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COMPARATIVE STUDY OF PERFORMANCE CHARACTERISTICS OF DIESEL ENGINE FUELLED WITH CALOPHYLLUM INOPHYLLUM AND PONGAMIA PINNATA

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ABSTRACT

Depletion of fossil fuels prompts to pursuit of an alternate fuel. In case of internal combustion engines the principle concern is about better performance with fuel economy and with lower emissions. With current circumstance there is critical necessity of option fuel to supplant the quickly diminishing fossil fuel. Biodiesel is one of the best contrasting options to supplant the fossil fuel in diesel engines, which has properties nearer to diesel yet high consistency and low unpredictability of biodiesel execution is inferior. In present work, fuel from a Calophyllum Inophyllum and Pongamia pinnata is chosen as an alternate fuel. Performance characteristics like Thermal efficiency and Brake specific fuel consumption is studied under different load conditions. Better Biodiesel use in coastal areas is suggested.

Keywords: Calophyllum Inophyllum, Biodiesel, Thermal Efficiency, Brake specific fuel consumption.

I. INTRODUCTION

Energy is the important towards the growth of economy development and is imperative to the sustenance of a present day economy. Future economic development urgently relies on upon the long haul accessibility of energy from sources that are moderate, available and ecological neighbourly. Except for hydroelectricity and atomic vitality, most of the world's energy needs are provided through petrochemical sources, coal and regular gas. These sources are limited and at current use rates will be devoured before the finish of the following century. From the perspective of securing the worldwide environment and the sympathy toward long haul supplies of routine energizes, it gets to be distinctly important to create alternate fuels similar with customary petrochemical fuels, which ought to be supportable as well as environment neighbourly. One of the prime possibility for option powers is the biofuel which will assume a critical part in meeting India's energy needs.

A. Environmental Benefits Of Biodiesel

- Biodiesel can be delivered from oilseed plant products, for example, Jatropha, Pongamia, Neem and Mahua. Along these lines lessening the utilization of contamination making fossil fuels.
- Utilization of biodiesel/vegetable oil diminishes carbon dioxide emanations, 90% decrease in unburnt hydrocarbons and 70-75% lessening in polycyclic aromatic hydrocarbon.
- Its further gives huge diminishments in particulates and carbon monoxide than petroleum diesel fuel.
- It gives a slight increment or decline in nitrogen oxides relying upon engine load and testing systems.
- Biodiesel contains oxygen and contains no sulphur.
- Biodiesel help in diminishing greenhouse gasses and increase the carbon credit.

B. Biodiesel Selection

Calophyllum Inophyllum: In this present work, chosen biodiesel is Calophyllum Inophyllum. It is an Indian Laurel tree with extraordinary potential for biodiesel. Calophyllum Inophyllum is a medium-sized to vast evergreen tree that midpoints 8–20 m in stature with a wide spreading crown of sporadic branches. The tree bolsters a thick overhang of lustrous, curved leaves, fragrant white blooms, and vast round nuts. It develops along coastal areas and adjoining marsh woods, in spite of the fact that it periodically happens inland at higher heights. Calophyllum inophyllum seed contains 35- 40 % oil.



Figure 1: Calophyllum Inophyllum fruit and flower

Pongamia Pinnata: Pongamia tree , Pongamia pinnata, Millettia pinnata, Pongamia, Honge tree, Karanj tree, and Indian Beech tree is a deciduous vegetate that grows up to around 50 to 80 feet tall and is local to subtropical districts. It is a feasible non-poisonous contrasting option to jatropa. Being a vegetable, it fixes nitrogen into the dirt and is frequently utilized as a windbreak between fields on farms. It has a wide spreading covering making and fragrant blossoms making it perfect for elaborate shade applications. The oil is non-palatable because of astringent tasting flaveroids. The plant has pharmaceutical utilizes however is not poisonous to the touch like jatropa. It is insect safe and there is say of utilizing the press cake as both insecticide and chicken sustain. It is one of only a handful few nitrogen settling trees (or vegetable trees) creating seeds containing 30-35% oil. Its thick system of sidelong roots and its thick, long taproot make it dry spell safe and appropriate to the extreme warmth and daylight.



