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Performance Examination of 4 Stroke Single Cylinder Compression Ignition Engine Using Different Blends of Cotton Seed Oil with Diesel Fuel - An Experimental Study

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Abstract-Industrial development, population growth and amplifying price are triggering an increasing replacement of conventional fuels with different oils derived from vegetable origin. This paper demonstrates experimental study to estimate the practice of numerous blends of cotton seed oil with diesel fuel, in various blend ratios 0/100, 10/90, 20/80, 40/60 and 60/40 in 4-stroke, high Speed Direct Injection diesel engine. Different checks were prepared using each of the above blends and 100 % diesel as well. During this study, the engine was operated at low, medium and high load. In this task, brake power, specific fuel consumption, brake specific fuel consumption, indicated power, mechanical efficiency, brake thermal efficiency and indicated thermal efficiency were measured. The variances in the enhancement from the base line action of the engine were determined and compared.

Index Terms-I.C. Engines, CSO – Cotton seed oil, blend, break power, thermal efficiency, mechanical efficiency.

1. INTRODUCTION

The world is currently fronting the two main crunches of diminution of fossil fuels and environmental deprivation. The undiscriminating removal and the generous absorption of fossil fuels have led to the diminishing of buried resources based on carbon content. More efforts are needed in research and development of substitute methods for the production of renewable resources fuels.

In India, this is more widely applied to oil fuel. The local and recurrent resources, the abundant availability and compatibility of the machine are the most important considerations, which require an alternative to diesel and petrol. In this context, vegetable oils have occupied a prominent place in the research list. Looking to the potential of different vegetable oils as substitute for diesel, the study of different oils is booming now a days. These studies consist of Palm oil, Tobacco seed oil, Cashew nuts oil, Mustard oil, Karanj oil, Jatropha oil, Canola oil and Cottonseed oil.

The main aim of this document is to estimate the resource like cotton seed oil as an auxiliary for diesel. Cotton seeds are obtained as a by-product of the cotton industry and can be used as an alternate raw material of the renewable fuel.

2. LITERATURE STUDY

Royon et al., 2006 and Kose et al., 2002 conducted a study of the production of bio-diesel using different vegetable oils which show significant progress in the field of substitute/alternative fuel [1,2]. The main problem of the making of bio-diesel is the high cost of the catalyst which is used in esterification process of the cotton seed oil. However, pure cotton seed oil reduces the incidence of catalyst cost.

Rakopoulos et al. had performed tests using various blends of CSO or its methyl ester with diesel at a medium and high load. He had analysed volumetric fuel consumption, Exhaust Smokiness and exhaust regulated gas emissions [3]. However, in that study, production of methyl ester of cotton seed oil was necessary. Due to this problem, we can test the use of pure CSO as an alternative of conventional fuel like diesel.

Satish Kumar et al. stated that Continuous dependence on fossil fuel energy resources is unsustainable, due to both the depletion of global reserves and threatening greenhouse gas emissions associated with their use. Therefore, intensive investigations are recommended to exam- ine the effects of alcohol–diesel blends on the performance, emissions and combustion behaviors of diesel engines. Major technological innovations and policy changes are required to facilitate the extraction of bio fuels from cellulosic biomass to increase the value of

biofuels as alternatives to traditional fossil fuels[4]. This study also supports the reflection and the efforts done by the authors Satish Kumar et al. with new aspects and inventive horizon.

