An Experimental Performance Analysis of Four Stroke Diesel Engine With blends of Karanja and Diesel

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Abstract— An experimental investigation was made to evaluate the performance and combustion characteristics of a four stroke, single cylinder C.I. engine with the preheated blends of KME and diesel fuel at 60˚ C. Karanja methyl ester was blended with diesel in proportions of 10%, 20% and 30% by volume and studied for the load range of No load to Max. load (15 kg), with the engine operated at constant speed. The performance parameters considered for comparing are brake power, brake specific fuel consumption , brake thermal efficiency etc. of the engine. The performance parameters were found to be very close to that of pure diesel. The brake thermal efficiency were better than pure diesel for the blend PB20 with preheating at 60˚C under certain loads. From the investigation it may be concluded that PB20 (20% KME + 80% Diesel) with preheating at 60˚C gives better performance in comparison to other modified oil. It is also concluded that either blending up to 20% or heating the Karanja oil can be used in diesel engines in rural areas for stationary applications like irrigation, processing of agricultural products and electric generation. From all these observations, it is recommended that the blends of karanja methyl ester with diesel up to 20% by volume with preheating at 60˚C is a replacement to diesel fuel for running the diesel engine without sacrificing the power output.

Keywords: Diesel, Karanja, Engine, Methyl Ester, Performance

I. INTRODUCTION

Energy is an essential input for economic growth, social development, human welfare and improving the quality of life. Since their exploration, the fossil fuels continued as the major conventional energy source. With increasing trend of modernization and industrialization, the world energy demand is also growing at a faster rate. Apart form their indigenous production, majority of developing countries import crude oil to cope up with their increasing energy demand. Thus, a major chunk of their hard earned export earnings is spent for purchase of petroleum products. India is also a net energy importer and almost 80% of the country’s export earnings are directly spent for purchase of petroleum products. There had been sharp increase in the consumption pattern of petroleum products in India. The transport and agriculture sectors are the major users of the conventional liquid fuels.

Karanja is a medium sized tree is found almost throughout India. Karanja tree is wonderful tree almost like neem tree. Pongamia (Karanja) is widely distributed in tropical Asia. Karanja Oil is a non edible oil of Indian origin.

The plant is also said to be highly tolerant to salinity and is reported to be grown in various soil textures viz. stony, sandy and clayey. Major producing country is East Indies, Philippines, and India. Karanja can grow in humid as well as subtropical environments with annual rainfall ranging between 500 and 2500 mm. This is one of the reasons for wide availability of this plant species. The oil content extracted by various authors ranges between 30 to 33%. The cake after oil extraction may be used as manure. Karanja oil has been widely tested for insecticidal and bactericidal activity. In south part of the Indian peninsula the karanja oil/cake are also used same like neem oil and neem cake. The seed oil has been used by the natives of India for hundreds of years. It can be regenerated through direct sowing, transplanting and root or shoot cutting. Its maturity comes after 4–7 years. The oil expelled from the seeds is also burned during the festival of lighting to purify the environment. All these applications are at local or regional level and 94% of the oil from plant is still underutilized.

Considering these facts, a set of engine experiments were conducted using preheated blend of Karanja oil with Petro-Diesel on a engine which is widely used for agriculture, irrigation and decentralized electricity generation. Further experimentations were carried out to determine the engine performance parameters for the given Karanja-Diesel blend.In this work, different proportions of karanja methyl ester, viz,10%, 20%, 30%, 40% and 50% are mixed with 90%, 80%, 70%, 60% and 50% respectively with diesel fuel on volume basis.

II. LITERATURE REVIEW

A. SujaThangaraj a, ,NagarajanGovindan b [2019]*

Sweeping examination of execution, emanation and burning qualities of karanja biodiesel mixes with diesel advanced with a steady progression of HHO gas with shifting EGR rates on correlation with slick diesel was finished. HHO generator and KOME generator can be introduced with the current test motor arrangement. Ends are drawn underneath:Constant stream pace of 0.73 LPM of HHO gas by means of admission complex gave promising result than that of slick diesel. Improved outcomes are acquired for execution and outflow qualities aside from NOx discharge.

