4	NO_X	0-5000ppm
5	O_2	0.0-23.0%
6	AFR	0.0-99.0
7	Operating	0-40^{0}C
8	Power Source	AC 220V±10% 60 HZ

Fig.1. Tested engine

Fig.2. Loading Rheostat

Fig.3 Gas Analyzer

10. RESULTS AND DISCUSSIONS

The following discussions have been made based on the experimental results.

10.1. Specific Fuel Consumption (SFC)

Fig.4 shows the specific fuel consumption (SFC) value of the engine is decreasing with the increased load on the engine. Then the SFC value decreased with compare diesel value at the same time increasing Honge oil blend resulting the decreased SFC value.B20 gives the better SFC value compare than other blend value and diesel.

10.2. Total Fuel Consumption (TFC)

Fig.5 shows the total fuel consumption (TFC) value of the engine is increasing with the increased load on the engine. Then the TFC value decreased with compare diesel value at the same time increasing Honge oil blend resulting the decreased TFC value. B20 gives the better TFC value compare than other blend value and diesel.

10.3. Heat Supply (QS)

Fig.6 shows the heat supply (QS) value of the engine is increasing with the increased load on the engine. Then the QS value decreased with compare diesel value at the same time increasing Honge oil blend resulting the decreased TFC value. B20 gives the better QS value compare than other blend value and diesel.

10.4. Brake Thermal Efficiency (BTE)

Fig.7 shows that the Brake thermal efficiency of the Engine gradually increased with increasing load (up to 3.5 KW) then slightly decreases with increased load Honge oil blend B20 gives the highest Brake Thermal Efficiency(28.50 %) compared with diesel (25.27%) and other Honge oil blend value. Diesel value gives low Brake thermal efficiency compared with all Honge oil blends.

10.5. Indicate Thermal Efficiency (ITE)

Fig.8 shows that the Indicate Thermal Efficiency of the Engine gradually increased with increasing load (upto1.5 KW) then slightly decreases with increased load. At load (1.5KW) the Honge oil blend B20 gives the highest Indicate Thermal Efficiency (39.10 %) compare than diesel (35.32%).

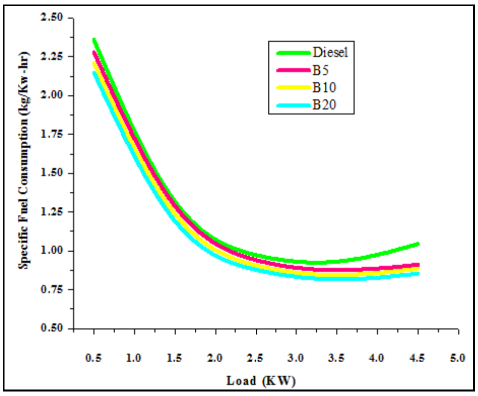

Fig.4 Load vs specific fuel consumption at varying loading conditions

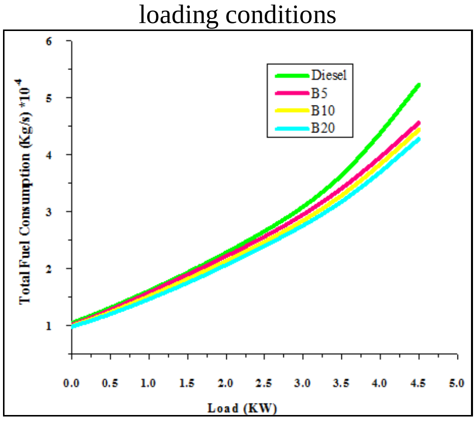

Fig.5 Load vs total fuel consumption at varying loading conditions

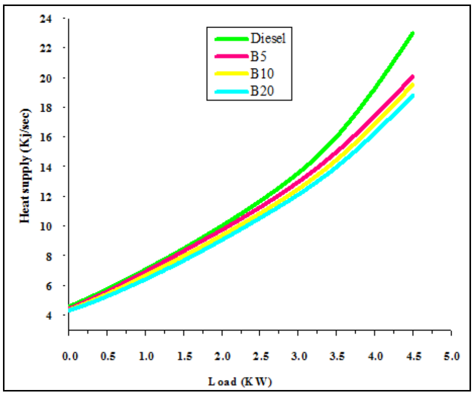

Fig.6 Load vs heat supply at varying loading conditions

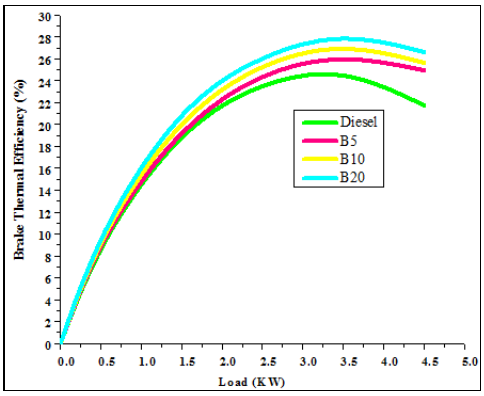

Fig.7 Load vs brake thermal efficiency at varying loading conditions

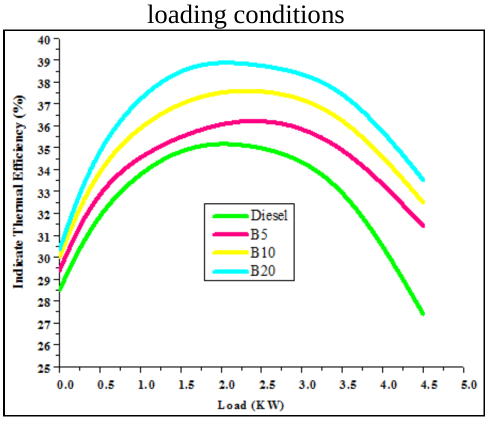

Fig.8 Load vs indicate thermal efficiency at varying loading conditions

Summary

Following are the conclusions based on the experimental results obtained while operating single cylinder diesel engine fuelled with biodiesel from Honge oil. Honge oil blended with diesel (biodiesel) can be directly used in diesel engines without any engine modifications. The specific fuel consumption is reduced by increase of blend of Honge oil. At starting condition SFC is high for various blends, and then it is reduced for increase of load. B20 gives the less SFC value compared with diesel. The total fuel consumption is reduced by increase of blend of Honge oil compared with diesel. At starting condition TFC is low for various blends, and then it is increase of load.

Brake thermal efficiency of B5, B10 and B20 blends are better than diesel. Indicate thermal efficiency of B5, B10 and B20 blends are better than diesel.

REFERENCES

[1] Ramadhas, A.S; Jayaraj, S; Muraleedharan, C. (2004): Use of Vegetable Oils as I.C engine Fuels: A Review". Renewable Energy. **29**, pp. (727-742).
[2] Barnwal, B.K; Sharma, M.P. (2005): Prospects of biodiesel production from vegetable oils India. Renewable and Sustainable Energy Reviews.**9,** pp. **(**363-378).
[3] Venkateswara Rao, T; Prabhakar Rao, G; Hema Chandra Reddy, K. (2008): Experimental Investigation of Pongamia, Jatropha and Neem Methyl Esters as Biodiesel on C.I. Engine. Jordan Journal of Mechanical and Industrial Engineering. **2,** pp. (117-122).