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EXPERIMENTAL INVESTIGATION ON DIESEL ENGINE FUELLED WITH DIESEL AND BIODIESEL EXTRACTED FROM SESAME OIL

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ABSTRACT

Petroleum products resources are limited and their consumption is increasing very fast with globalization and high technology development since last decade. The emissions from the usage of these petroleum products polluting the environment considerably. The objective of this project is to prepare the biodiesel from sesame oil and for reduction of exhaust emissions by using biodiesel as blend with diesel in single cylinder diesel engine .in this work different percentage of biodiesel consider as a blends for diesel.
The number of automobiles is increasing day by day especially in the metropolitan cities giving rise to pollution which is harmful to all forms of life. This makes it estimate and control pollution from vehicles.

Bio-fuels can be produced from diverse sources, which are subject to local geography, topology and climatology. Hence, every nation will have its own choice of a source. This study investigates the potential substitution of sesame oil methyl ester blends for diesel as fuel for automobiles and other industrial purposes. This study is concerned with performance and emission characteristics of diesel engine fuelled with diesel and biodiesel extracted from sesame oil and comparing with petroleum diesel.

The experimental result shows that 20% of blend shows better performance with reduced pollution. This analysis shows that sesame oil methyl ester and its blends are a potential substitute for diesel.

Keywords: Experimental Investigation; Diesel Engine; Diesel; Biodiesel Sesame Oil;

1.INTRODUCTION

Biodiesel is composed of long chain fatty acids with an alcohol attached, often derived from vegetable oils. It is produced through the reaction of a vegetable oil with methyl alcohol or ethyl alcohol in the presence of a catalyst. Animal fats are another potential source. Commonly used catalyst is potassium hydroxide (KOH) or sodium hydroxide (NaoH).The chemical process is called transesterfication which produces biodiesel and glycerin.
Chemically biodiesel is called a methyl ester if the alcohol used is methanol. If ethanol is used, it is called an ethyl ester. They are similar and currently, methyl ester is cheaper due to the lower cost for methanol. Biodiesel can be used in the pure form, or blended in any amount with diesel fuel for use in compression ignition engines
Bio-diesel is a domestic, renewable fuel for diesel engines and it is refer to a family of CI engines fuels that are produced from natural sources such as oils of sunflower, sesame, palm, neem, cotton seed, and jatropha.It is believed that Biodiesels which may be the oils themselves or their esters are the most likely successors to petroleum derived diesel. It is also more practical that these alternate fuels are introduced gradually as blends with diesel so that the production facilities are able to grow and markets are able to Biodiesel.
Biodiesel is a renewable, biodegradable, energy efficient, substitution fuel which can fulfill energy security needs without sacrificing engine's operational performance. Thus it provides a feasible solution to the twin crises of fossil fuel depletion and environmental degradation. The properties of the various individual fatty esters that comprise biodiesel determine the overall properties of the biodiesel fuel. In turn, the properties of the various fatty esters are determined by the structural features of the fatty acid and the alcohol moieties that comprise a fatty ester. Better understanding of the structure-physical property relationships in fatty acid esters is of particular importance when choosing vegetable oils that will give the desired biodiesel quality. By having accurate knowledge of the influence of the molecular structure on the properties determined, the composition of the oils and the alcohol used can both be selected to give the optimal

performance. In this paper the relationship between the chemical structure and physical properties of vegetable oil esters is reviewed and engineering fatty acid profiles to optimize biodiesel fuel characteristics is highlighted.

Biodiesel production is a very modern and technological area for researchers due to the relevance that it is winning everyday because of the increase in the petroleum price and the environmental advantages. In this work it is made a review of the alternative technological methods that could be used to produce this fuel. Different studies have been carried out using different oils as raw material, different alcohol (methanol, ethanol, buthanol) as well as different catalysts, homogeneous ones such as sodium hydroxide, potassium hydroxide, sulfuric acid and supercritical fluids, and heterogeneous ones such as lipases. In this work advantages and disadvantages of technologies are listed and for all of them a kinetics model is introduced.

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

(a) 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,

(b) National administrations to design their energy policies and to define measures to externalize environmental costs,

(c) 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

(d) 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 favouarble 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). Data on the agronomic performance of these new varieties are presented in this paper.1" by the Ministry of Agriculture, Forestry and Fisheries.

Seeds of two local cultivars (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 S. 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.

