

PERFORMANCE OF DIESEL ENGINE USING BIO-FUEL FROM SESAME OIL

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Abstract:- Energy has become a crucial factor for humanity to continue the economic growth and maintain high standard of living especially after industrial revolution. "Fossil fuels are still the main source of energy. But the endless consumption of fossil fuels will bring the reserve to an end in near future. As a result fuel prices are soaring because of diminishing supply than demand. So researchers world over are in constant search of alternate fuels in the last three to four years, aimed at reducing CO₂ emissions and global dependency on fossil fuels. The use of vegetable oils as a fuel in diesel engine causes some problems due to their high viscosity compared with conventional diesel fuel. Various techniques and methods are used to solve the problems resulting from high viscosity. One of these techniques is blending of fuel.

In this study, a mix of 5%, 10%, 15%, 20%, 25% sesame oil and diesel fuel was used as alternative fuel in a direct injection diesel engine. Diesel engine performance and exhaust emissions were investigated and compared with the diesel fuel in a diesel engine. The experimental results show that the engine power and torque of the mixture of sesame oil diesel fuel are close to the values obtained from diesel fuel and the amount of exhaust emissions are lower than those of diesel fuel. Hence it is seen that mix of sesame oil 20% and 80% diesel fuel can be used as an alternative fuel successfully in a diesel engine without any modification and also it is an environmental friendly" fuel in terms of emission parameters.

Keywords: Sesame oil, Diesel, Bio-Diesel, Alternate fuels, Performance, Emissions

I. INTRODUCTION

Biodiesel is an "alternative or additive to standard diesel fuel that is made from biological ingredients instead of petroleum (or crude oil). Biodiesel is usually made from plant oils or animal fat through a series of chemical reactions. It is both non-toxic and renewable. Because biodiesel essentially comes from plants and animals, the sources can be replenished through farming and recycling. Biodiesel can be made from numerous natural resources. Although animal fat can be used, plant oil is the largest source of biodiesel. Soya bean oil, rapeseed oil, canola oil, palm oil, cottonseed oil, sunflower oil etc, are already used to produce biodiesel.

The interest in bio-fuels has increased significantly amid unstable oil prices. At the same time, the cost of hydrogen

technology and the impracticality of delivering hydrogen remain high. Recent research has cast into doubt the cleanliness of electric vehicles. The net CO₂ saving of these vehicles depends heavily on how the electricity is produced. A large percentage of power stations are driven by fossil fuels. These factors have encouraged several auto manufacturers to focus on a fuel source that can deliver performance with sustainability like bio-fuels.

An improved knowledge of the potential to reduce regulated emissions from the use of biodiesel and its blends with petro-diesel could help

➤ Engine manufacturers to adapt their engines to the use of biodiesel and to optimize them, readjusting the compromise between efficiency, costs (mainly due to after treatment systems) and emissions within the regulation limits,

➤ National administrations to design their energy policies and to define measures to externalize environmental costs,

➤ Local administrations to promote its use in urban areas, especially in countries with extreme dieselization, where particle concentrations in the air are reaching alarming levels, and

➤ Private users, to encourage them to use biodiesel, attesting to their environmental concern.

Sesame (*Sesamum indicum* L.) is an important oilseed crop that ranks sixth in the world among vegetable oils. Out of the 3.66 million tons of sesame produced in the "world, Asia and Africa account for 2.55 and 0.95 million tons, respectively. Nigeria is the third largest producer of sesame in Africa after

Sudan and Uganda. Unfortunately, the net export of Africa sesame is just 38% of its production despite the favorable weather conditions to grow this crop on a large scale for commercial purpose. At present, majority of the primary growers of sesame in Africa produce non-certified organic sesame which can readily meet the specific requirements for organic sesame. Recently released sesame varieties: NCRIBEN-01M and NCRIBEN-02M, and Ex-Sudan (exotic variety) readily meet the premium quality requirements for sesame export (1000 seed weight >3.0 g, 40-50% oil content and pearly-white seed colour). Seeds of two local cultivars

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(dark and white) of Sesame (*Sesamum indicum* L.) were chemically analyzed for their Physico-chemical characters specific gravity, refractive index, acidity, peroxide value, iodine number, Saponification number and unsaponification unsaponified matter. Six mineral nutrients calcium, phosphorus, potassium, magnesium, sodium and iron contents of the seeds were also determined. The mineral composition *Sesamum indicum* seeds revealed relatively high amounts (mg/100g) of Ca (1200), P (580), K (374), Mg (185), Na (72), Fe (10.6) and low amount of Zn (3.8) The results were compared with some other cultivars growing worldwide. Our results revealed that incorporation of sesame seeds in bakery industry at suitable levels may satisfy the recommended daily dietary allowances of minerals (N.R.C.), as shown by chemical analysis of sesame seeds, confirming it as the richest source of most of the inorganic” nutrients.

