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"Performance analysis of Bio-diesel In C.I.Engine"

Mr. Niraj R. Shingala [1], Dr. Arick M. Lakhani[2], Mr. Hardik A. Khunt[3], Pankit B. Kondhiya[4], Mr. Parth V. delvadiya[5]

[1,2,3,4,5] Assistant Professor,

V.V.P. Engineering College, Rajkot Gujarat - India

*Abstract***— In the present study a 4-stroke 5hp diesel engine was tested with diesel oil plus cottonseed oil blends. The blends in different proportions (10 to 30% by volume) were tested at constant speed and characteristics like brake power, brake efficiency, specific fuel consumption etc. Engine performance for blends resulted in investigations reveal that the performance of the blend is comparable with that of diesel. Hence blends can profitably employed in an existing engine modification, further it can be an immediate solution for the development of area, and for the emergency use in the event of severe diesel fuel shortage.**

*Index Terms***—Diesel Engine, Performance Test, Bio Diesel**

I. INTRODUCTION

High prices coupled with the lack of petroleum reserves and environmental concerns have sparked a search for renewable engine fuels. As most of the developing nations are agricultural nation, producing plenty of oilseed crops and production of vegetable oils will not be a difficult task.

In the present investigation blends of cottonseed oil and diesel oil have been chosen, as a fuel for Cl engine, Experimental investigation has been carried out to assess the feasibility of these oils as CI engine fuels due to the following reasons (a) Present petroleum resources are dwindling at a fast rate (b) Some alternate fuel has to take the place of these fuels, in order to sustain the economic growth, and (c) the fuel must be violable in ample quantity conforming to economic & environmental condition. Vegetable oils as alternate Cl engine fuels have received modest interest for several decades, however economics factor have favored the use of petroleum based fuels.

The first use of peanut oil was made in 1895 by Dr. Rudolf diesel himself. It predicted "The use of vegetable oils for engine fuels may seem insignificant today. but such oils may become in course of time as important as petroleum and coal tar products f the present time". At present, the uncertainties concerning adequate, stable supplies of petroleum fuels have renewed interest in vegetable oils a CI engine fuel, initial use of vegetable oils as Cl engine fuels may be regional and confined to rural areas, where they are readily available.

One of the probable first applications could be on farm pumps and agricultural tractors and rural transportation. Engines using vegetable oils can produce the same power output, however with reduced thermal efficiency and increased emissions.

The specific objectives of the experimental study are as following.

1. The effect of cottonseed oil plus diesel oil blends on diesel engine performance characteristics
2. Cold starting characteristics of the engine
3. The effect of cottonseed oil plus diesel oil blends on exhaust ion of the engine.
4. Overheating problem and engine vibrations because of the use of cottonseed oil.
5. The feasibility of cottonseed oil plus diesel oil blends as diesel fuel extenders, and for emergency use in the event of severe diesel fuel shortage.
6. Determination of the optimum percentage of cottonseed oil and diesel oil blends for a fairly good engine performance.
7. Feasibility of other non-oils like Karajan oil. Jatropha oil. Mahua o linseed oil. Neem oil etc. in Cl engine at higher compression ratios.

II. LITERATURE REVIEW

Evaluation of biodiesel obtained from cottonseed oil-**Umer Rashid Farooq Anwar**, Gerhard Knothe Esters from vegetable oils have attracted a great deal of interest as substitutes for petro diesel to reduce dependence on imported petroleum and provide a fuel with more benign environmental properties. In this work biodiesel was prepared from Cotton oil by transesterification with methanol, using sodium hydroxide, potassium hydroxide sodium methoxide and potassium methoxide as catalysts. A series of experiments were conducted in order to evaluate the effects of reaction variables such as methanol/oil molar ratio (3 15 D, catalyst concentration (0.25-I-50%) temperature (25-65ºC), and stirring intensity (180-600 mm) to achieve the maximum yield and quality. The optimize variables of 6:1 methanol/oil molar ratio (mol/mol) 0.75% sodium methoxide concentration (wt.%), 65ºC reaction temperature, 600 RPM agitation speed and 90 min concentration reaction time offered the maximum methyl ester yield (96.9%), The obtained fatty acid methyl esters (FAME) were analyzed by gas chromatography (GC) and 1H NMR spectroscopy. The fuel properties of cottonseed oil methyl esters COME. cetane number, kinematic viscosity. oxidative stability, lubricity, cloud point, pour point, cold filter plugging point, flash point, as content, sulfur content, acid value, copper strip corrosion value, density, higher heating value, methanol content, free and bound glycerol were determined and are discussed in the light of biodiesel standards such as ASTM D675 and EN 14214.

