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EVALUATION ON PERFORMANCE AND EXHAUST EMISSIONS WITH BIO-DIESEL AND ETHANOL BLENDING ON A DIESEL ENGINE

K. Ganesh[1], C.Sampath Kumar[2], K.Arumuganainar[3]

[1]*Associate Professor, Department of Automobile Engineering, Ponjesly College of engineering, Nagercoil Tamil Nadu, India.*

[2]*Student, ME Thermal engineering, Department of Mechanical Engineering, Ponjesly college of engineering, Tamil Nadu, India.*

[3]*Assistant Professor, Department of Automobile Engineering, Ponjesly College of engineering, Nagercoil Tamil Nadu, India.*

Abstract

Due to Urbanized the demand of world energy raises, the 90 percentage of demand is equalized by the fossil fuels and the fossil fuels causes huge measure of carbon rate it causes much more pollution in the atmosphere, this influenced the researcher to hunt an alternative fuel that is friendly to the atmosphere, and it should be Renewable, non-flammable, biodegradable, and non-toxic, by this condition choosing of bio- diesel is the suitable solution for the future. Last few years more number of countries concentrate in the alternate energy source, in that bio- fuel play a virtual role. In this research, Via Transesterification techniques Jatrophacurcas oil and CI oil have been Manufactured and the Properties of the Manufactured biodiesels have been compared with the BIS standard: biodiesel well-known and trying out techniques. The important fuel properties are investigated through lab test resulted in the limits.it shows both are eligible to use as an Bio-fuel in diesel engines. The diesel engine both oil are injected and run the engine. By this emission parameters are evaluated. With various Brake power. Bio- diesel and diesel are compared. Biodiesel–diesel blends. 20% Jatropha and of 30% of Calophyllum Inophyllum biodiesel-diesel blends shows low emission.

Keywords: *bio-diesel, Jatropha curcas, calophyllum Inophyllum, blend, emission, Performance*

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1. INTRODUCTION

The Diesel engine vehicle plays a virtual role in the world wide transportation, this role directly influenced in the world energy demand and economic growth of the country [1].The diesel engines are used as primary movers in power generators, agriculture purpose, commercial transport, construction application and industrial purpose among several countries. Among all the developed and developing countries faces the issue in the demand and supply problem in the fuel products, cost of fuels, emission causes due to the fuels and depletion , inadequate Infrastructure , Huge population , undetermined Renewable Energy Options ,Power Plants , Delay in Commission and Energy Wastage, ,this all are opens a path to the countries in concentrate in encyclopaedic expedition for the alternative fuels.[2] Due increase in the population, the demand of fuel also increase up to 20% in the upcoming years, in india the requirement of energy resources may be raise up to 36% (in the year 2035) more than current scenario.[17] In India, the most demand is commercial energy that can meet largely with the imported fuels. India becomes the fourth biggest consumer as well as net importer of products such as petroleum and crude. By way of, the country is basically reliant on the import of energy, any shortage because of unexpected geopolitical condition could affect severe energy inadequacies which is successively obstruct the evolution of the industrial and commercial development.[6] So attain the energy liberation, the imported oil dependency is to be condensed by evolving the energy source alternation. The typical per capital energy consumption in India is quiet considerably smaller than the countries which are already developed. Though, the equivalent is anticipated to increase abruptly because of high development in economy and the possibility of quick industrialization.[8]

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2. EXPERIMENTAL PROCEDURES

2.1 Biodiesel Fuel as an Congruous Substitute of Diesel Fuel

Table 1: Fuel properties of diesel, Jatropha Curcas biodiesel and Calophyllum Inophyllum biodiesel

Properties	**Unit**	**Diesel**	**Jatropha curcas Biodiesel**	**Calophyllum Inophyllum Biodiesel**	**BIS15607:2005 Standard[18]**
Density	Density kg/m3	858	833.1	870	861–899
Cetane number	-	- 46	52.5	56.5	46 min
Viscosity	mm^2 /s	3.459	4.64	4.1	1.8–6.1
Flash point	C	78.5	190	142	129 min
Cloud point C	C	7.9	5.9	12.9	2.9 to 11.9
Pour point	C	6	2	4.2	-16 to 11
Calorific value (lower)	kJ/g	45.554	38.907	40.287	-