II. ENGINE TEST SET UP



Fig 1: Engine Test set up

Table 2: Specifications of the engine

Vegit able Oil	Kinemat ic Viscosit y (mm ² /s)38°C	Ceta na Nu mbe r (°C)	Hea ting Val ue (mj/ kg)	Cl ou d Poi nt (°C)	Po ur Po int (°C)	Fl as h Po int (°C)	Den sity (kg/ l)	Cal cu late Resi due (wt %)
Corn	34.9	37.6	39.5	-1.1	-40	277	0.9095	0.24
Cotton seed	33.5	41.8	39.5	1.7	-15	234	0.9148	0.24
Crotha	53.6	44.6	40.5	10.0	-12.2	274	0.9048	0.23
Linseed	27.2	34.6	39.3	1.7	15.0	241	0.9236	0.22
Peanut	39.6	41.8	39.8	10.0	6.7	271	0.9026	0.24
Rapesee d	37.0	37.6	39.7	1.7	31.7	246	0.9115	0.30
Safflow er	31.3	41.3	39.5	12.8	6.7	260	0.9144	0.25
Sesam e	35.5	40.2	39.3	-3.9	9.4	260	0.9133	0.24
Soya bean	32.6	37.9	39.6	-3.9	12.2	254	0.9138	0.25
Sunflo wer	33.9	37.1	39.6	7.2	15.0	274	0.9161	0.24
Mustard	24.67	37	32.4	3.5	-15	225	0.953	0.25
Babasa	30.3	38.0	-	20.0	-	150	0.9460	0.27
Diesel	3.06	50	43.8	-	-16	76	0.855	0.23

PARTICULARS	SPECIFICATIONS
Make	Kirloskar oil engines, India
Engine	Four stroke single cylinder
BHP	5 HP
Speed	1500 rpm
Fuel	Diesel
No. of cylinders	Single
Bore diameter	80 mm
Stroke length	110 mm
Starting	Hand start with cranking handle
Working cycle	Four stroke
Method of cooling	Water cooling
Method of ignition	Compression

III. TEST PROCEDURE:

The engine performance test was conducted on a single cylinder, four-stroke single cylinder engine. The engine was directly coupled to an “Eddy current dynamometer that permitted engine motoring either fully or partially. The schematic diagram of the experimental setup is depicted in Figure and the engine characteristics are cited in specifications of engine. The fuel is supplied to the test engine by a tank, which could easily be drained with the help of three way stop valve for Change of fuel. A glass burette of 100cc was also attached in parallel to this tank and was used for fuel flow rate measurement. For every fuel change the fuel line was purged out of the residual fuel. The engine was made to run under full load for at least 30 minutes to stabilize on new fuel conditions. Test-rig was provided with necessary equipment and instruments for recording the dynamic combustion pressure and crank-angle measurements.

1. The engine was started in neat petrol mode at no load condition.

2. The engine speed, time for 10 cc petrol consumption, exhaust temperature and Exhaust Gas analyzer values were noted

3. The above steps were repeated from no load to full load up to 13kgs.

4. The bio-diesel and diesel fuel substitutions are enter into the fuel tank substitution percentages are 5%,10%, 15%,20%, 25%.

5. First enter the bio-diesel of 5% blended with diesel.

6. The engine speed, time for 10cc petrol consumption, exhausts temperature and Exhaust Gas Analyzer values were noted.

7. The process was repeated at no load and at load conditions.

8. The similar procedure was followed for 5%, 10%, 15%, 20%, 25% and 100% bio-diesel and diesel blends.

9. All the observations for the various loads of substitutions and were tabulated and the efficiency obtained in each case was calculated.

10. The values of efficiency exhaust temperature, total fuel consumption and, emissions” were compared for bio-diesel and diesel fuels5%, 10%, 15%, 20%, 25% blends of” diesel conditions.