Combustion and emissions of cottonseed oil and its bio-diesel in blends with either n- butanol or diethyl ether in HSDI diesel engine **D.C. Rakopoulos** This experimental investigation evaluates the combustion and exhaust emission characteristics of cottonseed oil and its (methyl ester) bio-diesel in blends with 20% by vol. of either n-butanol or diethyl ether (DEE), fueling a standard, experimental, single cylinder, four-stroke, high-speed direct injection (HSDI), Hydra diesel engine, The tests are conducted using each of the above fuel blends or neat cottonseed oil or its neat bio. operating at three different loads. Fuel consumption, exhaust with the engine smoke, nitrogen oxides (NOx), carbon monoxide (CO) and total unburned hydrocarbons are measured. The differences in the performance and exhaust emissions of these fuel blends from the baseline operation of the diesel engine, i.e. when working with neat cottonseed oil or its neat bio-diesel are compared. Fuel injection and combustion chamber pressure diagrams are obtained, and heat release rate analysis of the latter ones is performed revealing some interesting features of the combustion mechanisms. These results and the widely differing physical and chemical properties of n-butanol and DEE against those for the cottonseed oil and its bio-diesel are used to aid the correct us interpretation of the observed engine behavior. It is revealed that n-butanol and DEE. which can be produced from biomass (bio-butanol and bio-DEE), when added to the vegetable oil or its bio-diesel improve the behavior of diesel engine.

Effects of injection timing on bio-diesel fuelled engine characteristics-An overview –N Panneerselvama, A Murugesan, **C.Vijayakumar, A.Kunnaravel, D. Subramaniam**, A. Avinash In day to day life, we are in need of alternative fuel to create an eco-friendly environment and also to meet increasing energy consumption rates. The specific characteristics such as renewability, sustainability and clean burning capacity put ahead the bio-diesels as one among the best choice for alternative fuels. Though there are several ideas and technologies to confront the challenges, they are often confined to distant future, especially with regard to CI engines. This are view depict show straight vegetable oil affects the fuel injection nozzle, ring sticking. dilution of the lubricating oil. Also, the different techniques of biodiesel production from straight vegetable oil (SVO) are included.

Preparation and characterization of methylic and ethylic biodiesel from cottonseed oil and effect of tert-butyl hydroquinone on its oxidative stability -David M. Fernandes, Dalyelli, Flaysner, M Portela, Rosana M.N. Assuncao, Rodrigo A.A. Munoz, Manuel **G.H. Terrones**. This work reports the preparation and characterization of methylic and ethylic biodiesel from cottons oil. Biodiesel was prepared by a transesterification process involving the reaction of the oil with methanol or ethanol using KOH as catalyst. The conversion of triglycerides to the corresponding methyl and ethyl ester was 91.5 and 88.5 (wt%). All the physical chemical properties of the obtained biodiesels met the minimum or maximum of the EN 14214 except oxidation stability. The addition of the synthetic antioxidant tert-butyl hydroquinone at the concentration of 300 mg kg was sufficient to obtain acceptable oxidation stability values (>6 h). Thermogravimetric analysis was also performed and similar profiles were verified for both ethylic and methylic biodiesels. Therefore, this work demonstrates the feasibility of using the ethanolic route to produce cottonseed oil biodiesel

III. PROBLEM CREATED BY DIESEL AND MINIMIZE BY COTTON SEED OIL

Problem by using diesel

1. Limited sources
2. Non renewable
3. Environmental Pollution Rate High Due To HC, Co, SO2, etc.
4. More Depend on Other Countries
5. More Friction Loss

Problem minimize by using cotton seed oil in diesel

1. Unlimited Sources
2. Reduce dependency on crude oil imports
3. Provide employments in agricultural field
4. Renewable
5. Less pollution rate due to HC. So2, PM, co etc.
6. Easily available in India
7. Less friction
8. Less transportation cost.

