RESEARCH ARTICLE OPEN

Experimental Investigation on Performance Characteristic of Diesel Engine by Using Methyl Ester of Linseed and Neem oil

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Abstract
The increasing industrialization and motorization of the world has led to a steep rise for the demand of petroleum products. Petroleum based fuels are obtained from limited reserves. These finite reserves are highly concentrated in certain regions of the world. Therefore those countries not having these resources are facing a foreign exchange crisis, mainly due to the import of crude oil. Hence, it is necessary to look for alternative fuels, which can be produced from materials available within the country. In addition, the use of vegetable oils as fuel is less pollution than petroleum fuels. In this thesis work, the transesterification process of linseed oil (lso) and neem oil (no) in order to obtain bio diesel. Different parameters for the optimization of bio diesel products were investigated in the first phase, and the effects were characterized to test their properties as fuel in diesel engines such as viscosity, density, flash point, fire point and cetane number. While in the next phase lsome & nome was produced by transesterification method using linseed oil, neem oil and methyl alcohol, and its effects on reaction temperature, catalyst percentages, and reaction time for optimum bio diesel production have been studied. The blends of various proportions of the lsome & nome with diesel were prepared, analyzed and compared with diesel fuel, and comparison was made to suggest the better option among the bio diesel understudy. However, its diesel blends showed reasonable efficiencies.
***Keywords*:** Biodiesel-diesel blends, combustion characteristics, fuel properties, performance parameters, transesterification process

I. INTRODUCTION

Research on renewable fuel “Biodiesel” is deemed to be essential in the present world. The term “biodiesel” commonly refers to fatty acid methyl or ethyl esters made from vegetable oils or animal fats, whose properties are good enough to be used in diesel engines [1]. Biodiesel has been considered as an ideal alternative fuel for diesel fuel. Biodiesel is an environmentally friendly fuel and has the potential to provide comparable engine performance results [2]. Biodiesel has much less air pollution due to its higher oxygen content and less aromatic compounds and sulfur. One exception to this is nitrogen oxide (NOX) emissions, which is slightly higher during the biodiesel usage. Proper tuning of the engine can minimize this problem [3-5]. However, the other kinds of regular exhaust emissions like hydrocarbons (HC) and carbon monoxides (CO) are significantly reduced by biodiesel [6]. The decrease of fossil fuels could considerably reduce pollutants; this can be realized by replacing fossil fuel with renewable fuels. Sustainable renewable energy sources will play a key role in the world’s future energy supply [7].
The fossil fuels reserves are limited and depleting day by day as consumption is increasing very rapidly. Moreover their use is alarming the environmental problems to the society. Hence Universities and Research centers have been working on projects, so as to get new energy resources from biofuels.

Table.1.Properties of the fuels

No.	Property	LSOME	NOME	ASTMD 6751
1	Density (kg/m3)	884	972	870-890
2	Specific gravity	0.884	0.972	.87 - .89
3	Flash Point (oC)	50	55	130 min
4	Fire Point(oC)	57	62	-
5	Heating Value (kJ/kg)	42920	41925	37500
6	Kinematic viscosity (mm2/sec)	0.534	0.840	1.9-6.0
7	Carbon%(w/w)	2.38	2.38	-

II. EXPERIMENTAL SET UP AND PROCEDURE

2.1 Experimental set up

The engine shown in plate.1 is a 4 stroke, vertical, single cylinder, water cooled, constant speed diesel engine which is coupled to rope brake drum arrangement to absorb the power produced. The engine crank started. Necessary dead weights and spring balance are included to apply load on brake drum. Suitable cooling water arrangement for the brake drum is provided. Separate cooling water lines fitted with temperature measuring thermocouples are provided for engine cooling. A measuring system for fuel consumption consisting of a fuel tank, burette, and a 3- way cock mounted on stand and stop watch are provided. Air intake is measure during an air tank fitted with an orifice meter and a water U- tube differential manometer. Also digital temperature indicator with selector switch for temperature measurement and a digital rpm indicator for speed measurement are provided on the panel board. A governor is provided to maintain the constant speed.