3. EXPERIMENTAL SETUP AND PROCEDURE

An experimental setup was prepared consisting of a 4-Stroke, Single Cylinder, Diesel Engine coupled with rope brake dynamometer and necessary arrangements for measurement of performance parameters. Following figure shows the experimental setup for the performance of an engine by using various blends of CSO with diesel:

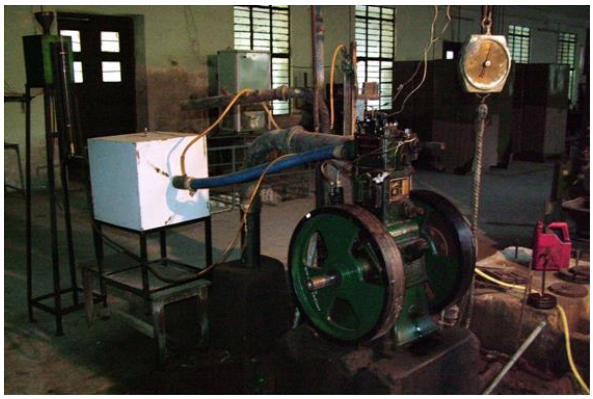

Fig. 1.Experimental Setup

Table 1. Engine specification

Brand	Capton Vertical, Single Cylinder, 4-Stroke CI, Water Cooled, Vertical Diesel Engine.
Manufactured By	Dhoraji Engineering Works,1-W Udyog Nagar, Rajkot
Type	Vertical Single cylinder 4-Stroke Compression Ignition water cooled vertical diesel Engine.
Engine No.	9835
KW	5.9 (8 hp).
R.P.M.	850
Bore	114.3 mm (4½")
Stroke	139.7 mm
Cylinder Head Clearance	1.52 to 1.65 mm
Compression Ratio	18:1
Injection pressure	140 Kg/cm2
Specific Fuel Consumption	268 gm/KW.hr
Governing	Class B-1
Fuel	HSD (High Speed Diesel)
Lubricating Oil	SAE 30
Cubic Capacity	1.43
Weight Of Engine(Net)	320 Kg
Weight Of Engine(Gross)	420 Kg
Lubricating Oil Sump Capacity	5 lit.
Fuel Tank Capacity	10 lit.
Nozzle	DL 30 S 1202
Nozzle Holder	9 430 031 264
Fuel Pump	9 410 032 032
Fuel Pump Plunger	H.P.P.K ½ Z MICO
Fuel Injection Timing by Spill	Starts from 20° Before TDC
Valve Tappet Clearance	➢ Inlet Valve – 0.45 mm ➢ Outlet Valve – 0.70 mm

4. EXPERIMENTALWORK

The experimental work towards engine performance estimation was done in two steps. The steps are as follows:

1. Base data generation
2. Performance evaluation under pure diesel and different blends of diesel with Cotton Seed Oil.

Initially, the engine was ensured for all its setting parameters using diesel as a fuel. The load on the engine was varied from no load to 8Kg, 16 Kg, 24 Kg, 32 Kg, 40 kg & 46 Kg of rated load. The analysis was done for each load applied on the engine. Complete load range from no load to over load was investigated for different performance parameters.

In this segment of experimental work, the engine was operated on diesel fuel with different percentage of CSO. Methodology used was identical with that of high-speed diesel operation with respect to change of loads, recording of fuel consumption, exhaust emission and various temperatures.

Different experiments were conducted on various blends of pure CSO with diesel.

The following different blends were tested on the engine.

1. 90% diesel and 10% CSO.
2. 80% diesel and 20% CSO.
3. 60% diesel and 40% CSO.
4. 40% diesel and 60% CSO.

5. EXPERIMENTAL RESULT

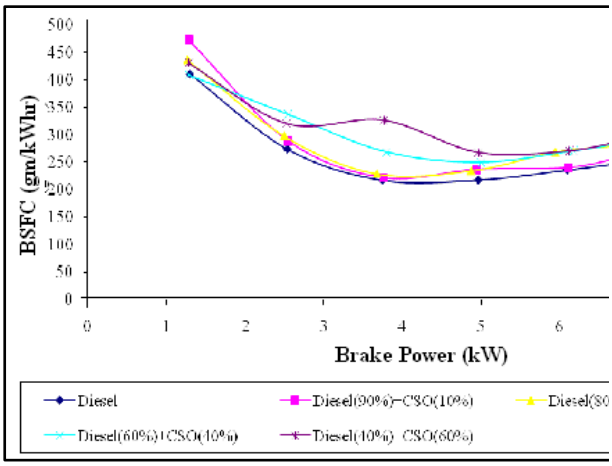

Fig.2. Brake power(kW) Vs BSFC(gm/kWhr)

