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RESEARCH ARTICLE

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EFFECT OF INJECTION PRESSURE AND FUEL INJECTION TIMING ON EMISSION AND PERFORMANCE CHARACTERSITICS OF KARANJA BIODIESEL AND ITS BLENDS IN CI ENGINE

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ABSTRACT

In recent years, much research has been carried to find suitable alternative fuel to petroleum products In the present investigation experimental work has been carried out to analyze the performance and emissions characteristics of a single cylinder compression ignition DI engine fuelled with the blends of mineral diesel and biodiesel at the difference injection pressures. In this paper the performance of blends such as B 20(20% neat Karanja oil and 80% diesel) .The optimal value of the injection pressure was observed as 200 bar in the range of 200 to 240 bar. The injection timing compared at 23°, 21°, 25° and optimal injection timing is 25°. It is found that as the injection pressure decrease the brake thermal efficiency (BTE), also increases and brake specific fuel consumption (BSFC) is lowered as the injection pressure is decrease. In the present work, experiments are conducted on 4.4 kW single cylinder, four stroke, air-cooled diesel engine using neat Karanja oil blended with diesel in various proportions to study the engine performance.

Keywords - biodiesel; diesel engine; karanja oil methyl ester; injection pressure; performance;

I. INTRODUCTION

Fossil fuels are one of the major sources of energy in the world today. Their popularity can be accounted to easy usability, availability and cost effectiveness. But the limited reserves of fossil fuels are a great concern owing to fast depletion of the reserves due to increase in worldwide demand. Fossil fuels are the major source of atmospheric pollution in today's world. So efforts are on to find alternative sources for this depleting energy source. Even though new technologies have come up which have made solar, wind or tidal energy sources easily usable but still they are not so popular due to problems in integration with existing technology and processes. So, efforts are being directed towards finding energy sources which are similar to the present day fuels so that they can be used as direct substitutes. Diesel fuel serves as a major source of energy, mainly in the transport sector. During the World Exhibition in Paris in 1900, Rudolf Diesel was running his engine on 100% peanut oil. In 1911 he stated ''the diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries, which use it'. Studies have shown that vegetable oils can be used in diesel engines as they are found to have properties closer to diesel fuel. It is being considered a breakthrough because of availability of various types of oil seeds in huge quantities. Vegetable oils are renewable in nature and may generate opportunities for rural employment when used on large scale . Vegetable oils from crops such as soya bean, peanut, sunflower, rape, coconut, karanja, neem, cotton, mustard, jatropha, linseed and castor have been evaluated in many parts of the world. Non edible oils have been preferred because they don't compete with food reserves. Karanja (pongamia) is an oil seed-bearing tree, which is non-edible and does not find any other suitable application due to its dark colour and odour. In this work, different proportions of 20% karanja methyl ester are used.

2. MATERIALS AND METHODS

Biodiesel can be produced by a variety of esterification technologies. The oils and fats are filtered and pre-processed to remove water and contaminants. If, free fatty acids are present, they can be removed or transformed into biodiesel using special pre-treatment technologies. Non-edible oil like karanja oils having acid values more than 3.0 were esterified followed by transesterified. Esterification is the reaction of an acid with an alcohol in the presence of a catalyst to form an ester. Transesterification on the other hand is the displacement of the alcohol from an ester by another alcohol in a process similar to hydrolysis, except that an alcohol is used instead of water. This reaction cleavage of an ester by an alcohol is more specifically called alcoholysis. In case of esterification processes, the karanja oil is preheated at different temperature and then the solution of sulfuric acid and methanol is added to the oil and stirred continuously at different temperature. Esterification is continued till the acid value was lowered and remained constant. (This should be between 0.1 and 0.5) Then the heating was stopped and the products were cooled. The un-reacted methanol was separated by distillation. The remaining product was further used for transesterification to obtain methyl esters. The karanja oil was converted to methyl ester by transesterification. The fatty acid composition of karanja oil is given in Table 1. Karanja oil contains 10-20% saturated acids (palmitic, stearic and lignoceric) and 55-90% unsaturated acids (oleic and linoleic). As the viscosity of karanja oil is higher than that of diesel fuel, it is necessary to use a viscosity reduction technique to evaluate its performance and emission in a diesel engine. Therefore, it is required to modify the fuel. So certain approaches are used to modify vegetable oils to better usable forms. Blending is a simple method of modification in which another liquid with a certain character is mixed to get the average required parameter. But the problems of separation of the mixture components and coking occur. So a chemical process called transesterification is preferred. This process produces uniform quality of the alkyl esters and reduces viscosity and increases cetane number