Figure 2: *Pongamia pinnata* fruit and flower

II. METHODOLOGY

A. Transesterification Process

The carbon chains (triglycerides) in vegetable and other plant oils are too long and viscous. They should be changed over into low viscous fuels to fill in as transportation forces. There are various ways to deal with achieve this, however the most used technique is trans-esterification. This system incorporates use of alcohol catalyst mix to change over the triglycerides into smaller hydrocarbon chains to make a choice fuel for diesel engines. Glycerine is formed as by-product which is used in various chemical ventures as raw material. The completed consequence of the oil change using methyl alcohol is Methyl Ester which is called "Biodiesel" The procedure for the production of biodiesel subsidiary was develop on a very basic level in light of that of Fanguri M A et al. (1999). A standard philosophy was gotten for biodiesel creation from 400 ml of test. Meher L C (2006) proposes 3.5 grams of sodium hydroxide impetus (0.38 wt %) for liter of virgin oil, which looks at in the extent of 0.1–0.5 wt%. In this way, the transesterification system for the methyl ester creation from crude oil began with dissolving 3.5 gram of catalyst NaOH beds in 60 ml of methanol (CH₃OH) by overpowering blending in a round base flask reactor, to convey methoxide. Sodium hydroxide is a strong base and will ingest soddenness from air and it is basic that the sodium hydroxide remains dry. By then, 400 ml of oil is moved into the round base flask reactor containing methoxide course of action. The mix is kept up at 60-65 C with steady blending using a stirrer for one hour length. The stirrer speed is adjusted almost 500rpm. Methanol is a low breaking point fluid and to keep the dissemination of methanol from the reactor a condenser was settled to the mouth of round base cup. Following one hour of reaction time, the mix is filled a channel molded container and the course of action is left for an overnight for parcel into two specific layers in light of gravity settlement. With everything taken into account, a viable reaction produces two separate layers viz. ester and fowl glycerol. Fowl glycerol, being heavier liquid, will accumulate at the base after five to six hours of settling. Arrange segment can be seen inside couple of minutes and can be depended upon to be done inside six hours. In the wake of settling is done, water is incorporated at a rate of 5.5% by volume of the oil and after that mixed slowly for five minutes. Whatever is left of is then allowed to settle again and exhausted off later.



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B. Properties Of Biodiesel

Fuel properties like density, viscosity, flash point, fire point, calorific value and specific gravity is analysed for diesel BP20 and BC20. Properties are shown in Table 2.

Table 2: Properties of Biodiesel

Parameters	Unit	Diesel	BP20	BC20
Density at 28 °c	Kg/m ³	812	818	827
Viscosity at 40 °c	Cst	2.2	2.4	2.4
Flash Point	°c	58	68	71
Fire Point	°c	62	72	76
Calorific Value	kJ/kg	43200	41875.2	42784
Specific Gravity		0.812	0.818	0.8224

C. Engine Setup

The engine test led on four-stroke single cylinder water cooled compression ignition engine associated with eddy current dynamometer loading. The specific of the engine is given in Table 1.

The engine was continually worked at an assessed speed of 1500rev/min. An encoder is settled for crank angle record. The signs from these sensors are interfaced with a PC to an engine marker to show P- θ , P-V and fuel injection pressure versus crank angle plots. The arrangement is also made for the estimation of volumetric fuel stream. The implicit program in the system learns indicated power, brake power, thermal efficiency, volumetric efficiency and heat balance. The product is totally configurable and P- θ diagram, P-V plot and liquid fuel implantation weight layout can be gained for various working conditions. Performance test is conducted for standard condition of diesel engine set it for fuel diesel.

Table 1: Specification of Diesel Engine

Sl. No.	Parameters	Specifications
1	Number of cylinders	Single
2	Number of strokes	Four
3	Rated power	3.7 kW (5 HP)
4	Bore	80 mm
5	Stroke	110 mm
6	Cubic capacity	553 cc
7	Compression Ratio	16.5:1
8	Rated speed	1500 rpm
9	Dynamometer	Eddy Current dynamometer
10	Type of cooling	Water cooling
11	Fuel	Diesel
12	Injection Opening Pressure	200 bar



III. RESULTS AND DISCUSSION

1. Brake Specific Energy Consumption (Bsec)

Figure 3 illustrates the variation of BSEC with load for an injection opening pressure of 200 bar. As load increases, BSEC decreases for all the fuels because of a higher percentage increase of Brake Power with load as compared to energy consumption.