In the present work, experimental tests have been carried out to evaluate the performance, emission and combustion characteristics of a diesel engine using cotton seed oil (CSO) and its blends of 10% 20% and 30%and standard diesel fuel separately. The common problems posed when using vegetable oil in a compression engine are poor carbon deposits, ring sticking, etc. This is because of the high viscosity and low volatility of vegetable oil. When blended with diesel CSO presented volatility, better combustion and less carbon deposit. It was found that there was a reduction in NO, emission for CSO 100 and its diesel blends that with a marginal increase in HC and Brake thermal efficiency was slightly lower for CSO 100 and its diesel blends.From the combustion analysis, it was found CSO-diesel blends performed better than CSO 100.

IV ENGINE SPECIFICATION AND EXPERIMENTAL SETUP

Engine specifications

1. Types of fuel : Diesel and cotton seed oil
2. No. of cylinder : Single
3. No. of stroke : 4-stroke
4. Cooling method : Water cool
5. Method of injection : Direct injection
6. Bore = 80mm
7. Stroke = 110mm
8. Rated power = 3.7 KW at 1500 RPM
9. Dynamometer : Eddy current dynamometer

Experimental setup

The present experimentation is carried out on single cylinder, direct injection, water cooled diesel engine having (5 HP) 3.7KW as rated power at 1500 RPM. The engine is provided with an open combustion chamber. The engine was coupled to a dynamometer to measure its output. The fuel flow rates were measured with calibrated a burette. Blends of cotton seed oil+ diesel oil were prepared as 10%, 20%, 30% for better homogenization compressed air is passed through the blends. All the tests conducted at identical conditions of engine stability.

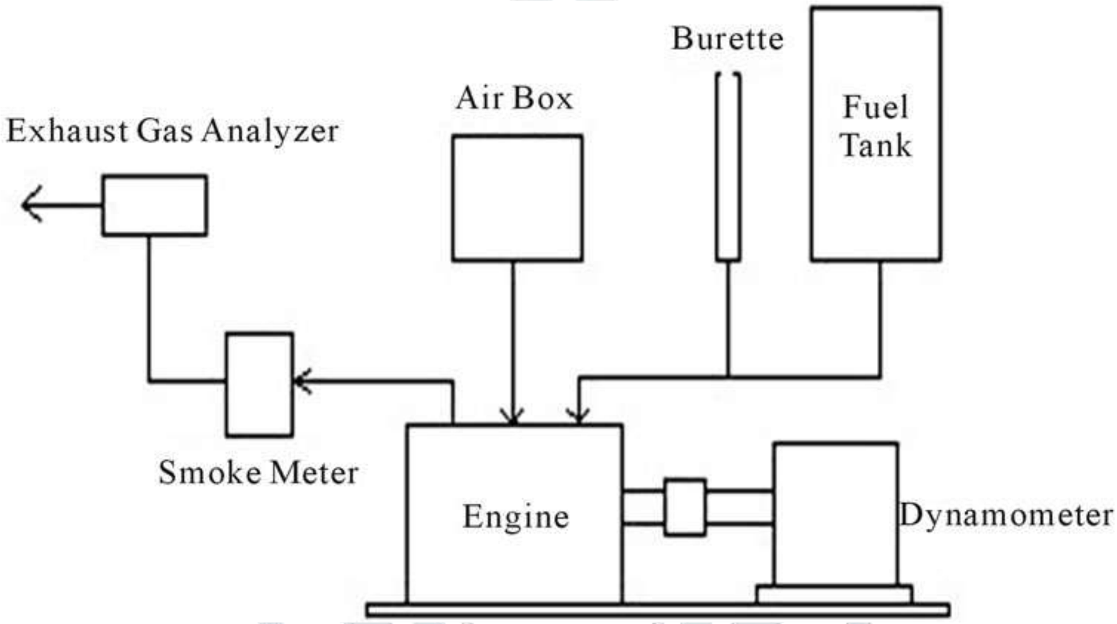

Fig. Experimental setup

(1) Engine
(2) Dynamometer
(3) Smoke Meter
(4) Exhaust Gas Analyser
(5) Air box
(6) Burette
(7) Fuel tank

The injection timing and compression ratio were unaltered during the entire testing. By keeping the speed constant at 1500 rpm and without changing any engine setting the following parameters were studied, Brake power output, Brake thermal efficiency, Exhaust gas temperature, Exhaust particulate the matter etc. Before testing, all components are inspected and cleaned properly. Crankcase lubricating oil is changed because partially burned fuel reacts with cylinder walls to dilute or contaminate lubricant. Initially operated on 100% diesel for 10 minutes to preheat the engine and then blends of CSO+DO in the ratio of 10%+90% is supplied to the engine and its performance, exhaust emissions are determined. The procedure is repeated with 20%+80%, and 30%+70%, it is observed that though the exhaust emissions are not much affected the performance is seriously affected. Hence further reduction in the proposition of diesel is not advisable as it results in maximum wear and tear due to improper combustion.

