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Research Article

EXPERIMENTAL ANALYSIS OF METHYL ESTER FROM LOW GRADE PONGAMIA PINNATA AND ITS INFLUENCEI WITH BLENDSION SINGLE CYLINDER FOUR STROKE DIESEL ENGINE

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ABSTRACT

As the price of petroleum oil is increasing, the need to develop alternate fuels has become acute. Bi odiesels produced by transesterification of vegetable oils or animal fats with simple alcohol and cat alysts attracts more and more attention recently. Biodiesels a clean burning alternative and has may attractive features including renewability, biodegradability and low emission. The aim of the presen t review is to study the biodiesel production from transesterification process, effect of various reacti on parameters on conversion of biodiesel yield and its combustion performance and emission chara cteristics. Characteristic fuel properties of crude pongamia pinnata oil methyl ester (CPPOME) ad it s blends with conventional diesel oil in the proportions of 20:80(B20), 40:60(B40), 60:40(B60) ad 8 0:20(B80) respectively is studied. Based on the study conducted various results like effect of viscos ity, specific gravity, heat of combustion, flash point, etc. were derived and comparisons weread. Th e experimental setup for each of the following is explained in detail along with the required pictures for each explanation. The engine used for the study is a single cylinder four stroke engie which has a rated power of 4 kw at 1500 RPM. As a result of these experiments the percentagemission of car bon-monoxides, various hydrocarbons and nitrous-
oxides are tabulated against varying loads from zero load to full load. Also the performance charact eristics like brake power, brake thermal efficiency and brake specific energy consumption has also been tabulated for the same varying loads. Later these performance characteristics are illustrated in the form of graphs for better clarity. The study is concluded with biodiesel production methods andi nvestigation of fuel properties of methyl ester and its blends

INTRODUCTION

The word demand for energy is rapidly increasing .we need en ergy to cook our meals, to travel and communicate, and to pow er our factories. The amount of energy available to us determin es not only our standard of living, but also how long we live.o ne of the main energy sources is oil and rate of production is e xpected to peak in the next few years. There are still plentiful s upplies of coal, the other principal energy source, but it is even more because to meet our requirement. Nonrenewable fuel emi ts more hydrocarbons, oxides of nitrogen, sulfur, and carbon m onooxides, leading to acid rain and climate change. This combi nation of increasing need a clean energy source that is able to meet word energy needs.Efficient use of natural resources is o ne of the fundamental requirements for any country to become self-
sustainable with the fossil fuel depleting very fast, researchers have concentrated on developing new agro based alternative fu els, which will provide sustainable solution to the energy criss. There are more than 300 different species of trees in India, whi ch produces oil. Since India is net importer of vegetable oils, e dible oils cannot be used for production of bio diesel. India has the potential to be a leading world producer of bio diesel, asio diesel can be harvested and sourced from nonedible oils like Ja tropha circus, Neem, Mahua, caster, linseed etc. Some of these oils produced even now are not being properly utilized.

Out of these plants, India is focusing on Pongamia pinnata, wh ich can grow in arid and wastelands. Oil content in the Ponga mia seed is around 3040%. India has about 80100 million hect ares of wasteland, which can be used for Pongamia and other n onedible plants. Implementation of bio diesel in India will lead to many advantages like green cover to wasteland, support to

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agriculture and rural economy and reduction in dependence on imported crude oil and reduction in air pollution. The use of bi odiesel for private or public fleets has grown considerably in r ecent years. Biodiesel can be used in the existing engine witho ut any modification. The use of biodiesel in conventional diese l engines results in substantial reduction of unburnt hydro carb on, carbon monoxide and particulate matters (but NOX about 2% higher). Biodiesel has almost no sulphur (0.05%), no arom atics and has about 10% built in oxygen which helps in better combustion. Its higher flash point (>100 as against 35 in dies\) is good from safety point of view. Unlike fossil fuels the use of biodiesel does not contribute to global warming as CO2 emi tted is once again absorbed by the plants grown for nonedible oil production. Thus CO2 balance is maintained. Biodiesel is p roduced from renewable nonedible oil and hence improves the fuel or energy security and economy independence.

background of the research work

When Dr. Rudolf diesel demonstrated the first diesel engine at the word exhibition in Paris in 1900, he used 100% peanut oil as fuel. Dr. Diesel originally intended that the diesel engine be fuelled by a variety of fuels, including vegetable oil and miner al oil. He promoted the use of vegetable oil as fuel by suggesti ng that it would greatly benefit the development of agriculture in countries that utilized this potential. The adoption of petrole umbased fuel as the primary fuel for the diesel engine was an a rbitrary decision that was largely influenced by the cheaper cos ts of petroleum at the time.