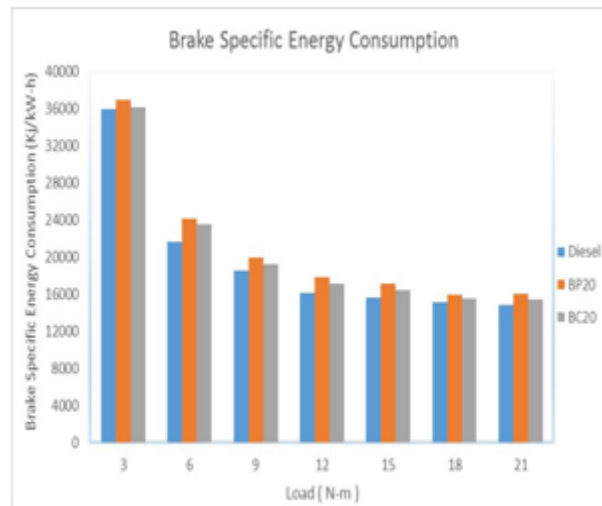


Figure 3: Variation of BSEC with load at 200 bar

In Figure 3 for 200 bar it is clearly observed that BC20 is giving lesser energy consumption when compared to BP20. BSEC was found to increase with 20 percent proportion of Calophyllum Inophyllum oil in the blend compared to diesel in the entire load range. Calorific value of Calophyllum Inophyllum oil and Pongamia Pinnata oil is relatively lower compared to that of diesel, therefore increasing proportion of Calophyllum and pongamia oil in blend decreases the calorific value of the blend, resulting in increased BSEC. Hence, blend BC20 is optimum blend when compared to BP20.

2. Brake Thermal Efficiency

Figure 4 illustrates the variation of BTE with load for an injection opening pressure of 200 bar.

In Figure 4, as load increases Brake thermal efficiency increases. Thermal efficiency of calophyllum and pongamia blend is lower than that of diesel. However thermal efficiency of blend BC20 is close to diesel. Oxygen present in the fuel molecules improves the reference of combustion characteristics. Therefore thermal efficiency was found to be relatively lower for higher blend concentrations compared to that of diesel. So it is clear in the Figure 4 that BC20 Brake thermal efficiency is nearer to diesel. Hence BC20 is the optimum blend when compared to BP20 operating under specified conditions.

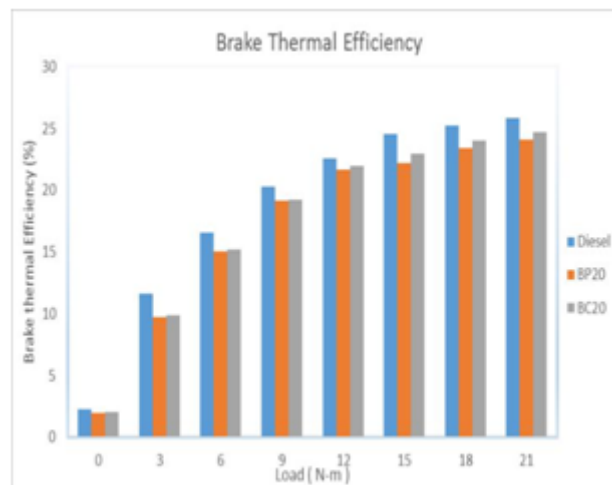


Figure 4: Variation of Brake Thermal Efficiency With load at 200 bar

IV. CONCLUSION

The most familiar biodiesel production seed is Pongamia Pinnata, which can be grown in any climatic conditions. The pongamia seed obtained from the coastal areas content more moisture in it. Therefore it is very difficult to extract oil from the pongamia seed which is grown in coastal areas. Calophyllum Inophyllum tree grown in coastal areas contains 35-40 % of oil in its seed which is maximum than the pongamia pinnata seed i.e:30-35 %. Figure shows that BSEC for BC20 is giving better result than BP20. Figure shows that Brake Thermal Efficiency

of BC20 is giving good result than BP20. Henceforth, instead of producing biodiesel from pongamia pinnata, it is suggested to produce biodiesel from Calophyllum Inophyllum in coastal areas.

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