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Performance and Emission Studies of Hydro treated Refined Sunflower Oil As Alternate Fuel in DI Diesel Engine

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ABSTRACT: In now a days vegetable oil is one of the most attractive alternatives for diesel engine. The present work is focused on evaluation of the performance and emission studies of a diesel engine fuelled with a sunflower oil diesel blends. Sunflower seed oil was extracted from the sunflower seed and tested the physical and chemical properties. By analyzing the graphs, it was observed that the brake thermal efficiency was increased by 5.5% and NO, HC emissions were found to be increased compared to diesel at full load. From the experimental results, it can be observed that 10% of sunflower seed oil mixture mixed with 90% of diesel is the suitable blend for Diesel engine without heating and any engine modifications.
KEYWORDS:*Alternative Fuel, Vegetable Oil, Biodiesel, Diesel engine and etc.*

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I. Introduction

In India, energy crisis, though not yet assumed alarming pro- portions, has started causing concerns because of burgeoning population, fast depleting fossil fuels, and increase in environ- mental pollution which have forced us to look for an alternative fuel. Atadashi et al. [1] showed that by using membrane separate technique they could remove the potassium catalyst from palm oil biodiesel using transesterification. Further they optimized the temperature, flow rate and the transmembrane pressure in order to reduce the amount of potassium. Basha et al. [2] experimented with the jatropha methyl ester emulsion blended with carbon nanotubes at different proportions to effect an increase in brake thermal efficiency and decrease in peak cylinder pressure.

El kassaby et.al.[3] investigated by varying the compression ratio from 14 to 18 in the diesel engine with the transestirified waste cooking oil being the fuel. The result showed in increase in brake thermal efficiency. NO_x, CO2, whereas a decrease in CO, HC. Hansdath.et.al. [4] produced bioethanol from madhuca India flower and blended with diesel fuel at different proportions. the blend was tested in the 45KW diesel engine. longer ignition delay, decrease in $NO_{X.\ smoke}$ and improved performance were the results. Gopal et al [5] observed that waste using waste cooking oil had similar properties as diesel. The CO,unburnt hydrocarbon, smoke and break thermal efficiency decreased,whereas there was an increase in NO_X and specific fuel consumption. Heikkilla et. El [6] studied the performance by adjusting the intakevalve closure timing and start of injection using hydro treated vegetable oil compared with fossil diesel fuel . the result showed reduction in NO_X and particle size at all loads. Liu et al [7] produced the biohydrogenerated diesel and liquid petroleum gas from the palm, canola, and jatropha vegetable oil using Ni – Mo/Sio ,as catalyst.

The paraffins are converted from vegetable oil and used as fuel in diesel engine .The tuned valve timing and injection parameter are tested with hydro treated oil.the NO_x emission was reduced by the tuned engine .The diesel engine uses murtonen et al.[9] Used EN590 diesel fuel, FAME, HVO and GLT .The results showed that NO_x emission in FAME was high when compared with HVO and GLT.The EN590 reduces other emissions .The improvement for the low quality cetane diesel resulting in better performance is by Karonis et al .[10] used the hydro processed cooking oil blended with EN590. By hydro treatment process Hauser et al .[11] converted the crude tall oil into renewable diesel fuel .The diesel is blended with 30% of renewable diesel and the diesel engine tests it .The performance and emission were same in comparison with the diesel fuel as shown from result .Lehto et al .[12] focused on miller cycle and exhaust gas recirculation .The start of injection timing and inlet valve close timing were varied in miller cycle .The hydro treated fuel was tested in this condition and compared with EN590 diesel fuel .The diesel fuel is compared with hydro treated rape seed oil and NO_x Bhardwaj et al .[13] .The reduction in CO,HC and soot was shown in the result the improvement of performance

and reduction in the emission of the diesel fuel in diesel engine is the aim the of this work .The diesel engine's emission and performance were studied .