The term, bio diesel, was first introduced in United States duri ng 1992 by the national soy development board (presently nati onal biodiesel board), which has pioneered the commercializati on of biodiesel in the USA.

The use of biodiesel is nothing new in the United States, but a pplicability of biodiesel for large scale use in private and gover nment fleets is only now beginning to be realized. There are a number of reasons for the growing support of biodiesel. The dr iving force is, of course, the need to reduce the harmful emissi ons that result from the burning of petroleum oil as well as ou dependence on diminishing reserves of petroleum oil. The eae in which biodiesel can be used as an alternative to regular petr oleum diesel fuel, along with its economic and environmental benefits, makes it an attractive choice.

Objective of Present Work

Following are the objectives of the present work

1. To select nonedible, low grade, waste oil as a source f or the production of biodiesel.
2. Conversion of crude pongamia piñata oil into methyl ester (Biodiesel).
3. Use of central composite design for the optimization of transesterification process parameters.
4. To study the performance and emission characteristics of a single cylinder diesel engine fuelled with methyl ester and conventional diesel.

METHODOLOGY

Table 3.1 Material usage

Sl no	Materials	No. of units
1	Separating Funnel (250ml)	2
2	Conical Flask (250ml)	6
3	Measuring Jar (250ml)	1
4	Pipette (15ml)	1
5	Electric Heater (1kw capacity)	1
6	Thermometer	1
7	Magnetic stirrer (150 to 200rpm)	1
8	H2SO4(200ml)	
9	Sodium hydroxide (500g)	
10	Crud Rice Bran Oil (10 litres)	
11	Methanol 99% Purity	

Bio diesel production was done by using following methods

- Transesterification reaction
- Titration Process
- Esterification process

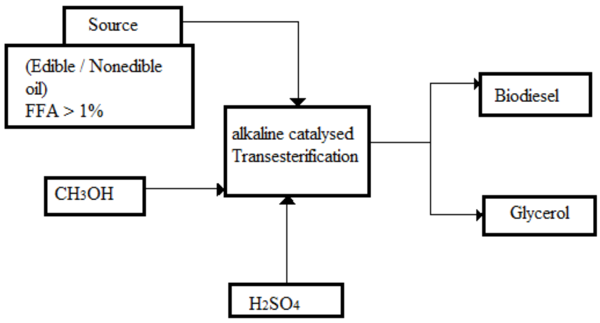

Fig 3.1 Production of Biodiesel

RESULTS AND DISCUSSION

Acid catalyzed transesterification process

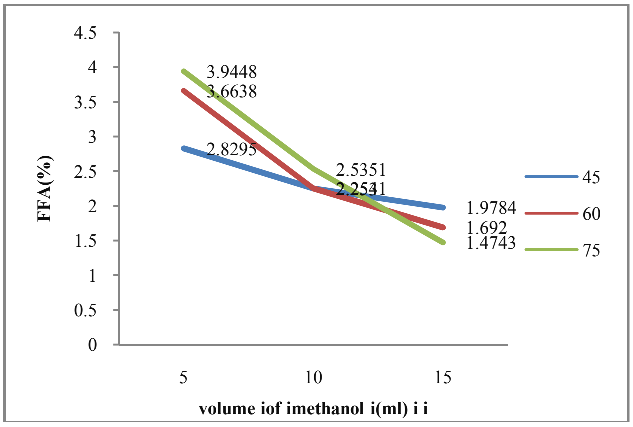

Fig 4.1 Influence of quantity of methanol and reaction time on FFA Level of CPPO (Stage-1)

Figure 4.1 shows that the reaction precedes rapidly in the initia l stage and becomes slow in the later stage. Figure 3.1 also ind icates that FFA level has decreased steadily with increase in th e volume of methanol at the same period of the reaction. Samp le S9 has minimum FFA (0.9%) at the optimized methanol am ount of 10%v / v of oil and reaction time 75 minutes. S9 has s elected as a source for next stage (stage2).

