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PERFORMANCE ANALYSIS OF CI ENGINE USING BIO DIESEL

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Abstract: Bio-diesel is one of the most promising alternatives for diesel needs. Use of Vegetable oil may create shortage of oil seeds for daily food, which necessitates identification of new kinds of vegetable oil. With this objective, the present work has focused on the performance of waste vegetable oil and its blend with diesel on a single cylinder, 4 stroke, naturally aspirated, direct injection, water cooled, rope brake dynamometer, Kirloskar Diesel Engine at 1500 rpm for variable loads. Initially, waste soya bean neat oil and their blends were chosen. The physical and chemical properties of soya bean oil were determined. In general, viscosity of neat vegetable oil is high, which can be reduced through blending with diesel and heating them. The heating temperature of the blends increases with the increase in the percentage of neat oils with diesel ranging from 700C to 1200C before entering into the combustion chamber. The suitability of waste Soya Bean oil and their blends are evaluated through experimentation. The performance and emission characteristics of engine are determined using Castor neat oil and their blends with diesel. These results are compared to those of pure diesel. These results are again compared to the other results of neat oils and their blends available in the literature for validation. By analyzing the graphs, it was observed that the performance characteristics are reduced compared to those of diesel. This is mainly due to lower calorific value, high viscosity and delayed combustion process. From the critical analysis of graphs, it can be observed that 50% of waste vegetable (Soya Bean) oil mixed with 50% of diesel is the best suited blend for Diesel engine without heating and without any engine modifications. It is concluded that Waste Soya Bean oil can be used as an alternate to diesel, which is of low cost. This usage of neat bio-diesel has a great impact in reducing the dependency of India on oil imports.
Keywords: Bio Diesel fuels, DI diesel engine, Performance Analysis, Waste vegetable oil.

I. INTRODUCTION

Every gallon of bio-diesel displaces 0.95 gallons of petroleum-based diesel over its life cycle. It is also very energy efficient. For every unit of fossil energy used to produce Bio-diesel, 3.37 units of Bio-diesel energy are created. Additionally, Bio-diesel reduces the amount of carbon dioxide (CO2) being released into the atmosphere. It releases less fossil CO2 than conventional diesel, and the crops used to produce Bio-diesel absorb large amounts of CO2 as they grow. And because Bio-diesel is nontoxic and biodegradable, it is an excellent fuel for use in fragile environments such as estuaries, lakes, rivers, and national parks. So biodiesel (WVO) is used in diesel engine and a test rig. is used for testing the performance of diesel engine like brake power, brake specific fuel consumption, brake thermal efficiency etc and compare it to the reading which we found by the use of petro-diesel in the same apparatus. This task is being done for checking the performance of C.I engine if we use bio diesel at place of petro-Diesel. Bio diesel in blending with petro-diesel is also being used for checking the performance of diesel Engine on this case.

II. PROCESS PARAMETERS

2.1 Set-up for testing brake specific fuel consumption and brake thermal efficiency of the C.I engine

(i) C.I Engine

A four stroke, direct injection, naturally aspirated single cylinder diesel engine is employed for the present study. The detailed specifications of the engine are given below: 1.Make type Kirlosker Engine
2. Stroke 110 mm
3.Bore 80 mm
4.Rated output 5 Horse power
5. Rated speed 1500 rpm
6. Loading device Rope Brake Dynamometer

Fig. 1 Set-up For finding the brake power of C.I Engine (Rope Brake Dynamometer)

2.2 Principle for making bio- diesel Vegetable oils and animal fats are triglycerides, containing glycerin. The bio-diesel process turns the oils into esters separating out the glycerin. The glycerin sinks to the bottom and the bio-diesel

floats on top and can be siphoned off. The process is called transesterification, which substitute's alcohol for the glycerin in a chemical reaction, using lye as a catalyst.
Making our first test batch Here is what we need: -
1 liter of new WVO.
200 ml of methanol, 99+% pure.
Lye catalyst -- either potassium hydroxide (KOH) or sodium hydroxide (NaOH).
Blender.
Scales accurate to 0.1 grams or preferably less.
Measuring beakers for methanol and oil.
Half-liter translucent white HDPE (2 plastic) container with bung and screw-on cap.
Two funnels to fit the HDPE container.
Thermometer.