II. Materials And Methods

The local dealer procures the sunflower oil .in two phases the experiments were conducted. Phase 1: the hydro treatment is done in refined sunflower oil. Phase 2: in the diesel engine the hydro treated oil was treated and analysis of emission and performance with diesel were done.

Preparation of hydro treated refined sunflower oil

The feed is refined sunflower oil. The feed was treated with high pressure trickle bed reacted. The volume of 400 ml is the capacity of tubular reactor .The catalyst was dried and sulfided using diesel spiked with di methyl di sulfide from the standard procedure .The hydrogen gas and the pre heated refined sunflower oil was treated together.

S.NO	Properties	Euro -4 Bharat stage 1460:2005 diesel fuel	ASTM D-751 (IS 5607:2005)	Refined sunflower oil(feed)	HTSFO(product)
1.	Calculated cetane index	51	-	35	81
2.	Density at 15^0 C kg/m^3	822-845	860-900	922.5	798.8
3.	Kinematic viscosity at 40^0 C cst	2-4.5	1.9-6	28.3	3.69
4.	Flash point ^{0}C min	35^0 C	130^0 C	254	64.5
5.	Calorific value Kj/kg	39,000	-	38,796	43,754

Table 1 Comparison of properties of diesel, biodiesel standards and HTSFO.

S.No	Type	Vertical ,4S,high speed DI diesel engine
1.	Combustion	Direct injection
2.	Rated power	4.3 KW
3.	Rated speed	1500 rpm
4.	Compression ratio	17.5:1
5.	Injector type	Single 3 hole jet injector
6.	Fuel injection pressure	210 bar
7.	Dynamometer	Eddy current

Table 2 Specification of test engine

The hydrogen gas at the temperature of 360 ^{0} and a pressure of 60 bar is treated with pre heated sunflower oil .The n –alkanes were formed by various reactions .The isoalkanes are converted from n-alkanes with isomerization catalyst .The propane is converted from tri glycerides .The increase in cetane numbers were observed by this reaction .The more hydrogen is observed by de oxygenation more than de carboxylation reaction .The cetane index , flash point , calorific value were increased ,the density and kinematic viscosity were decreased .These were observed and specifications of test engine as given in table 1&2.

III. Experimental Setup

In stationary, vertical, 4S DI diesel engine the green diesel was tested to analyze the performance and emission of diesel engine .At constant speed of 1500 rpm and various load conditions the engine was tested .The alternator is coupled with the engine and the eddy current was used to load in steps of 20% .The0% ,25%,50% ,75% and 100% are different loading conditions.

Figure 1 Refined sunflower oil.

Figure 2 Hydro treated oil.

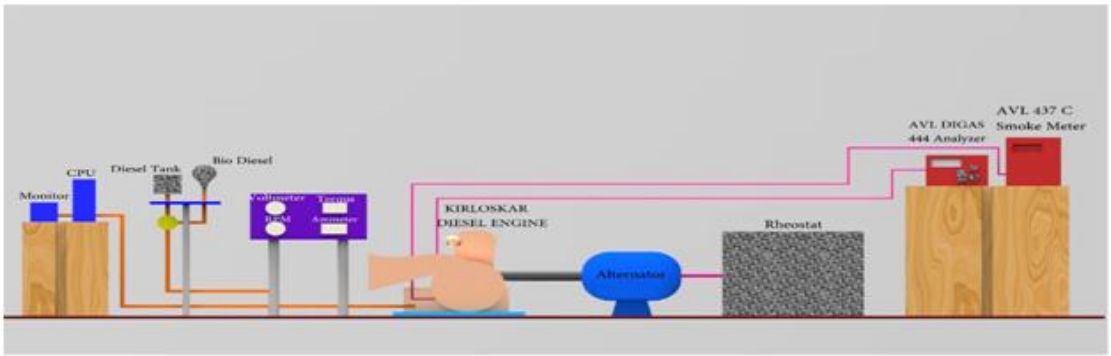

Figure 3 Schematic set-up of the compression ignition engine

Diesel can be produced in various propositions such as HTSF B25 and HTSF B100 which are tested in the engine. for every proportion of oil blend, the engine was allowed to run for 15 min for each proportion before loading and the average of 3 tests was recorded the emissions (CO, HC, and NO_x) and the AVL DIGAS 444 and ALV smoke meter were used measure the level of smoke. The schematic set-up of the compression ignition engine is shown in fig.3.