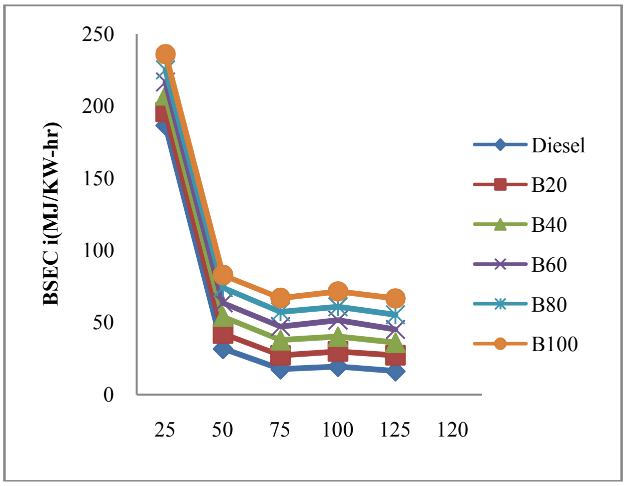

Fig 4.2 Effect of load on Brake Specific Energy Consumption when diesel eng ine has run on B20, B40, B60, B80, B100 and diesel.

Effect load on BSEC

Figure 4.2 shows that the effect of load on BSEC when diesel engine has run on B20, B40, B60, B80 and B100 respectively. Figure 5.1 indicates that with increases in the percentage of loa d on the engine BSEC has decreased from no load to full load for all the samples. The decreases in BSEC are high at part loa ds [0 to 20%] and low at high loads. Sample B20 has similar B SEC as that diesel in all load ranges. BSEC has increased with the increases in percentage of methyl ester in blends. B100 ha s maximum BSEC as compared to all other samples.

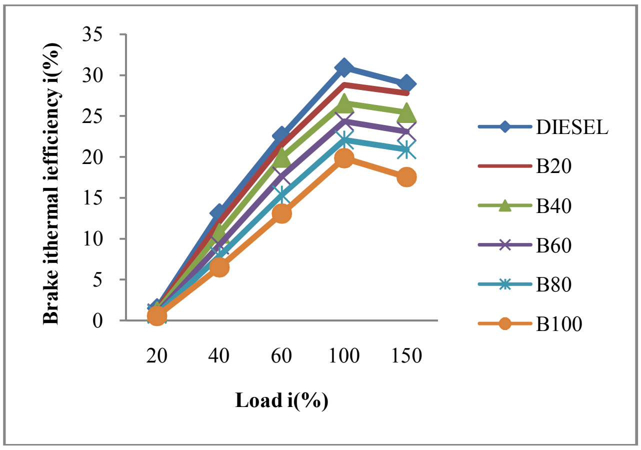

Fig 4.3 shows that the effect of load on BTE when diesel engine has run on B 20, B40, B60, B80, B100 and diesel.

Effect of load on Brake Thermal Efficiency (BTE)

Figure.4.3 shows that B20 has maximum BTE and B100 has m inimum BTE at all loads. B20 has minimum BTE (28.81%) w hich is 6.82% lower than that of diesel at 75% rated load. B10 0 has minimum BTE (19.85%) which is 35.8% lower than that of diesel at 75% rated load. B20 has minimum BTE (12%) wh ich is 8.54% lower than that of diesel at 25% rated load. Figur e 5.3 also indicates that BTE decreases with increase in the per centage of methyl ester in the blend.

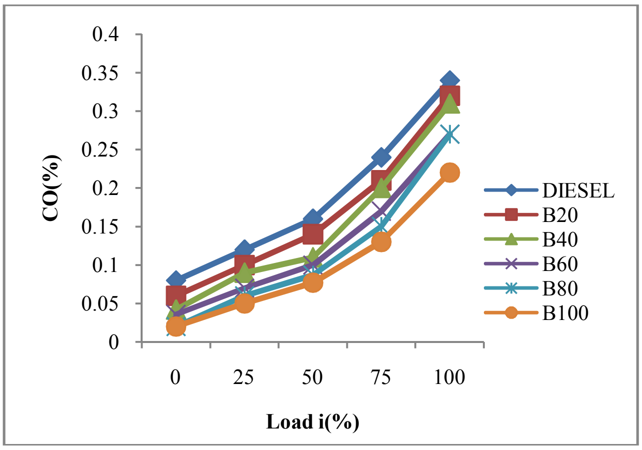

Fig 4.4 Effect of load on CO emission when diesel engine has run on B20, B4 0, B60, B80 and diesel

Effect of load on CO emission

Figure 4.4 shows the effect of load on CO emission when dies el engine runs on B20, B40, B60, B80, B100 and diesel. Figur e 5.5 indicates that CO emission increases with increase in per centage of load and decreases with increase in percentage of es ter. B100 has minimum CO emission at all loads. B20 has max imum CO emission (0.32%) which is 6% lower than that of di esel at 100% rated load. B100 has minimum CO emission (0.0 2%) which is 75% lower than that of diesel at 0 load.