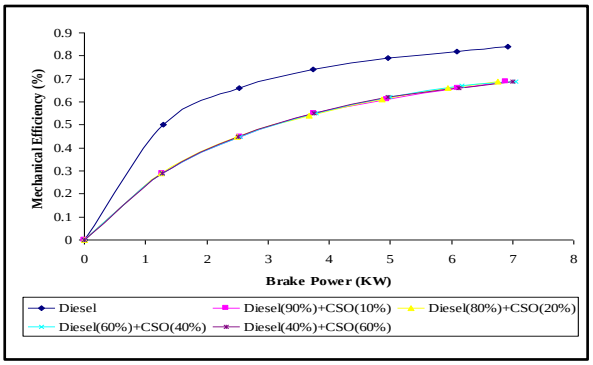

Fig.3. Brake power(kW) Vs Mechanical effi.(%)

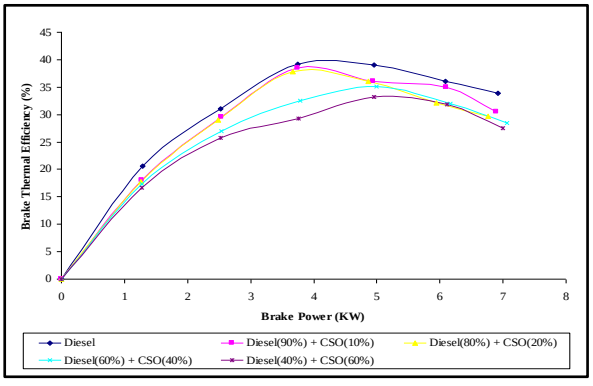

Fig.4. Brake power (kW) Vs Brake thermal efficiency(%)

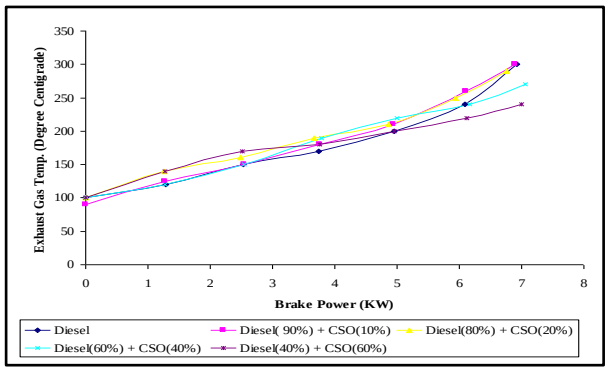

Fig.5. Brake power (kW) Vs Exhaust gas temperature (°C).

6. CONCLUSION

The following conclusion can be drawn based on the results and discussions:

1. Higher brake specific fuel consumption is obtained in the case of CSO but in case of the blend of 10% CSO with 90% diesel at higher load the brake specific fuel consumption reduces little than diesel and this is because of at higher temperature the viscosity of CSO and ultimately the viscosity of the bland decreases. This is shown in Figure 1.
2. The mechanical efficiency increased with increase in load in all blends of CSO with diesel but it is less than pure diesel because the loss due to friction (frictional power) in case of the blends of diesel with CSO (3.1 KW) is more as compared with diesel(1.3 KW). This higher frictional loss is due to higher viscosity of the cotton seed oil.
3. The brake thermal efficiency increased with increase in load with all the blends of CSO with diesel but it is less as compared with pure diesel because the higher calorific value of the CSO is 6.42% (39.30 MJ/Kg), which is lower than the diesel.
4. The temperature of exhaust gas is also little high in case of the different blends of CSO with diesel because due to a bit incomplete combustion of the CSO unburned carbon particles formed and they absorb more heat during combustion so the exhaust temperature is little higher than the diesel fuel.

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