IV. Results And Discussions

EMISSION ANALYSIS

Carbon monoxide (CO) emission:

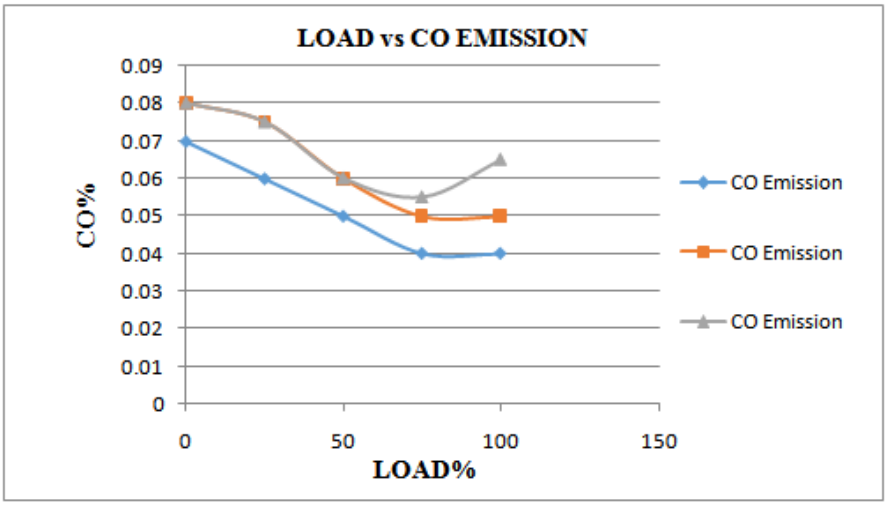

Figure 4 Comparison of CO emission for HTB25 and HTB100 with diesel.

The CO emissions of the hydro treated sunflower oil are shown in Fig. 4. The comparison between the HTSF B25 and HTSF B100 was done with reference to petro diesel. It can be observed from the graph that HTSF B25 is the same as diesel up to 75% of the load, whereas it decreases at full load condition by 9%. HTSF B100 decreases by 37% at full load condition. This might be due to the higher calculated cetane index facilitating better combustion.

Hydrocarbon (HC) emission:

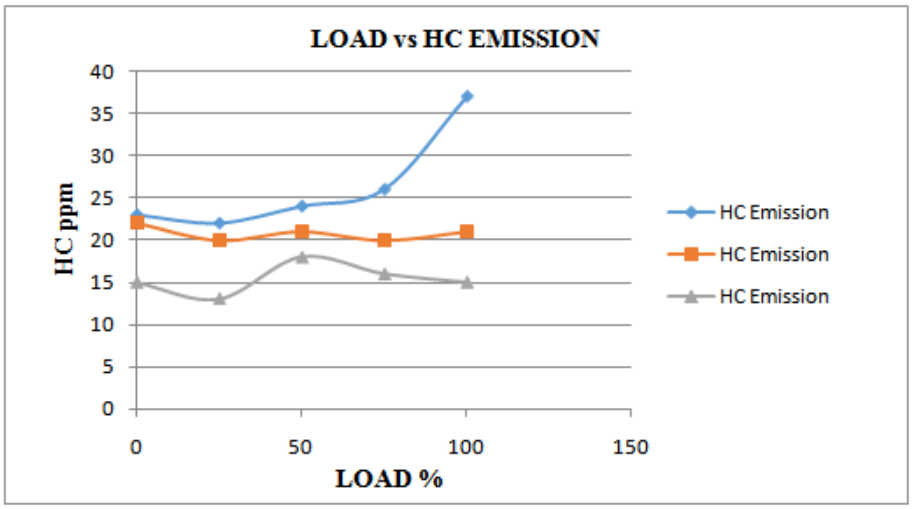

Figure 5 Comparison of HC emission for HTB25 and HTB100 with diesel.