All equipments were clean and dry

Fig. 2 Blender for mixing waster soya bean oil and catalyst.

Fig.3 setting of Biodiesel

III. ADVANTAGES: THE BIO-FUEL HAS THE FOLLOWING BENEFITS

Alternatives for Farmers: It is widely accepted that, with Irish farmers under increasing pressure from imports and the decline of traditional tillage industries, such as the sugar beet industry, farmers need alternative enterprises or areas of production. A bio energy crop offers farmers the opportunity to diversify into an area of production with huge growth potential if this fledging industry is given the support it requires. Environmental Benefits: For bio diesel, the CO2 equivalent savings range from 44% to 66% compared with conventional diesel. The increased use of bio fuel will dramatically reduce the level of CO2 emissions. Job Creation Opportunities: It is estimated that for every 100 litres of bio fuel produced, 1 job is created. Create a market for bio fuels by introducing legislation to allow for all motoring petrol and diesel products to include a blend of fuel from renewable sources. All fuel sold at filling stations will include 5% ethanol mix, while all diesels shall include 2% bio diesel. This will not necessitate the conversion of standard motor engines and will represent a good start to reducing emissions from cars. It will also provide an immediate market for farmers to sell energy crops. As the benefits become clear, motorists may move to convert their engines to allow for greater use of bio fuel, thus reducing emissions further.

IV. EXPERIMENTAL SET-UP FOR TESTING

The following procedure is adopted for calculating the Brake specific fuel consumption and brake thermal efficiency of C.I engine using Vegetable Oil and different blends of biodiesel:-
1.The Rope Brake Dynamometer is coupled with the required prime mover, properly on a suitable bed.
2.Fix the hanger (with a dead weight) to the hook. (Once this hanger is fixed, it need not to be removed, it can stay there permanent.)
3.Adjust the hand wheel above the balance, so that the pointer reads zero on the balance.
4.Now, start the prime mover and bring to its normal speed.
5.Open the gates slowly, by rotating the hand wheel 'OPEN' direction. There is a lock on the top gearwheel.
6.Take the reading in the balance.
Measure the speed of the rotation.
The B.P.= $2\Pi(N/60)\ \{9.81x(s1-s2)\}R_{eff} / 1000$ KW
Where S1= spring balance reading (kg) S2= spring balance reading (kg) Reff= effective radius of brake drum = (D+d)/2 D= brake drum dia. d= rope dia. N=R.P.M.
7.If the balance reading exceeds 20kg then the additional dead weight of 10kg is placed on the Hanger. The balance reading is added with 10kg to find the total weight.
8.BSFC = (mass of the fuel consumption per unit time / B.P.)
9.Brake Thermal efficiency (ηth) = (Brake Power) / (Mass of fuel x Calorific Value of fuel).

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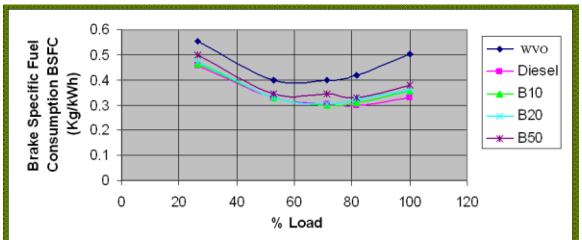
Fig. 4 Set-Up of Diesel Engine For Testing With Biodiesel.

V. RESULTS AND DISCUSSION

Performance test are carried out on the compression ignition engine, using various blends of bio-diesel and diesel as fuels. The tests are conducted at the rated speed of 1500 rpm at various loads. The experimental data generated are documented and presented here using appropriate graphs. These tests are aimed at optimizing the concentration of ester to be used in the biodiesel-diesel mixture for long-term engine operation. In each experiment, engine parameters related to thermal performance of the engine such as fuel consumption and applied load are measured. The results are compared with the characteristics of 100 % vegetable oil fueled engines as well. Bxx represents the percentage of ester (xx %) used in the mixture, i.e. 10 % ester in the blend is represented by B10.