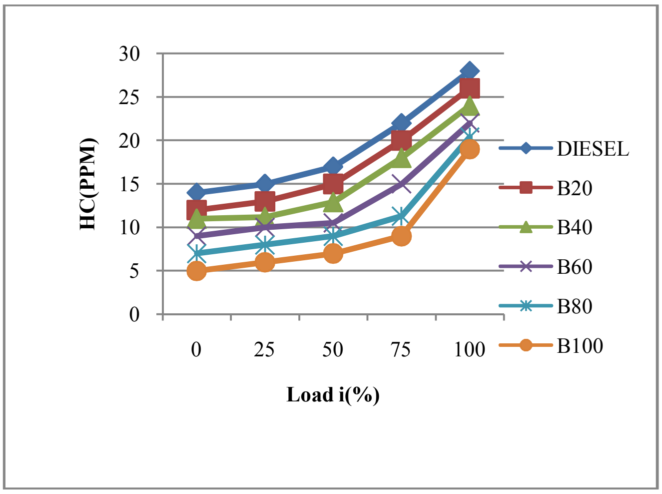

Figure 4.5 Effect of load on UNBHC emission when diesel engine has run on B20, B40, B60, B80 and diesel

Effect of load on unburnt hydrocarbons (UNBHC) emissin

Figure 4.5 shows the effect of load on UNBHC emission when diesel engine runs on B20, B40, B60, B80, B100 and diesel. F igure 5.7 indicates that UNBHC emission increases with increa se in percentage of load and decreases with increase in percent age of ester. B100 has minimum UNBHC emission at all load. B20 has maximum UNBHC emission (26ppm) which is 7% lo wer than that of diesel at 100% rated load. B100 has minimum UNBHC emission (5ppm) which is 64% lower than that of die sel at 0 load.

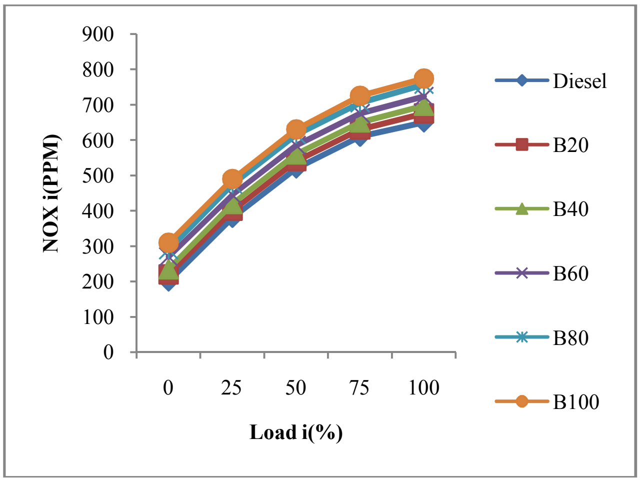

Fig 4.6 Effect of load on NOX emission when diesel engine has run on B20, B 40, B60, B80 and diesel

Effect of load on NOX emission

Fig 4.6 shows the effect of load on NOX emission when diesn gine has run on B20, B40, B60, B80, B100 and diesel. Figure 5.9 indicates that NOX emission increases with increase in the percentage of ester. B100 has maximum NOX emission at all l oads. B20 has minimum NOX emission (220ppm) which is 9 % higher than diesel (200ppm) at 0 load. B100 has maximum NOX emission (774ppm) which is 16% higher than diesel oil (650ppm) at 100% rated load.

CONCLUSIONS

- Maximum yield of 94% was obtained at the optimized p rocess parameters of
- Methanol quantity of 15ml (% v/v of oil) and NaOH of 0.5g (% w/v of oil), reaction time 60 minutes and reacti on temperature ranges from 550C to 600C.
- Scientific optimization techniques such as CCD can be used successfully to get maximum yield with better qual ity.
- The use of PPOME (Pongamia pinnata oil methyl ester) as diesel fuel mainly depends on its characteristic fuel p roperties. Fuel properties such as viscosity and flash poi nt of Crude Pongamia pinnata oil were found to be far g reater than those of diesel oil and therefore, make it uns uitable for use as fuel in diesel engines.

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