The emission of HC is shown in Fig. 5. The HC emission reduces in HTSF B25 and HTSF B100 by 42% and 55%. At full load condition and at a constant speed of 1500 rpm respectively. This could be due to the higher hydrogen content in the fuel which enhances better combustion when compared with diesel fuel. The hydro treated seed oil and animal waste fat can produce high paraffins and this reduces the HC [13].

Nitrogen oxides (NOx) emission

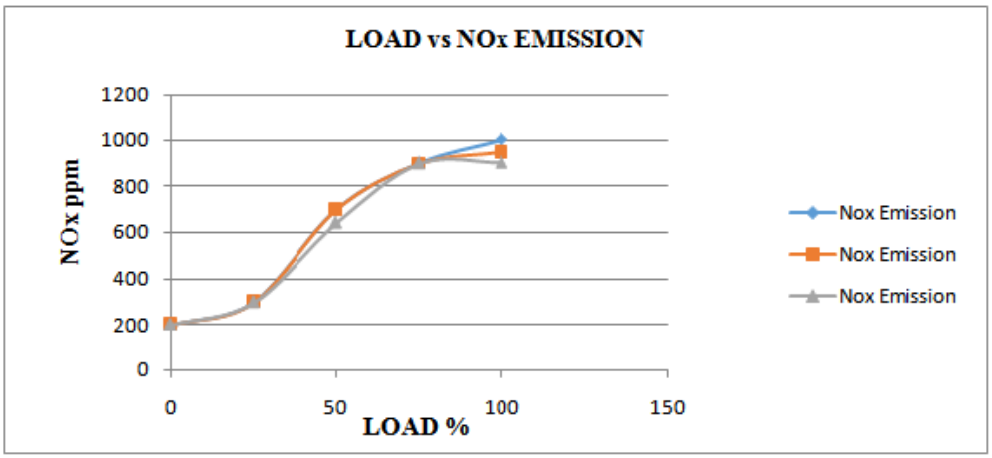

Figure 6 Comparison of NOx emission for HTB25 and HTB100 with diesel.

Fig. 6shows NOx emissions of the Hydro treatedrefined sunflower vegetable oil and diesel fuel. The NOx is formed due to increase in combustion temperature. The NOx is reduced the HTSF B25 by 10% and HTSF B100 by 18.18%. This might be due to the flame characteristics of the hydro treated vegetable oil causing reduction in the flame temperature.

V. Performance Analysis

Brake specific fuel consumption (BSFC)