Inlet manifold plays an important role in performance of an engine. Air flows into the cylinder through the intake port via intake manifold in the form of a jet with maximum velocity at the exit of the intake valve. In the present work inlet manifolds are manufactured with different angle inclinations using mild steel. The manifolds are manufactured with angles 300, 60 0, 90 0 and normal. Also in most of the cases, it is seen that the jet of air after leaving the intake port impinges onto the cylinder wall and diverts back causing the formation of small and large scale vertices within the cylinder Arrangement of intake manifolds in to different angles as shown in below figures.

V EXPERIMENT RESULT OF DIESEL & BIODIESEL

DIESEL:

- Brake power = 0.9325 KW

η_m = 0.8
η_b = 0.18
CV = 44000 KJ/kg.hr

Mass flow rate = $\frac{BP*3600}{CV*\eta b}$
= $\frac{0.9325*3600}{44000*0.18}$
= 0.423 Kg/hr

$\eta_i = \frac{\eta b}{\eta m} = \frac{0.18}{0.8} = 0.23$

I.P = $\eta_i * M_f * CV$
= $\frac{0.23*0.423*44000}{3600}$
= 1.18KW

F.P = I.P – B.P
= 1.18-0.9325
= 0.247 KW

10% Cotton seed oil + 90% Diesel :
Brake power = 0.9325 KW
η_m = 0.8
η_b = 0.15
CV = 43800KJ/kg.hr

Mass flow rate = $\frac{BP*3600}{CV*\eta b}$
= $\frac{0.9325*3600}{43800*0.15}$
= 0.51 Kg/hr

$\eta_i = \frac{\eta b}{\eta m} = \frac{0.15}{0.8} = 0.187$

I.P = $\eta_i * M_f * CV$
= $\frac{0.187*0.51*43800}{3600}$
= 1.162KW

F.P = I.P – B.P
= 1.162-0.9325
= 0.23 KW

20% Cotton seed oil + 80% Diesel :
Brake power = 0.9325 KW
η_m = 0.8
η_b = 0.135
CV = 43400KJ/kg.hr

Mass flow rate = $\frac{BP*3600}{CV*\eta b}$
= $\frac{0.9325*3600}{43400*0.135}$
= 0.57 Kg/hr

$\eta_i = \frac{\eta b}{\eta m} = \frac{0.135}{0.8} = 0.168$

I.P = $\eta_i * M_f * CV$
= $\frac{0.168*0.57*43400}{3600}$
= 1.154KW

F.P = I.P – B.P
= 1.154-0.9325
= 0.222 KW

30% Cotton seed oil + 70% Diesel :
Brake power = 0.9325 KW
η_m = 0.8
η_b = 0.13
CV = 43000KJ/kg.hr

Mass flow rate = $\frac{BP*3600}{CV*\eta b}$
= $\frac{0.9325*3600}{43000*0.13}$
= 0.60 Kg/hr

$\eta_i = \frac{\eta b}{\eta m} = \frac{0.13}{0.8} = 0.16$

I.P = $\eta_i * M_f * CV$
= $\frac{0.16*0.60*43000}{3600}$
= 1.146KW

F.P = I.P – B.P
= 1.146-0.9325
= 0.213 KW

Brake Power = 0.9325KW

Fuels	Breake Power (KW)	Brake Efficiency (%)	Mass Flow Rate (Kg/hr)	Indicated Efficiency (%)	Indicagted Power (KW)	Friction Power (KW)
Diesel	0.9325	18	0.423	23	1.18	0.247
10% Cotton seed oil + 90% Diesel	0.9325	15	0.51	18.7	1.162	0.23
20% Cotton seed oil + 80% Diesel	0.9325	13.5	0.57	16.8	1.154	0.222
30% Cotton seed oil + 70% Diesel	0.9325	13	0.60	16	1.146	0.213

VI CONCLUSION

1. Based on the investigation the following conclusions are drawn:
2. From the chart we can say that pollutants HC, Co, CO2, SO2 are decreased.
3. Blends of up to 30% can be successfully employed in the rural areas to meet short-term, fuel scarcity, without engine modification.
4. There is a very small nozzle tip deposition and no clogging of fuel filter was observed, which can be controlled by esterification.

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