2.EXPERIMENTAL SET UP

CI Engine Specifications

MAX. BP	:	4.4kW (5 H.P)
SPEED	:	1500 RPM
BORE	:	80mm
STROKE	:	110mm
ORIFICE DIA	:	20mm
COMPRESSION RATIO	:	16.5:1

The engine is four stroke vertical single cylinder diesel engines. The Mechanical brake drum is fined to the engine flywheel and are mounted on a frame and futures mounted on anti-vibrations. The panel board is provided with 3 way cock, digital temperature indicator with selector switch, digital RPM indicator and U-tube manometer.

2.1 Test Procedure

The engine performance test was conducted on a single cylinder, four-stroke, naturally aspirated, open chamber (direct injection) water-cooled, 4.4Kw output computerized diesel engine test-rig.

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 1 and the engine characteristics are cited in specifications of engine.

The fuel is supplied to the test engine by an external tank of 5 liter capacity, 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. Provision was also made for interfacing airflow, fuel flow, temperatures and load measurement with computer.

The setup facilitates, the study of engine performance for brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, volumetric efficiency, specific fuel consumption, A/F ratio and heat balance. Windows based engine performance analysis software package was used for online performance evaluation.

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 for 0 kg, 2 kg, 4 kg, 6 kg, 8 kg and full load conditions.
4. The bio-diesel and diesel fuel substitutions are enter into the fuel tank substitution percentages are 20%,40%, 60%,80%and 100%
5. First enter the bio-diesel of 20% 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, 2 kg, 4 kg and so on.
8. The similar procedure was followed for 40%, 60%, 80%, and 100% bio-diesel and diesel blends.
9. All the observations for the various kgs of substitutions and for the various loads 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 fuels 20%, 40%, 60%, 80% and 100% blends of diesel conditions.

Formulae

1) Mass of fuel consumed (m_f) = (c.c /t) x (s / 1000) x 3600 kg / hr.

Where, s = specific gravity of fuel

c.c = fuel consumption in sec

2) Brake power (bp) = $2\pi NT / (60 \times 1000)$ kW.

Where N = speed of the engine in r.p.m.

T = torque in n-m.

T = R ×W x 9.81 N-m

R= distance from the centre of dynamometer shaft to center of the spring balance=0.32

W= spring balance reading in kg-f

3. Friction power (fp) = from graph bp Vs m_f.
4. Indicated power (ip) = bp + fp
5. Specific fuel consumption (SFC) = m_f / bp kg / kW-hr.
6. Mechanical efficiency (η_{mech}) = (bp / ip) x 100
7. Brake thermal efficiency (η_{Bth}) = (bp / (m_f x C.V)) x 3600 x 100

Where CV = calorific value of the fuel.

C .V = [(percentage of diesel substitution × diesel C.V) + (Percentage of blend substitution × biodiesel C.V)]

C.V for biodiesel = 36000 kj/kg

C.V for diesel = 44000 kj/kg

8. Volumetric efficiency:

Manometer reading = h1 – h2

Hw = m of water

Equivalent air column (ha) = hw *(ρwater/ ρair) m of air
Orifice diameter, d = 0.02 m
Area of orifice A = (Π / 4) * d²
= 0.000314 m²
Actual volume of air intake Va = 60*Cd*A*(2gha)½ m³/min
Ambient temp, Ta = 33ºc = 306 K
Standard temp, Ts = 15ºc = 288 K
Swept volume at S.T.P, Vs = Va * (Ts / Ta)
= 0.423 * (288 /306)
= 0.398 m³/min
Dia of piston, D = 0.0875 m
Stroke length, L = 0.11m
Theoretical volume of air intake, Vt = (Π / 4) * D² * L *n
= (Π / 4) * 0.0875² * 0.11 * (1500 /2)
= 0.496 m³/min

Volumetric efficiency, η_{v0l} = (Vs / Vt) * 100
Density = [(percentage of diesel substitution × diesel density) +
(Percentage of blend substitution × biodiesel density)]
Density of biodiesel = 920 kg/m³ Density of diesel = 830 kg/m³