IV. RESULTS & DISCUSSION

4.1 Brake Thermal Efficiency

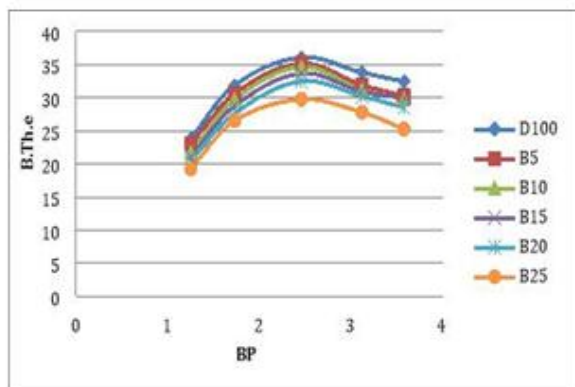


Fig 2: Brake Power vs Brake Thermal Efficiency

It is observed that “brake thermal efficiency indicates the ability of the combustion system to accept the experimental fuel, and provides comparable means of assessing how efficient the energy in the fuel was converted to mechanical output. The relationship between brake thermal efficiency and brake power with diesel and other blends of bio diesel is shown in the above figure. The thermal efficiency increase up to a certain load and then decreases, the highest thermal efficiency was observed at 3/4th load.

4.2 Brake Specific Fuel Consumption

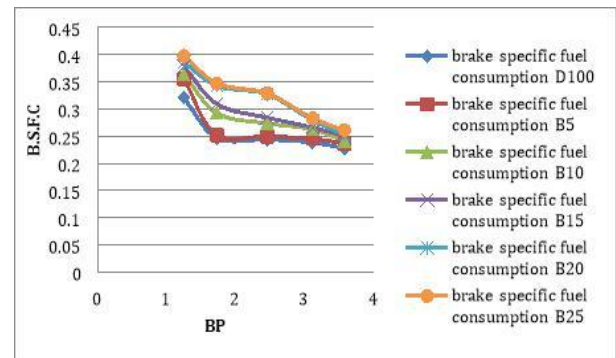


Fig 3: Brake Power vs Brake Specific Fuel Consumption

It is observed from the above figure that the BSFC for all the fuels decreases with increase in load. “This is due to higher percentage increase in break power with load as compared to increase in the fuel consumption and due to the presence of oxygen in the biodiesel and its blends that enable complete combustion and the negative effect of increased viscosity would not have” been initiated.

4.3 Exhaust Gas Temperature

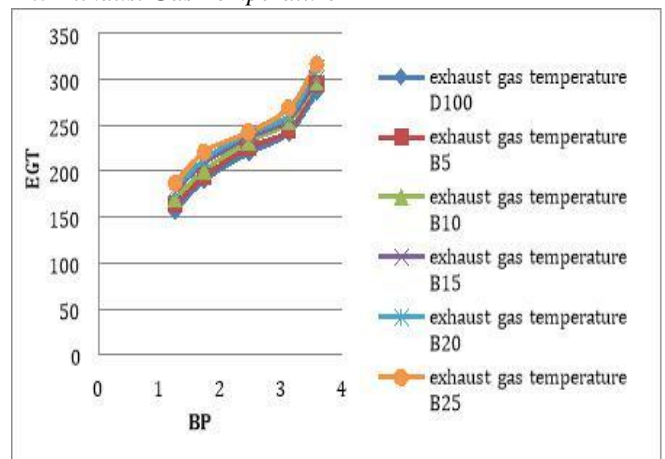


Fig 4: Brake Power vs Exhaust Gas Temperature

From the above figure we can observe the rise in exhaust gas temperature with increase in temperature, i.e. with increase of load the exhaust gas temperature has increased. It could be seen from the figure that exhaust gas temperature for biodiesel is more than that of diesel at all full loads. This is due to higher boiling point in vegetable oil than diesel. These relative higher boiling point constituents were no adequately evaporated during main combustion phase and continued to burn in the late” combustion phase.

4.4 Carbon Monoxide

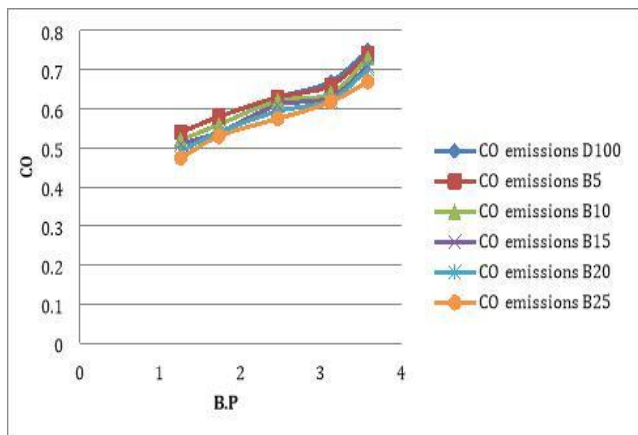


Fig 5: Brake Power vs Carbon Monoxide

The comparison “of carbon monoxide for various biodiesel blends with respect to brake power shows in above figure. Carbon monoxide (CO) occurs only in engine exhaust, it is a product of incomplete combustion due to insufficient amount of air or insufficient time in the cycle complete combustion. It is observed that the CO emissions for B25 and its blends are lower than for diesel fuel. This is due to their more complete oxidation as compared to diesel. Some of the CO produced during combustion of biodiesel might have converted into CO₂ by taking up the extra oxygen molecules present in these chain and thus reduces CO formation. We can clearly note that the B25 blend” has less CO emission..