Table 1 - Fatty and unsaturated acids in karanja oil

Acid	Percentage
Palmitic acid C16:0	3.7-7.9
Stearic acid C18:0	2.4-8.9
Lignoceric acid C24:0	1.1-3.5
Oleic acid C18:1	44.5-71.3
Linoleic acid C18:2	10.8-18.3

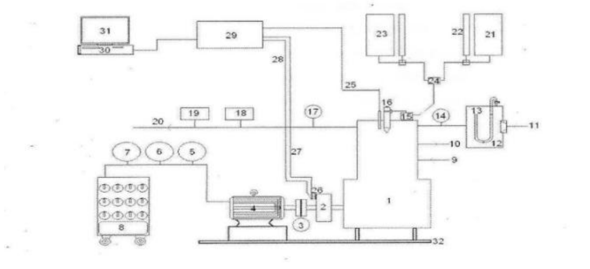
The physical properties of karanja oil, karanja methyl ester are compared with diesel fuel and are given in Table 2.

Table 2.Comparison of Karanja Methyl Ester with Diesel

Property	Karanja Oil	KME	Diesel
Specific Gravity	0.933	0.936	0.85
Viscosity (cst) at 40° C	41.8	20.5	2.87
Flash point (°C)	232	204	76
Calorific Value (KJ/Kg)	-	35940	44020

3. EXPERIMENTAL SETUP

The engine for the experimental investigation is single cylinder 4-stroke naturally aspirated, air cooled diesel engine having 4.4 kW as rated power at 1500 rpm. The engine was coupled to an electric dynamometer to measure the output. Fuel flow rate is timed with burette. The exhaust gas analyzer to measure exhaust gas and the pressure crank angle diagram is obtaining with the help of a piezo electric pressure transducer. The experimental setup is shown in Fig.1



1.	Engine	17.	Exhaust Gas Thermocouple
2.	Flywheel	18.	Whaugen Cubic 5 Gas Analyser
3.	Speed sensor	19.	Bosch Smoke Meter
4.	Alternator	20.	Exhaust Gas Out
5.	Digital Watt meter	21.	Diesel tank
6.	Digital Ammeter	22.	Burette
7.	Digital Volt meter	23.	Bio-Diesel tank
8.	Loading Rheostat	24.	Three way cock
9.	Cooling water in	25.	Cylinder pressure signal
10.	Warm water out	26.	Magnetic pick up
11.	Atmospheric air in	27.	TDC signal
12.	Anti Pulsating Drum	28.	Crank angle signal
13.	U-tube manometer	29.	Data acquisition system
14.	Inlet air thermocouple	30.	CPU
15.	Fuel Injection Pump	31.	Computer monitor
16.	Fuel Injector	32.	Base plate

Figure 1 - Experimental setup

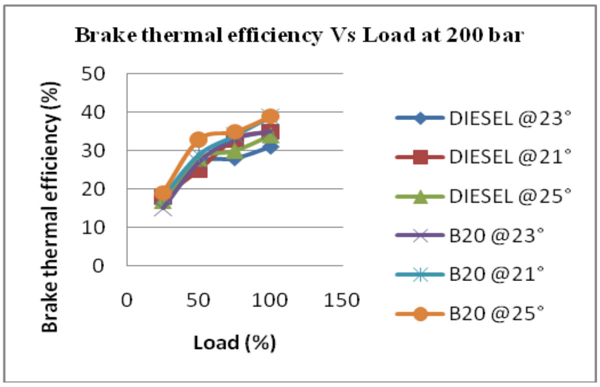
Table 3: Test Engine Specifications

Make	Kirloskar
Type of Engine	Four stroke, single cylinder, DI diesel engine
Speed	Speed 1500 rpm
Bore	87.5 mm
Stroke	110 mm
Compression ratio	17.5
Method of cooling	Air cooled