3.PERFORMANCE ANALYSIS

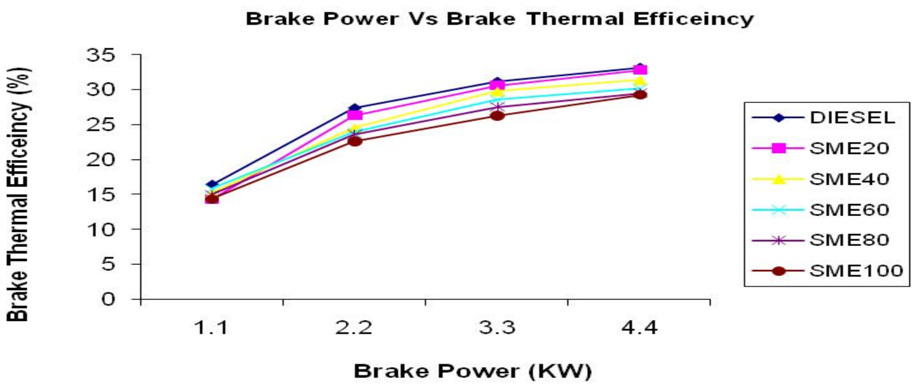

FIG.1 : COMPARISION OF B.P Vs BTE FOR DIFFERENT BLENDS OF SESAME OIL

4.EMISSION ANALYSIS

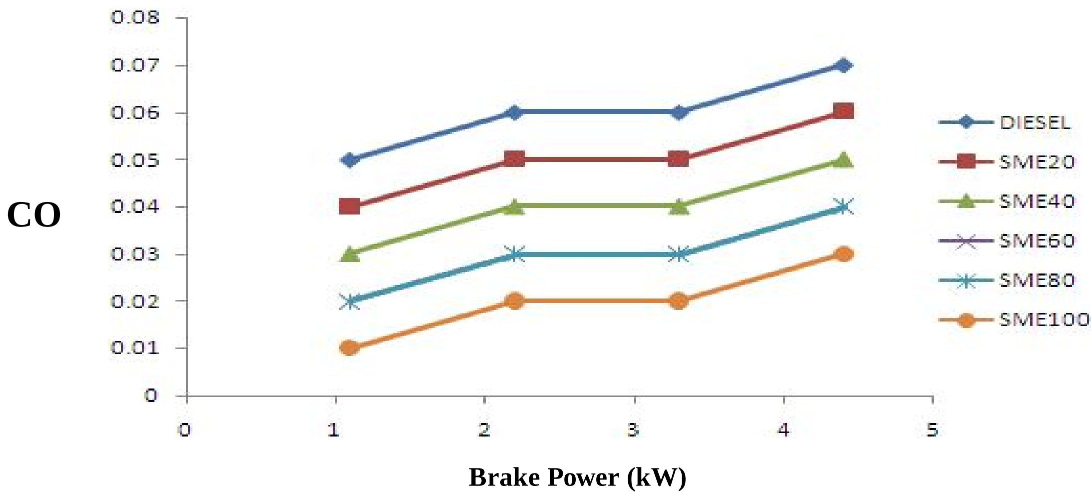

FIG.2 : COMPARISON OF BP Vs CO EMISSION FOR DIFFERENT BLENDS OF SESAME OIL

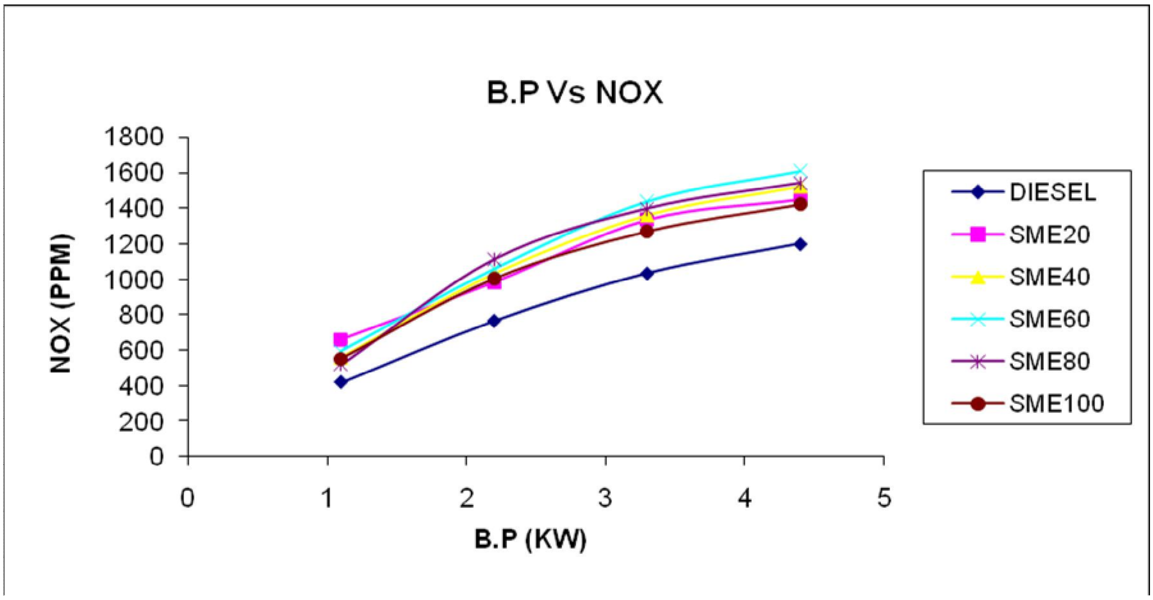

FIG.3: COMPARISON OF BP Vs NOx EMISSION FOR DIFFERENT BLENDS OF SESAME OIL

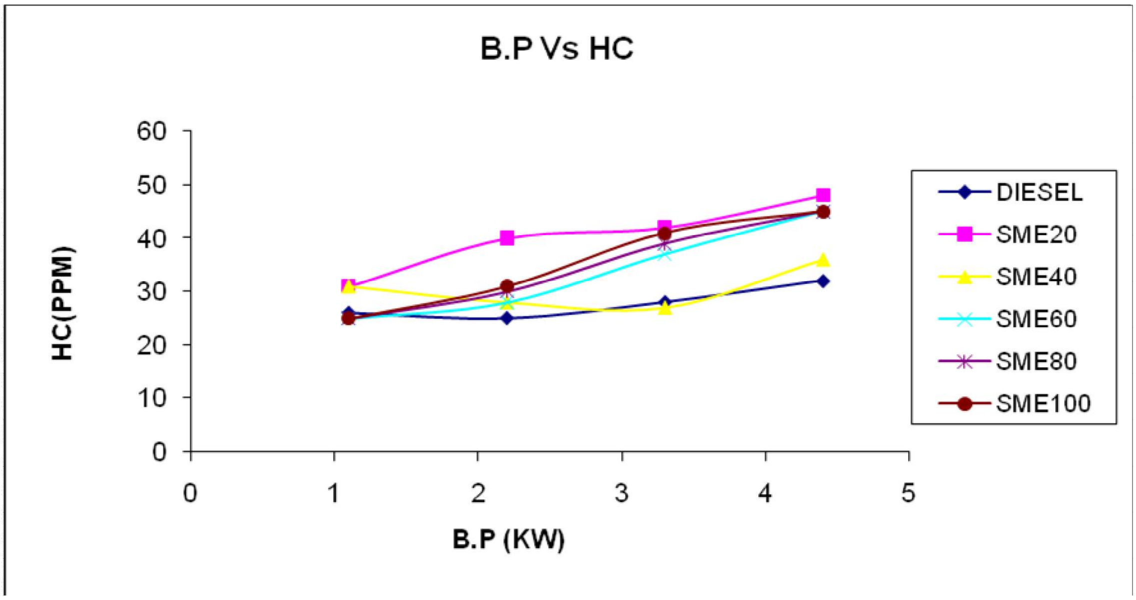

Fig.4: COMPARISON OF B.P Vs HC EMISSION FOR DIFFERENT BLENDS OF SESAME OIL

5.CONCLUSION

The performance, emissions and combustion characteristics of a 4.4 kW DI compression ignition engine fuelled with SME and its blends have been analysed, and compared to the baseline diesel fuel. The results of present work are summarized as follows:

The engine develops maximum rate of pressure rise and maximum heat release rate for diesel compared to SME and its blends. With increase in percentage of SME 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 SME in the blend due to the lower calorific value of SME. The brake thermal efficiency decreases with increase in percentage of SME in the fuel.

Increase in oxygen content in the UCME-diesel blends as compared to diesel results in better combustion and increase in the combustion chamber temperature. This leads to increase in NOX. UCME recorded higher values of NO_X compared to diesel at rated load.
Emissions of CO and HC decrease with increase in percentage of SME in the blend. It is also observed that there is a significant reduction in smoke intensity especially at higher loads even with 20%SME

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