2.2 Feed Stock

2.2.1 Jatropha Curcas

From the Euphorbiaceous family there is the Jatropha which is a small tree and the growth of this plant is around 5 to 7 in height. Jatropha grows well in the dry, semi-dry, and in the tropical areas annual rainfall is 1100–1600 mm. This plant is instinctive to the India, America, Mexico, Brazil, Argentina, Bolivia, Africa and Paraguay. This seed comprises of around 20 to 60 % oil. After plantation of 12 months, this Jatropha yields seeds and reaches its extreme productivity through 5 years. Also they has the survivability rate of from 30 to 50 years. The extracted oil from this tree is primarily composed of linoleic which is 31.4–43.2% of unsaturated constituents and oleic acids of 34.4–45.7%, and some other unsaturated species such as stearic of 7.1–7.4% and palmitic acids of 13.6–15.1%.

2.2.2 Callophyllum Inophyllum

A non-edible oilseed ornamental evergreen tree is the Calophyllum inophyllum which can be generally mentioned as polanga and it fits the clusiaceae family. Also it has some other names among the various parts of the world such as kamani, Alexandrian laurel, honne, tamanu, pinnai, etc. Normally they has better growth in on sands of open sea or deep soil ,it requires 800 to 5000 mm rain fall for its growth. This plant has several origins comprising India, Eastern region of Africa, South East region of Asia, and Australia. Around 100 to 200 fruits are produced by the tree and the oil production is reported to be 2100 kg/ha. From the seed the high concentration of oil that is around 65 to 75% are produced with tinted green and dense with the smell of woodsy or nutty oil.

2.3 Biodiesel Production

To examine the overall performance of the biodiesel. We required to know the process involved in biodiesel production. Biodiesel was manufactured by esterification trailed by trans esterification. Filtering methods are utilized to clean the oils and fats for eradicating the water and impurities. The relied free fatty acids could be detached or transmuted at the state of biodiesel via superior pre-treatment method. The pre-treatment oils and fats are joined utilizing an alcohol and a catalyst. Typically methanol is used in place of alcohol and sodium meth oxide is applied in place of catalyst. The oil molecules which we called as triglycerides are broken separately and transformed keen on esters and glycerol, which are then divided commencing every other and decontaminated.

The Jatropha oil and Calophyllum Inophyllum has acid values of 3.0 and more than that which are experiences esterification tracked by trans esterification. The methyl esters created by the aforementioned approaches are examined to discover their appropriateness as per diesel fuels. It is typically manufactured by the transesterification reaction of triglycerides with a small chain alcohol, generally methanol or ethanol, in existence of a catalyst, leading to the creation of combinations of fatty acid methyl esters (FAMEs) or fatty acid ethyl esters (FAEEs).The transesterification response involves a continuous rescindable reactions that befalls in three dissimilar phases, in the existence of an alcohol (A). In the primary step, triglycerides (TG) are transformed to diglycerides (DG) which get converted to monoglycedies (MG) in the next step. In the third and last step monoglycerides are converted to glycerol (G). A mole of esters is enlightened at each step, normally namely fatty acid methyl esters (FAME). Thus three FAMEs are attained from one triglycerides molecule.

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The reactions are revocable, while the steadiness place in the direction of the manufacture of fatty acid esters and glycerol.The transesterification can be used; while acid andnzymatic catalysis The acid catalysis is slower and requires higher temperatures; while the enzymatic partake slight or not at all manifestation catalysis suffers from the enzymes being too expensive