B. Avinash Kumar Agarwal a,⇑ , AtulDhar a , Jai Gopal Gupta a , Woong Il Kim b , Kibong Choi b , Chang Sik Lee b , Sungwook Park b [2018]

Impacts of fuel infusion weight and beginning of infusion timings on CRDI motor execution, emanations and burning qualities of Karanja biodiesel (KOME) mixes and pattern mineral diesel were explored at a steady motor speed, notwithstanding far reaching splash examinations. Lower biodiesel mixes demonstrated lower BSCO and BSHC outflows in contrast with mineral diesel anyway BSHC and BSCO discharges were seen as higher for some working conditions for KOME50. BSNOx outflows of KOME20 and KOME10 were higher than mineral diesel for all FIPs anyway

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they were practically indistinguishable from mineral diesel for KOME50.

C. VaratharajuPerumal, M. Ilangkumaran [2018]

From the test results the presentation, ignition and outflow attributes of direct infusion diesel motor by utilizing water emulsified half breed pongamia biodiesel mixes and diesel were examined and a correlation was made with that of the base diesel. While the emulsified pongamia biodiesel demonstrated a calculable decrease in NOx emanation, the smoke outflow level was somewhat expanded and having a closer incentive to that of diesel and B20 mixes. Subsequently by considering the general discharge execution the EHBD5 mix of pongamia biodiesel might be suggested as substitute fuel for diesel motor. The outcomes and the exploratory discoveries are summed up as underneath.

D. K. Sivaramakrishnan [2017]

The presentation and outflow qualities of multifuel variable pressure proportion motor energized with karanja oil biodiesel and diesel mixes have been researched and contrasted and that of standard diesel 1. Brake warm effectiveness of the mixes increments as pressure proportion increments. The most extreme brake warm productivity is 30.46% for B25 at full burden at pressure proportion 18, which is 5% higher than that of diesel 2. The Hydrocarbon Emissions of different mixes have been decreased contrasted with diesel. The base outflow is 16 ppm at B20 while it is 96 ppm for diesel at CR 16. 3. The CO emanation of the mix B25 is lesser than that of the standard diesel.

III. METHODOLOGY

The typical engine used for stationary application has been selected for present experimental investigation. The main problem of using Karanja oil in unmodified form in diesel engine is its high viscosity. Therefore, it is necessary to reduce the fuel viscosity before injecting it in the engine. High viscosity of Karanja oil can be reduced by heating the oil using electric heater and also blending the Karanja oil with diesel. A single cylinder, four strokes, constant speed, water-cooled, direct injection diesel engine is used for the experiments.

After esterification of Karanja oil, attempts were made to reduce its viscosity by preheating it, using electric heater. It is also known that the pure vegetable oils create more problems in engines than blended oils. So it was then decided to use Karanja oil as blending fuel in Diesel to obtain Karanja-Diesel blends in proportions of 10%, 20% and 30% by volume.

The engine was coupled to a dynamometer to provide load to the engine. A sensor is connected near the flywheel to measure the speed. Air intake was measured by air flow sensor that is fitted in an air box. A burette was used to measure fuel flow to the engine via fuel pump. A thermocouple with a temperature indicator measures the exhaust gas temperature. Combustion parameters such as mechanical efficiency, brake thermal efficiency, brake specific fuel consumption, and maximum rate of heat release and emission parameters like exhaust gas concentrations and temperature were evaluated. The experiments were carried out by using various blends (B0, B10, B20, B30, PB10, PB20 and PB30) of karanja methyl ester with diesel at different load conditions on the engine keeping all the independent variables same. For every 5 cc fall in the oil level in the burette, the corresponding time has been noted down. From these data, the values of Fuel consumption, Power measurement , Break mean effective pressure, Break specific fuel consumption, Break thermal efficiency, Air fuel ratio and Volumetric efficiency has been calculated using different formulae.

IV. EXPERIMENTAL SETUP

V. RESULT AND DISCUSSION

The results In this experiment, the blends are preheated at 60˚C. Thus the results in this work pertain to preheated Karanja-Diesel blend having 20% Karanja oil and 80% Diesel oil (B20). Engine performance at constant speed and variable load are covered in this experimental investigation.

VI. ENGINE PERFORMANCE PARAMETERS FOR DIFFERENT BLENDS WITHOUT PREHEATING.

A. Brake Power (kW):

The brake power produced in case of PB10 and PB20 were slightly better than that of diesel.