5.1 Brake specific fuel consumption

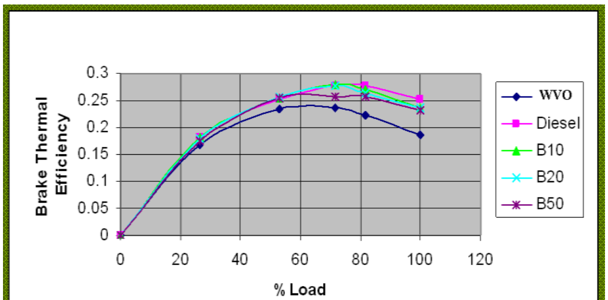
The variation of brake specific fuel consumption with load for different fuels is presented in Fig. 3.1. For all fuels tested, brake specific fuel consumption is found to decrease with increase in load. This due to the higher percentage increase in brake power with load as compared to the increase in fuel consumption. Using lower percentage of biodiesel in biodiesel-diesel blends, the brake specific fuel consumption of the engine is lower than that of diesel for all loads. In case of B50, the brake specific fuel consumption is found to be higher than that of diesel. At maximum load condition, the specific fuel consumption of 50% biodiesel is more than 6% than of diesel. It may be noted that the calorific value of biodiesel is 14% lower than that of diesel. With increase in biodiesel percentage in blends, the calorific value of fuel decreases. Hence the brake specific fuel consumption of the higher percentage of biodiesel in blends increases as compared to that of diesel. The brake specific fuel consumption of Waste vegetable oil is higher than that of diesel for all loads. This is caused due to the combined effect of higher viscosity and lower calorific value of waste vegetable oil.



Variation of BSFC for wvo and different blends of biodiesel

5.2 Brake thermal efficiency

The variation of brake thermal efficiency with respect to load for different fuels considered for the present analysis is presented in Fig. 3.2. In all cases, brake thermal efficiency has the tendency to increase with increase in applied load. This is due to the reduction in heat loss and increase in power developed with increase in load. The maximum brake thermal efficiency obtained is about 28 % for B10, which is quite high than that of diesel (25%). The maximum brake thermal efficiency obtained while using B20 and B50 are respectively 25 and 26%. The mixing of biodiesel in diesel oil yields, in general, good thermal efficiency curves. Initially the thermal efficiency of engine is improved with increasing concentration of the biodiesel in the blend. The possible reason for this is the additional lubricity provided by the biodiesel. The molecules of biodiesel (i.e. methyl ester of the oil) contain some amount of oxygen, which takes part blend. The thermal efficiency trend is reverted and it starts decreasing as a function of the concentration of blend. This lower brake thermal efficiency obtained for B50 due to reduction in calorific value and increase in fuel consumption as compared to B10. While running the engine with Vegetable oil, brake thermal efficiency is always lower than the biodiesel as well as diesel.



variation of Brake Thermal Efficiency for wvo and different blends of biodiesel

VI. CONCLUSION

The Waste Vegetable oil is chosen as potential non-edible oil for the production of biodiesel. Successful efforts are made here for the production of biodiesel from new WVO. Viscosity and density of methyl esters of rice bran oil are found very close to that of diesel. Lower concentration of esters in biodiesel blends can be used as the performance improver. The important properties of biodiesel produced from rice bran oil can be a perspective fuel or performance improving additive in compression ignition engines. The various blends of biodiesel-diesel are used as fuel in compression ignition engines and its performance emission characteristics are analyzed. The lower concentrations of biodiesels blends found to improve the thermal efficiency. B10 biodiesel blends gives improvement in brake thermal efficiency of diesel engine by about 3% at the rated load conditions. Also reduced brake specific fuel consumption is found out while using B10. The present experimental results support that methyl esters of rice bran oil can be successfully used in existing diesel engines without any modification. Use of the biodiesel as partial diesel substitute can boost the farm economy; reduce uncertainty of fuel availability and make farmers, more self-reliant. Also, this help in controlling air pollution to a great extent.

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