Triglycerides + ROH —CATALYST→ Diglycerides + FAME

Diglycerides + ROH —CATALYST→ Monoglycerides + FAME

Monoglycerid + ROH —CATALYST→ Glycerol + FAME

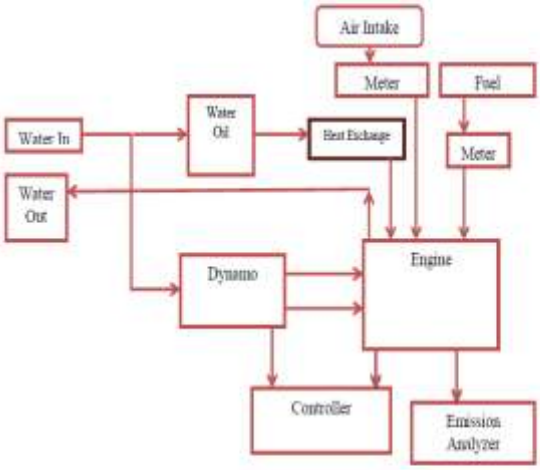

Fig 1: Schematic diagram of engine test bed

2.4 Engine Specification and Setup

Table 2: Specification of the Engine

Engine type	Single Cylinder
Displacement	2.5 L (1800 cc)
Rated power:	3.7 KW at 1500 rpm
Loading device:	Eddy Current
Bore and stroke:	80 x 110 mm
Compression ratio	21:1

An single cylinder, water cooled engine is used to test the biofuel and blending. An eddy current dynamometer is coupled with the engine to given load and do the test. 20 kw of maximum power is operated by the dynamometer with running velocity Rated power of engine is 3.7 KW at 1500 rpm The engine test was conducted at different brake power , Fuels tested had been: Diesel, JEB20 (20% Jatropha curcas and diesel combination), CIEB20 (20% Calophyllum biodiesel- diesel blend). JEB30 (30% Jatropha curcas and diesel combination), CIEB30 (30% Calophyllum biodiesel-diesel blend). JEB40 (40% Jatropha curcas and diesel combination), CIEB40 (40% Calophyllum biodiesel- diesel blend). JEB60 (60% Jatropha curcas and diesel combination),, CIEB60 (60% Calophyllum biodiesel- diesel blend). . The engine specification indexed in the In Table-2. BOSCH and AVL 4000 exhaust fuel analyser was used to analyse the exhaust gas that came from the engine were used to measure the emissions. The engine was connected with the load and simultaneously it was connected with the acquisition system, acquisition machine collects sign, rectify, filter out and convert the sign to the statistics to be study. The acquisition board and laptop interlinked with the help of software named as REO-dCA. the researcher can operate and view the statistics. With this arrangement the test have been conducted for emission and performance parameters in various blends of biodiesel and diesel.

3. RESULT AND DISCUSSION

In general, the blends have 5% ethanol which has close fuel properties than diesel fuel. The experiment is conducted by blend of these two biodiesels of Calophyllum Inophyllum oil and Jatropha oil with the help of Ethanol. Performance and emission experiments were conducted on the engine utilizing blends of various concentrations (20%, 30%, 40% and 60%) of biodiesel and diesel at different load. Blends of The Jatropha oil with ethanol is mentioned JEB 20, JEB 30, JEB 40, and JEB 60. Calophyllum Inophyllum oil blending with ethanol is mentioned as CIEB 20, CIEB 30, CIEB 40 and CIEB 60. Best blend was selected based upon the experimental results.

3.1 Brake Thermal Efficiency

Brake thermal efficiency of Jatropha oil and Calophyllum Inophyllum oil is blended with ethanol at the fraction of 20%, 30%, 40%, and 60% and it is indicated in figure 3.1 and 3.2 .Brake thermal efficiency of diesel shows high value in all the cases of brake power. It was shown that JEB 20 and CIEB 30 shows better performance.