Table.1 Engine Specifications

Manufacture	Kirloskar
Engine	Single Cylinder DI-CI
Admission of air	Naturally aspirated
Bore/ Stroke	80 mm/110 mm
Compression ratio	16.5:1
Max power	3.72 kW @1500 rpm
Dynamometer	Rope brake Dynamometer
Method of cooling	Water cooled
Type of ignition	Compression ignition
Method of start	Crank start

Fig.1.diesel engine test ring

2.2Test Fuels

For experimental investigations, biodiesel derived from linseed oil and neem oil was mixed with diesel in varying proportions 10%, 20% and 30% by volume respectively to all the blends.

2.3Experimental Procedure

Calculate full load (W) that can be applied on the engine from the engine specifications. Clean the fuel filter and remove the air lock. Check for fuel, lubricating oil and cooling water supply. Start the engine using decompression lever ensuring that no load on the engine and supply the cooling water allow the engine for 10 minutes on no load to get stabilization. Note down the total dead weight, spring balance reading, time taken for 20cc of fuel consumption and the manometer readings. Repeat the above step for different loads up to full load. Connect the exhaust pipe to the smoke meter and exhaust gas analyzer and corresponding readings are tabulated. Allow the engine to stabilize on every load change and then take the readings. Before stopping the engine remove the loads and make the engine stabilized Stop the engine pulling the governor lever towards the engine cranking side. Check that there is no load on engine while stopping

III. RESULTS AND DISCUSSION

This section describes the various results obtained from the investigation of DI-CI engine fueled with LSOME, NOME and its blends with diesel. The various parameters brake specific fuel consumption (BSFC), indicated specific fuel consumption, brake power, indicated power, brake mean effective pressure, indicated mean effective pressure, a/f ratio, volumetric efficiency, brake thermal efficiency (BTE), indicated thermal efficiency, mechanical efficiency for fuels, B10, B20 and Diesel are discussed as follows.

3.1 (BSFC), (ISFC)

From the Fig.2&3 it is observed that, after analyzing the brake and indicated specific fuel consumption (bsfc and isfc) in case of diesel, with lsome and nome it has been found that the BSFC and ISFC is decreasing for Bio-Diesel when compared to diesel

3.2 Brake Power (BP),

From the Fig.4 it is observed that, after analyzing the brake power in case of diesel, LSOME & NOME it is found the brake power is slightly equal and increasing when compared to Diesel.

3.3 Indicated Power (IP)

From the Fig.5 it is observed that, after analyzing the indicated power in case of diesel, LSOME AND NOME it has been found that the indicated power is decreasing when compared to diesel.

3.4 (BMEP) (IMEP)

From the Fig.6&7 it is observed that, after analyzing the brake mean effective pressure (bmep) and indicated mean effective pressure (imep) in case of diesel, LSOME & NOME it has been found that bmep is increasing and imep is decreasing.

3.5 A/F Ratio (A/F)

From the Fig.8 it is observed that after, analyzing the Air-Fuel ratio in case of Diesel, LSOME &

NOME it has been found that Air-Fuel ratio is increasing when compared to Diesel.

3.6 Volumetric Efficiency

From the Fig.9 it is observed that, after analyzing the Volumetric Efficiency in case of Diesel, LSOME & NOME it has been found that Volumetric Efficiency is increasing when compared to Diesel.

3.7 Brake Thermal Efficiency (BTE),(ITE)

From Fig 10&11 it is observed that, after analyzing the Brake thermal & indicated thermal efficiency in case of Diesel, LSOME & NOME it has been found that the Brake thermal efficiency is increasing, and Indicated thermal efficiency is also increasing when compared with Diesel.

3.8 Mechanical Efficiency (ME)

From the Fig.12 it is observed that, after analyzing the Mechanical efficiency in case of Diesel, LSOME & NOME it has been found that the mechanical efficiency is equal when compared to Diesel.