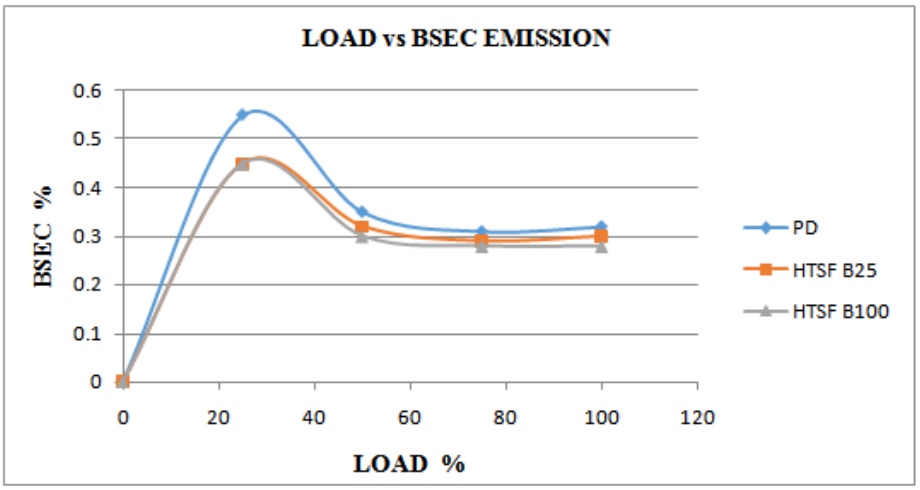

Figure 7 Comparison of BSFC emission for HTB25 and HTB100 with diesel

The brake specific fuel consumption (BSFC) of the hydro treated refined sunflower oil at different loads is compared with petro diesel as shown in Fig. 7. From the graph, it can be seen that the fuel injection to the engine is decreased for HTSF B25 and HTSF B100 at full load condition compared with the petro diesel. HTSF B25 and HTSF B100 decrease by 25% and 12.5% respectively compared with diesel fuel. This might bedue to the lower density of the hydro treated fuel.

Brake thermal efficiency (BTE)

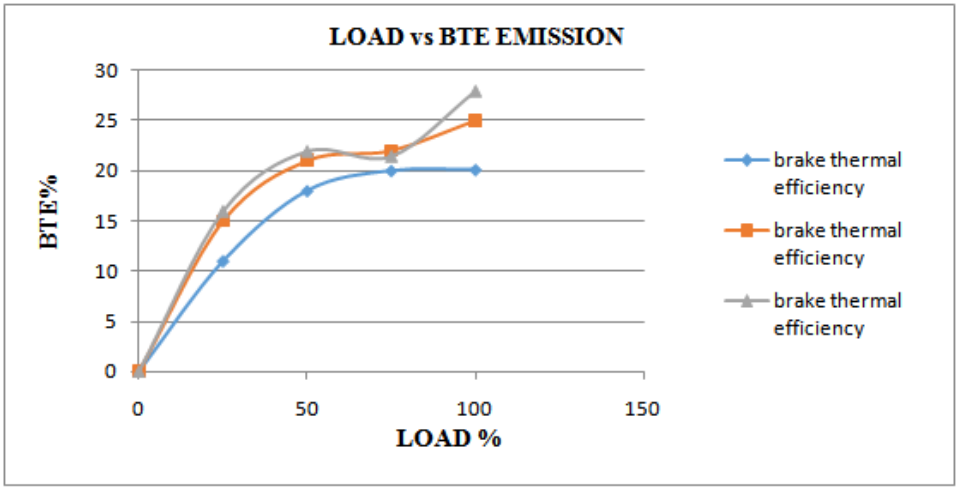

Figure 8 Comparison of BTE emission for HTB25 and HTB100 with diesel.

Fig. 8shows the comparison of hydro treated vegetable oil blends and petro diesel. The brake thermal efficiency of the Hydrotreated vegetable oil is greater than that of petro diesel. It is evident from the graph that the brake thermal efficiency of HTSF B25 and HTSF B100 increases up to 10% and 38% compared with petrodiesel. This could be due to the higher calorific value and the high calculated cetane index of the hydrotreated vegetable oil.

VI. Conclusion

The aim of the work is to reduce the emissions of the diesel engine. The hydro treated refined sunflower oil as biodiesel have been found to be a suitable alternative fuel in the diesel engine. By the usage of sunflower oil the result of emissions to be reduced. At a constant speed of 1500 rpm for different loading condition and different blends in the number of tests. When comparison of petrol diesel the findings are based on the full load condition.

1. The CO emission decreases for HTSF B25 and HTSF B100 by 9% and 37%.
2. The emissions of HC decrease for HTSF B25 and HTSF B100 by 42% and 55% respectively.
3. The NOx emission decreases for HTSF B25 and HTSF B100 by 10% and 18.18%.
4. The BSFC decreases in HTSF B25 and HTSF B100 by 25% and 12.5% respectively.
5. There is an increase in brake thermal efficiency for HTSF B25 and HTSF B100 by 10% and 38%.

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