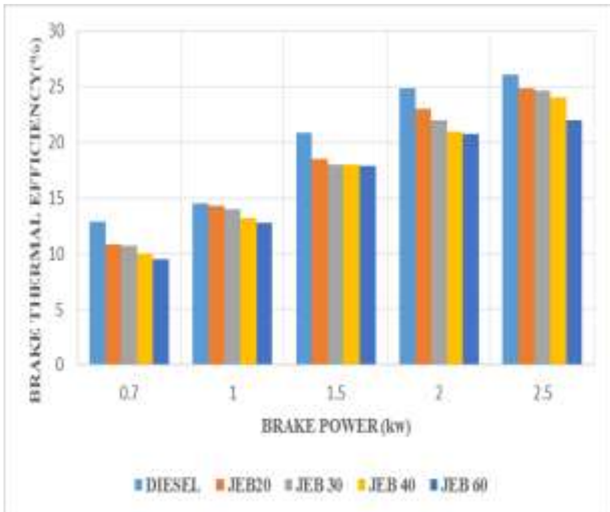

Fig 3.1: Brake thermal efficiency of Jatropha oil blended with Ethanol

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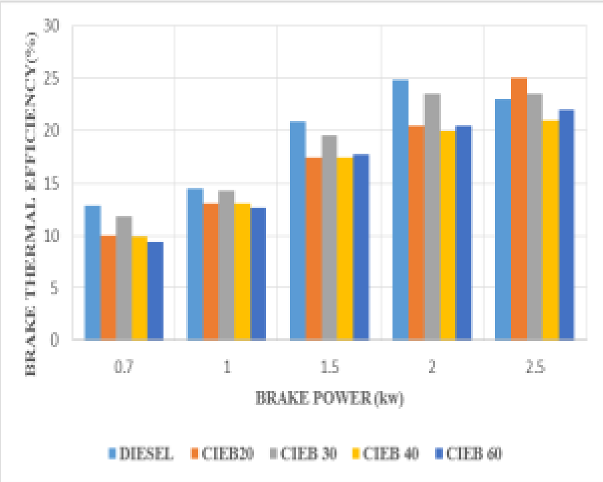

Fig 3.2: Brake thermal efficiency of Calophyllum Inophyllum blended with Ethanol

3.2 Brake Specific Fuel Consumption

Brake Specific Fuel Consumption of Jatropha oil and Calophyllum Inophyllum oil is shown in figure 3.3 and 3.4 at various blends with ethanol. JEB 30 is achieved highest value of SFC and diesel is achieved low SFC.

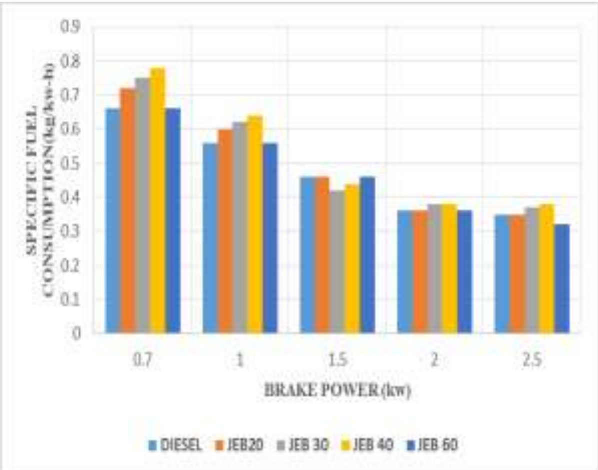

Fig 3.3: Specific Fuel Consumption of Jatropha oil blended with Ethanol

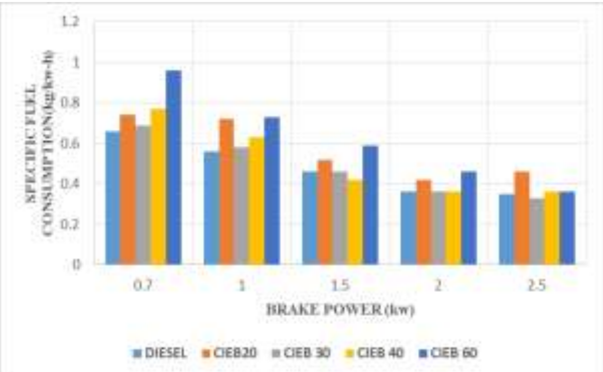

Fig 3.4: Specific Fuel Consumption of Calophyllum Inophyllum Blended with Ethanol

3.3 Pressure - Crank Angle Diagram

Minimum difference occurs in the pressure crank angle diagram. X axis indicates the Pressure in bar and Y axis indicates the Crank angle in degree. The values are shown in the figure 3.5 and 3.6 respectively.