4.6 Nitrogen Oxides Emissions

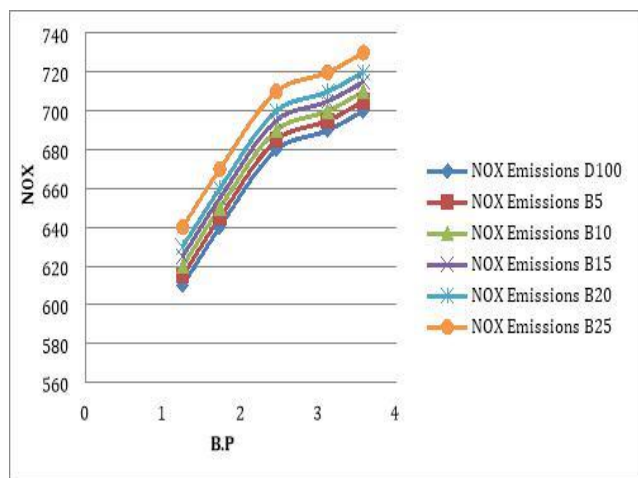


Fig 7: Brake Power vs Nitrogen Oxide Emissions

Variations “of NO_x with engine Brake power for different fuels tested are presented in above figure. The nitrogen oxides emissions formed in an engine are highly dependent on combustion temperature, along with the concentration of oxygen present in combustion products. For blend B25 we have observed the highest NO_x emission while lowest is observed for diesel. This is due to higher combustion temperature inside the cylinder at higher load. In general, the NO_x concentration varies linearly with the load of the engine. General, the NO_x concentration varies” linearly with the load of the engine.

4.7 Smoke Density

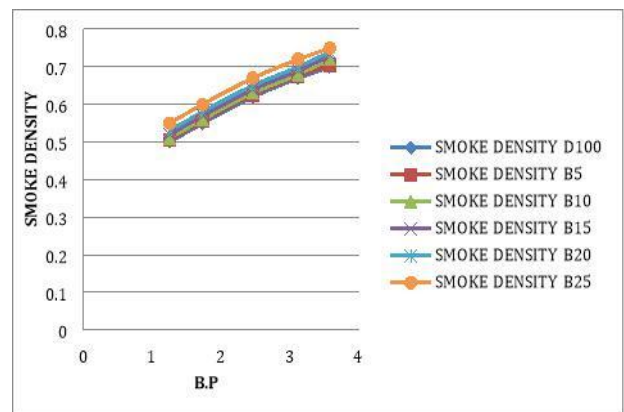


Fig 8: Brake Power vs Smoke Density

The Smoke emissions for B25 blend have increased as there might be oxygen level high during its combustion. Smoke “is formed due to incomplete combustion of fuel in the engine cylinder. Then blend B25 has shown high soot in the smoke. However the smoke density has consistent increase in blends of B5, B10, B15, B20. While diesel has the lowest smoke density values. The smoke density increases as the percentage of biodiesel increased. This is due to the higher viscosity and poor volatility of higher blends of bio-diesel as compared to lower blends which was more dominating over inherent oxygen and higher Cetane number and was mainly due to emission of heavier molecules” of hydrocarbon and particulates.

V. CONCLUSION

The “results of present work are summarized as follows:

- As no engine modifications are required sesame biodiesel may be directly used in any diesel engine.
- Only short term tests were conducted, long term tests may reveal clearer picture of engine operation and life.
- The engine develops maximum rate of pressure rise and maximum heat release rate for diesel compared to sesame and its blends. With increase in percentage of sesame in the blend, the maximum rate of pressure rise and maximum heat release rate decrease
- The specific fuel consumption increases with increase in percentage of sesame in the blend due to the lower calorific value of sesame.
- The brake thermal efficiency decreases with increase in percentage of sesame in the fuel.
- Increase in oxygen content in the diesel blends as compared to diesel results in better combustion and increase in the combustion chamber temperature. This leads to increase” in NO_x.

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