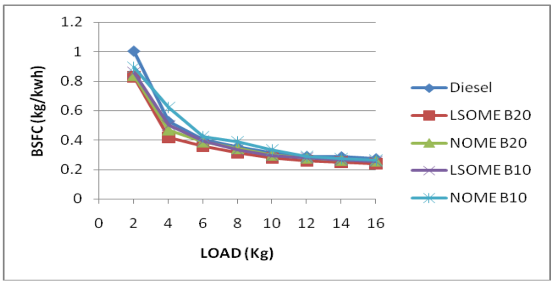

Fig.2.brake specific fuel consumption with load

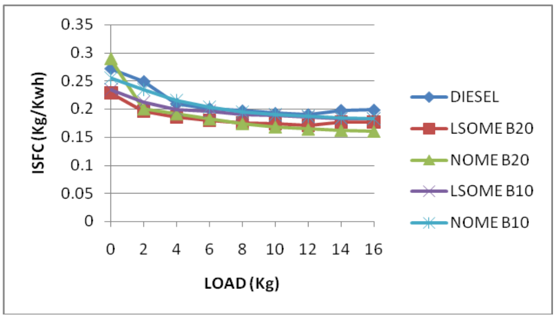

Fig.3.indicated specific fuel consumption with load

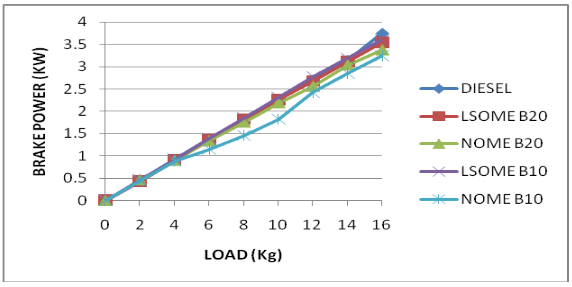

Fig.4.brake power with load

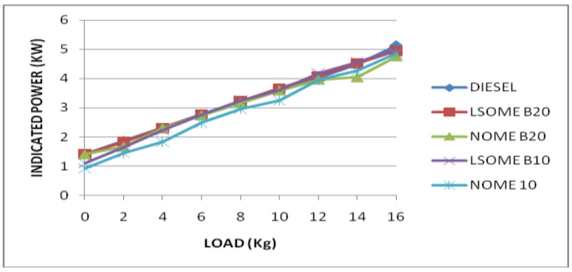

Fig.5.indicated power with load

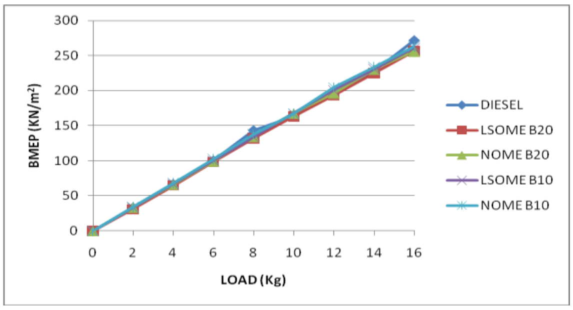

Fig.6.brake mean effective pressure with load

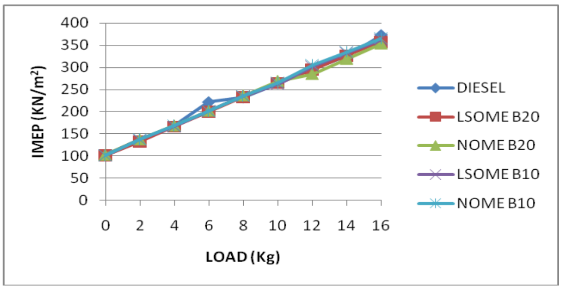

Fig.7.indicated mean effective pressure with load

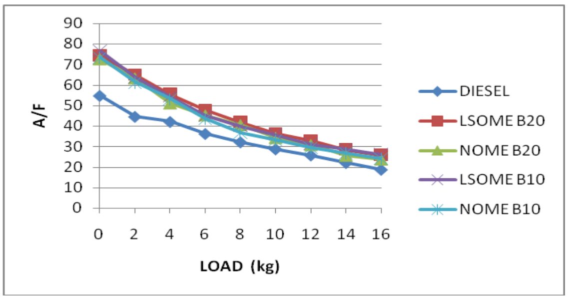

Fig.8.air-fuel ratio with engine load

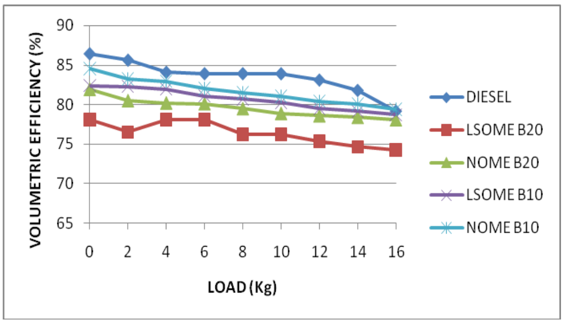

Fig.9.volumeteric efficiency with engine load

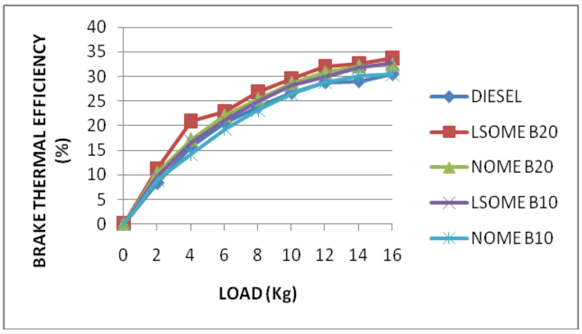

Fig.10.brake thermal efficiency with load

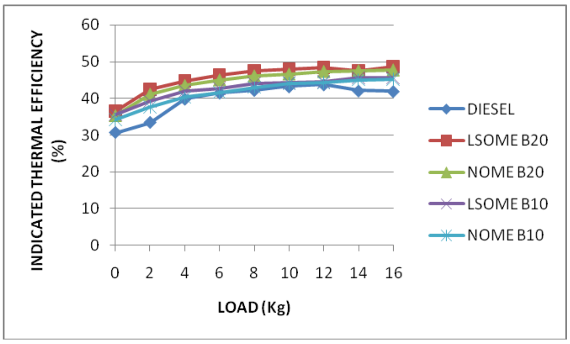

Fig.11.indicated thermal efficiency with load

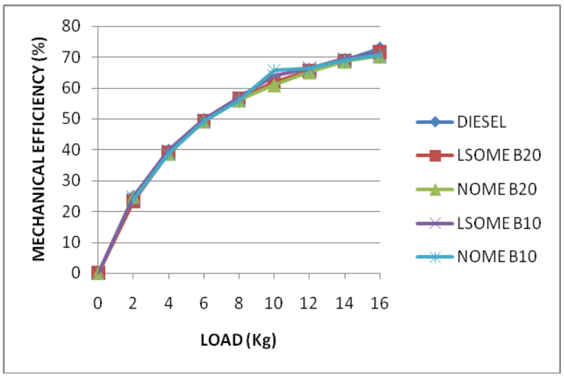

Fig.12.mechanical efficiency with load

IV. CONCLUSION

The conclusions deriving from present experimental investigation to evaluate the experimental tests are conducted on 4-stroke, single cylinder, water cooled and direct injection diesel engine by using linseed oil & neem oil blends of B10 and B20, pure diesel at constant speed of 1500 rpm. From the first set of results it can be conclude that the blend L30 has given the better performance in the sense of brake thermal efficiency, specific fuel consumption and emission parameters. No engine seizing, injector blocking was found during the entire operation while the engine running with different blends of linseed oil and diesel are summarized as follows:

1. From LSOME&NOME blends BSFC and ISFC is decreasing when compared to diesel.

2. Brake power is slightly equal and increasing in bio diesel when compared to Diesel.

3. Indicated power is decreasing in biodiesel blends when compared to diesel.

4. From the above results bmep is increasing and imep is decreasing compared to diesel

5. Air-Fuel ratio for biodiesel blends is increasing when compared to Diesel.

6. Volumetric Efficiency is increasing in bio fuel blends when compared to Diesel

7. Brake thermal efficiency is increasing, and Indicated thermal efficiency is also increasing in LSOME&NOME blends when compared with Diesel.

8. Mechanical efficiency in biodiesel blends is equal when compared to Diesel

A slight drop of efficiency was found with methyl esters (bio-diesel) when compared to diesel. This drop in thermal efficiency must be attributed to the poor combustion characteristics of methyl esters due to high viscosity. It was observed that the brake thermal efficiency of B10 and B20 are very close to brake thermal efficiency of diesel. B20 methyl ester had equal efficiency with diesel. So B20 can be suggested as best blend for bio-diesel preparation.

It is concluded that both fuels (LSOME&NOME) are sustainable alternatives for diesel engine. Biodiesel obtained from linseed oil can be used as a sustainable fuel for conventional diesel fuel in future.

V. ACKNOWLEDGEMENT

Authors thank the Management and Principal of Lakkireddy Balareddy College of Engineering, Mylavaram, Krishna Dist, A.P, India, and India for providing necessary experimental setup to perform this research

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