4. RESULTS & DISCUSSION

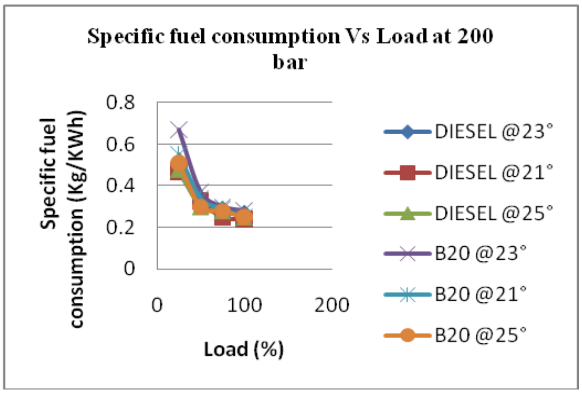
Blends B20 are tested for 23°, 25° and 21°bTDC (normal, retarded and advance) injection timing respectively. Tests are carried at 23°, 21° and 25°bTDC injection timing and injection pressure are 200bar and performance is to be studied. A test is conducted on a single cylinder four stroke diesel engine. In this test the engine is loaded from 0% to 100% and the readings are noted with constant speed

4.1.1 Brake Thermal Efficiency



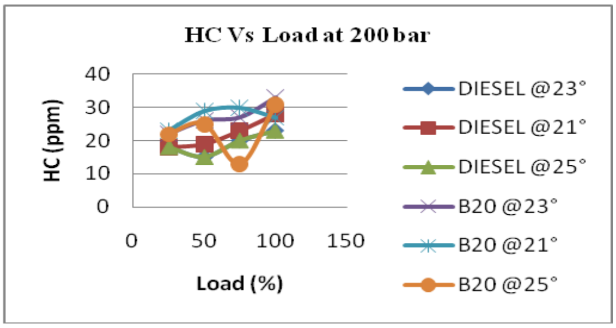
The variations of the brake thermal efficiency with load and injection timing for diesel and KOME blend are shown in fig .the effect of injection timing on engine performance is significant. For B20 blend test, BTE increase with increase in load. Highest BTE is achieved with blend B20 at 25°bTDC.The BTE is found to be lower for diesel at 23° bTDC.

4.1.2 Specific fuel Consumption



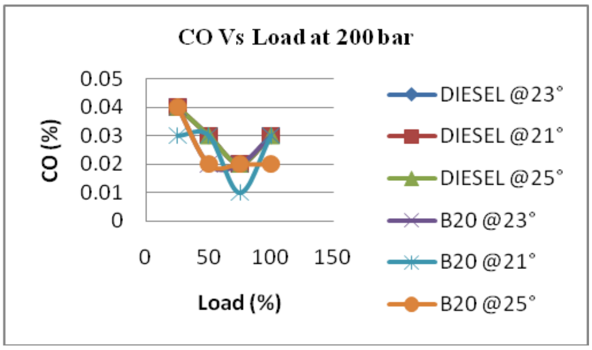
The variations of the brake specific fuel consumption with load and injection timing for diesel and KOME blend are shown in fig. the effect of injection timing on engine performance is significant. Graph indicates that normal injection timing 23°btdc blend B20 is having higher BSFC compared to B20 at 25°btdc at rated load. This is because at 23°btdc longer delay period, which results in incomplete combustion and lower combustion pressure which results in higher BSFC. With the normal of the injection timing, the specific fuel consumption increase whereas retarding leads to improvement. On retarding the injection the delay period increase but fuel delivery to cylinder reduces with a higher mean effective pressure in the cycle maintaining the power, thereby reducing specific fuel consumption.

4.1.3 HC Emission



The variation of the HC with load and injection timing for diesel and KOME blend are shown in fig. It can be observed from fig, that HC emission at 100% full load. At 23°btdc injection timing at B20 , HC emission are high .at B20, 25°btdc HC emission are less than 21°. At 23°btdc there is shorter delay period, which results in complete combustion and lower combustion pressure which results results in higher emission of CO.