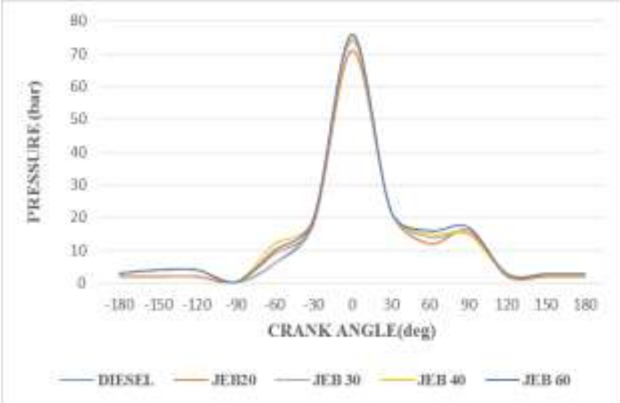

Fig 3.5: Pressure crank angle diagram of Jatropha oil blended with Ethanol

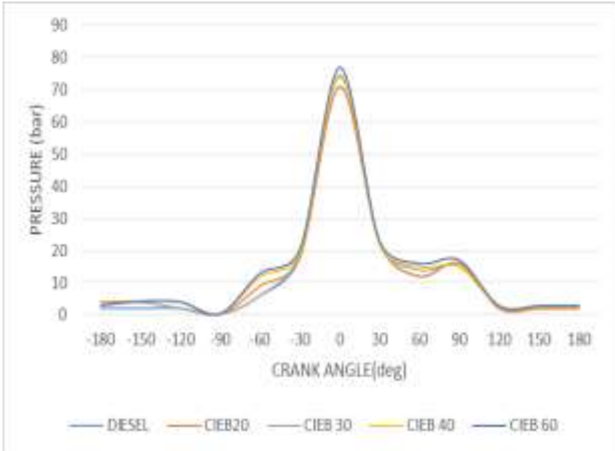

Fig 3.6: Pressure crank angle diagram of Calophyllum Inophyllum blended with Ethanol

3.4 Heat Release Rate

Heat release rate of Jatropha oil and Calophyllum Inophyllum oil is indicated in the following figures of 3.7 and 3.8 respectively and it was observed that 60% blending releases more heat in Jatropha oil next to the diesel and 20% blending of CI releases more heat.

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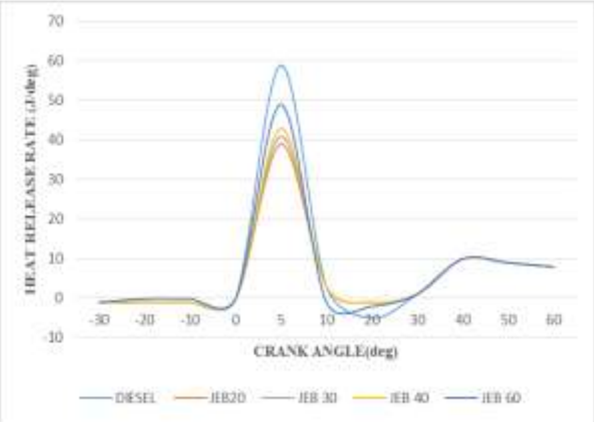

Fig 3.7: Heat Release Rate of Jatropha oil blended with Ethanol

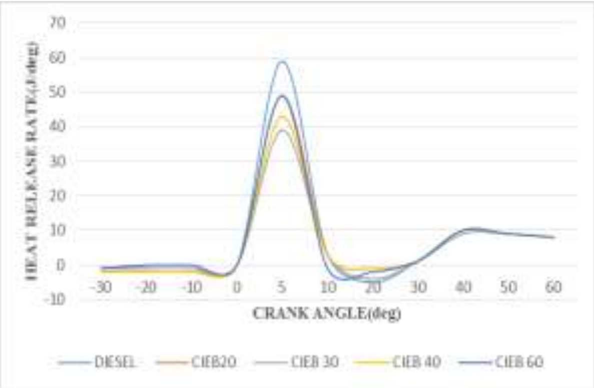

Fig 3.8: Heat Release Rate of Calophyllum Inophyllum blended with Ethanol

Partially burned or completely unburned fuel causes the carbon monoxide emission and hydro carbon emission. The emission parameters of the Calophyllum Inophyllum oil and Jatropha oil blended with Ethanol is shown in the following figures 0f 3.9 and 3.10. Emission percentage of diesel is higher than the bio diesel. Biodiesel is an oxygenated fuel and oxygen contained in the bio diesel helps for complete combustion.