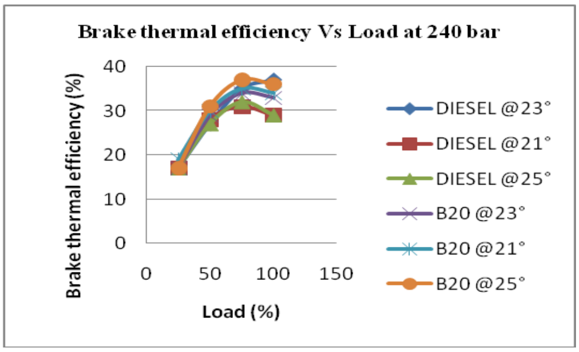
4.1.4 Carbon mono-oxide Emission



The variation of the CO with load and injection timing for diesel and KOME blend are shown in fig.CO is formed mainly due to incomplete combustion of fuel , which may be due to shortage of air. At rated load, in KOME blends CO emission was lower than diesel at 25°btdc.at rated loads incomplete combustion takes place because of which excess CO emission more for all. KOME contain extra oxygen content which results in complete combustion of fuel and converts CO to CO2.

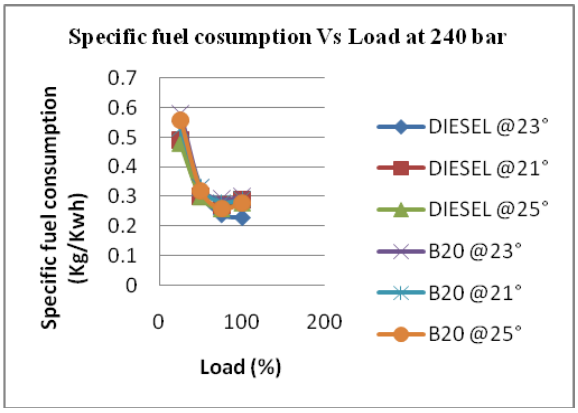
Blends B20 are tested for 23°, 25° and 21°bTDC (normal, retarded and advance) injection timing respectively. Tests are carried at 23°, 21° and 25°bTDC injection timing and injection pressure are 240bar and performance is to be studied. A test is conducted on a single cylinder four stroke diesel engine. In this test the engine is loaded from 0% to 100% and the reading are noted with constant speed.

4.2.1 Brake Thermal Efficiency



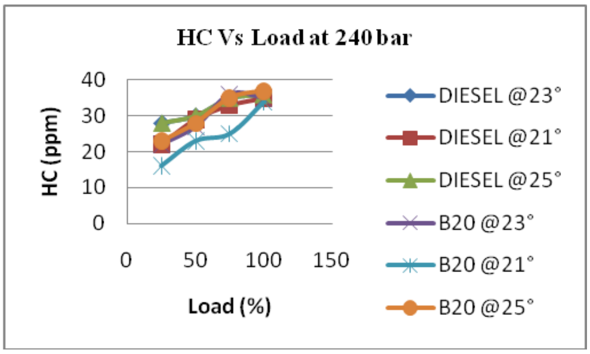
The variations of the brake thermal efficiency with load and injection timing for diesel and KOME blend are shown in fig .the effect of injection timing on engine performance is significant. For B20 blend test, BTE increase with increase in load. Highest BTE is achieved with blend B20 at 25°bTDC.The BTE is found to be lower for diesel at 25° bTDC.

4.2.2 Specific fuel Consumption



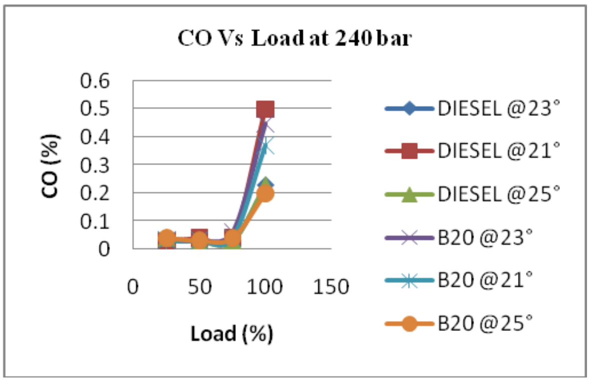
The variations of the brake specific fuel consumption with load and injection timing for diesel and KOME blend are shown in fig. The effect of injection timing on engine performance is significant. Graph indicates that normal injection timing 23°btdc blend B20 is having higher BSFC compared to diesel at 23°btdc at rated load. This is because at 23°btdc for B20 longer delay period, which results in incomplete combustion and lower combustion pressure which results in higher BSFC. With the normal of the injection timing, the specific fuel consumption increase whereas retarding leads to improvement. On retarding the injection the delay period increase but fuel delivery to cylinder reduces with a higher mean effective pressure in the cycle maintaining the power, thereby reducing specific fuel consumption.

4.2.3 HC Emission



The variation of the HC with load and injection timing for diesel and KOME blend are shown in fig. It can be observed from fig, That HC emission at 100% full load. At 25°btdc injection timing at B20, HC emissions are too high. At B20 for 21°btdc, HC emissions are less than 25°. At 25°btdc there is shorter delay period, which results in complete combustion and lower combustion pressure which results in B20 is higher emission of CO.

4.2.4 Carbon mono-oxide Emission



The variation of the CO with load and injection timing for diesel and KOME blend are shown in fig. CO is formed mainly due to incomplete combustion of fuel, which may be due to shortage of air. At rated load, in KOME blends CO emission was lower than diesel at 25°btdc.at rated loads incomplete combustion takes place because of which excess CO emission more for all. KOME contain extra oxygen content which results in complete combustion of fuel and converts CO to CO2.

5. CONCLUSIONS

This work was undertaken to study and compare the effects of the KOME and diesel blended fuels on the performance and emissions of a direct injection diesel engine; the following conclusions can be drawn.

- As availabity of diesel is reducing day to day an alternative fuel is to be used. Researchers have found that addition of oils extracted from plants to the available diesel reduce the overall consumption of the diesel
- With injection timing 23°btdc , 21°btdc and 25°btdc, blend B20 With timing 25°btdc retarded shows higher performance and less emission and 200 bar injection pressure.
- BTE is B20 matches higher than the diesel.
- BSFC is B20 matches nearly to that of diesel.
- CO are emission less than diesel.
- HC and NOx emission are marginally high.
- Without engine modification (at retarded 25°btdc injection timing) blend B20 can be used as alternate fuel.

6. REFERENCES

[1]. Dilip sutraway, Y.U.Biradar, V.V.Katti (2014), "Effect of fuel injection time on performance of CI engine using simarouba biodiesel as fuel", journal of mechanical engineering research and technology, pp.556-572

[2]. S.Naga sarada, M.Shailaja, A.V.Sita rama raju (2010) "optimization of injection pressure for a compression ignition engine with cotton seed oil as an alternate fuel", international journal of engineering science and technology, pp.142-149

[3]. K.Kannan and M.Udayakumar (2010) "Experimental study of the effect of fuel injection pressure on diesel engine performance and emission" ARPN Journal of engineering and applied sciences, ISSN 1819-6608

[4]. M L S Deva kumar , M Venkata ramudu (204) " Effect of injection pressure on the performance and emission characteristics of DI diesel engine running on nelli oil and diesel fuel blend" journal of mechanical engineering research, ISSN 2278-0149

[5]. P.L.Naik and D.C.Katpatal (2010) "performance analysis of CI engine using pongamia karanja biodiesel as an alternative fuel" international journal of engineering science and technology, ISSN 2319-7064

[6]. Vinay kumar D and Veeresh babu A (2011) "Effect of injection pressure on the performance and smoke formation of low heat rejection engine using pongamia methyl ester", Journal of engineering and applied sciences, ISSN 0976-7916

[7]. A.Haiter lenin and R.Ravi (2013) "Performance characteristics of a diesel engine using mahua diesel as alternate fuel", Iranica journal of energy & Environment, ISSN 2079-2115

[8]. N.Stalin and H. J .Prabhu (2007) "performance test of IC engine using Karanja biodiesel blending with diesel",

ARPN Journal of engineering and applied sciences, ISSN 1819-6608

[9]. A.G. Matani, Mukesh A. Mane(2014) "Performance Of Direct Injection C.I. Engine Using Karanja Oil At Different Injection Pressures" International Journal of Research in Engineering and Technology, Volume: 03 Issue: 03, ISSN: 2321-7308

[10]. Ashok Kumar Gupta, Dilip Gehlot And Akhilesh Mishra,(2014), "Optimum Fuel Injection Timing Of Direct Injection CI Engine Operated On Karanja Oil Investigation" International Journal Of Innovation In Engineering Research & Management Issn :2348-4918