3.5 Carbon Monoxide Emission

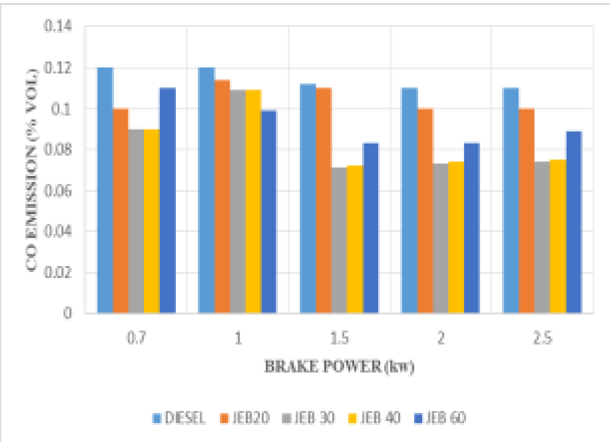

Fig 3.9: CO emission of Jatropha oil blended with Ethanol

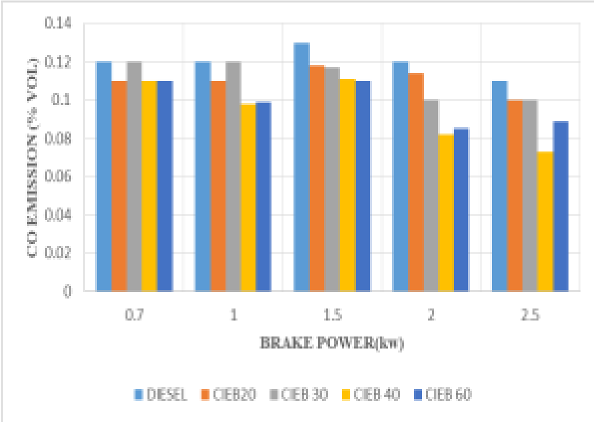

Fig 3.10: CO emission of Calophyllum Inophyllum blended with Ethanol

3.6 Hydrocarbon Emission

The Hydro Carbon emission parameters of the Calophyllum Inophyllum oil and Jatropha oil blended with Ethanol is shown in the following figures 0f 3.11 and 3.12.

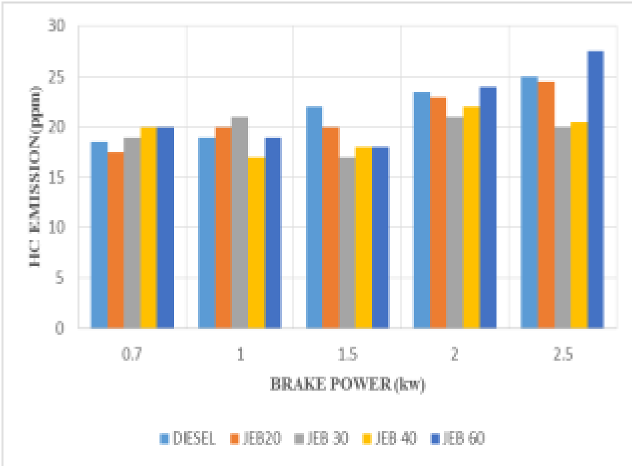

Fig 3.11: HC emission of Jatropha oil blended with Ethanol

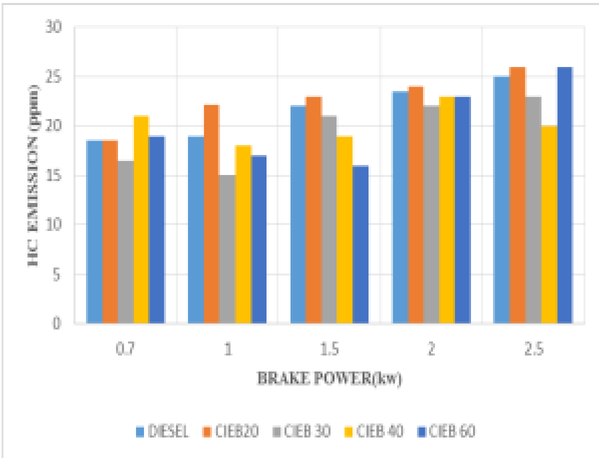

Fig 3.12: HC emission of Calophyllum Inophyllum oil blended with Ethanol

3.7 Oxides of Nitrogen Emission

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The NOx emission parameters of the Calophyllum Inophyllum oil and Jatropha oil blended with Ethanol is shown in the following figures 0f 3.13 and 3.14.

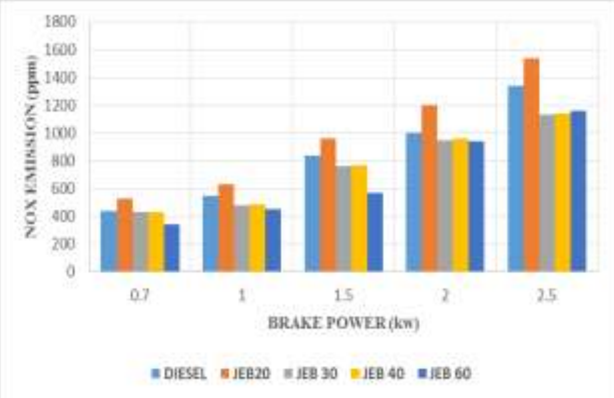

Fig 3.13: NOX emission of Jatropha oil blended with Ethanol

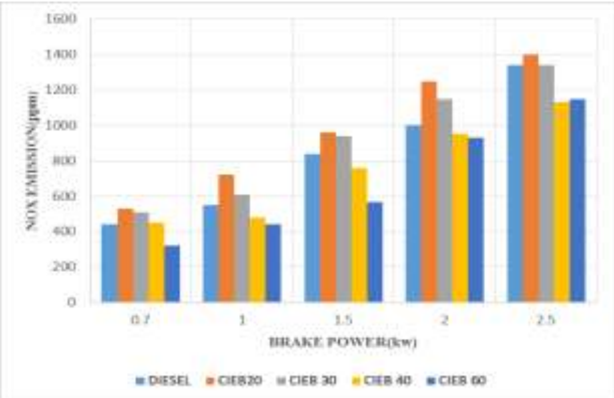

Fig 3.14: NOX emission of Calophyllum Inophyllum oil blended with Ethanol

3.8. Smoke Emission

Smoke emission parameters of the Calophyllum Inophyllum oil and Jatropha oil blended with Ethanol is shown in the following figures 0f 3.15 and 3.16.

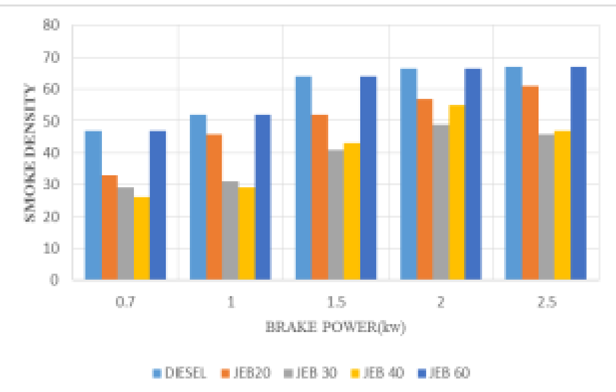

Fig 3.15: Smoke Density of Jatropha oil blended with Ethanol

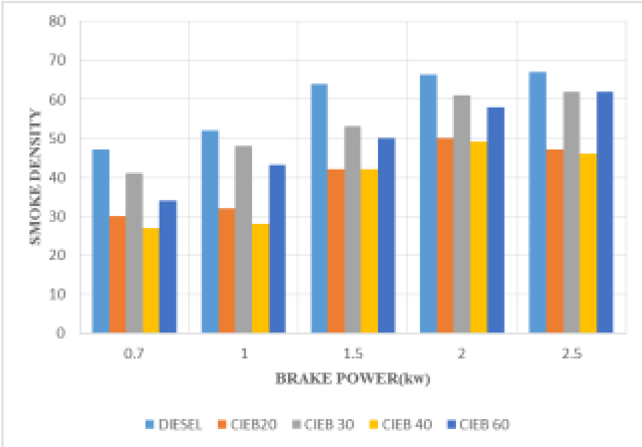

Fig 3.16: Smoke Density of Calophyllum Inophyllum Oil Blended with Ethanol

4. CONCLUSION

Compared to the engine parameters and emission parameters of diesel engine under the various blends of Jatropha oil and Calophyllum Inophyllum oil mixed with ethanol, the Jatropha oil of 20% blend shown better performance (JEB 20) compared to the other blends of Jatropha oil and the Calophyllum Inophyllum oil of 30% blend shows better performance compared to the other blending. Compared to the overall blends of Jatropha oil and Calophyllum Inophyllum oil CIEB 30 shows better performance next to the diesel engine.

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