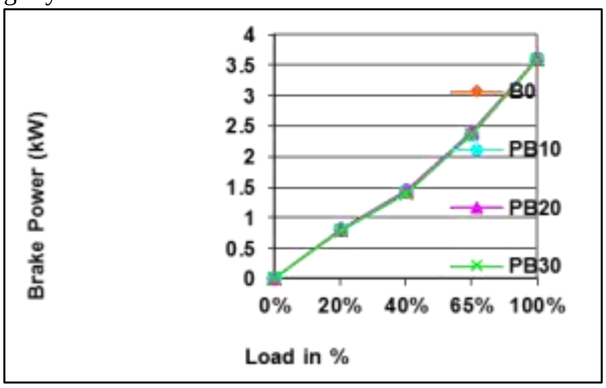

Fig. VI.I: Variation of brake Power with % of load.

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B. Brake Specific Fuel Consumption (BSFC):

The BSFC for B10 and B20 was lower than that of diesel fuel at lower load conditions.

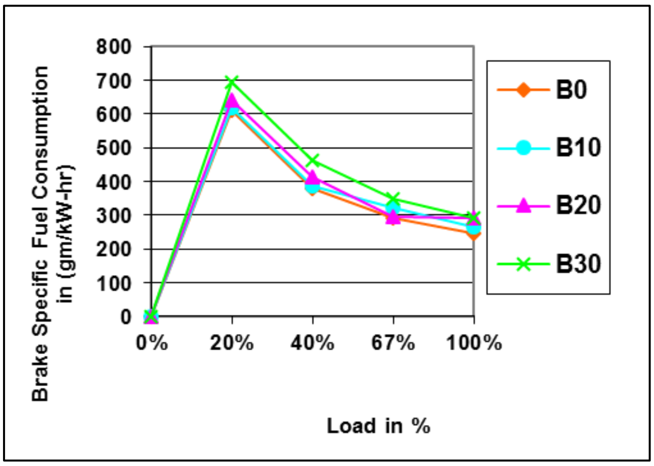

Fig. VI.II: Variation of brake specific fuel consumption with % of load.

C. Brake Thermal Efficiency (η_B): B20 shows higher brake thermal efficiency at lower load conditions compared to that of diesel fuel.

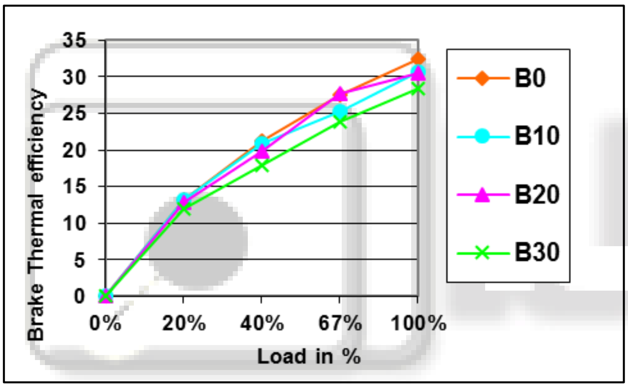

Fig. VI.III: Variation of brake thermal efficiency with % of load.

D. Volumetric Efficiency ($\eta_{vol.}$):

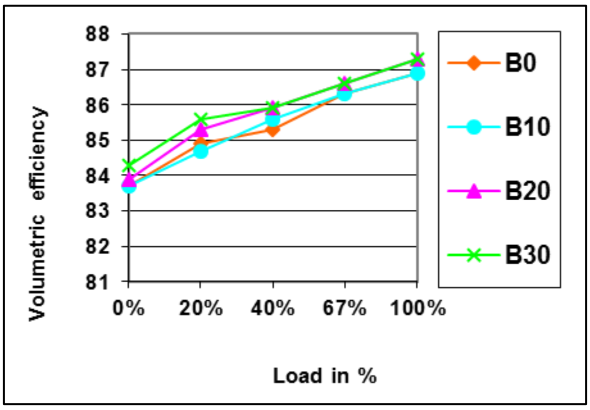

Fig. VI.IV: Variation of volumetric efficiency with % of load.

E. Brake Specific Energy Consumption (BSEC):

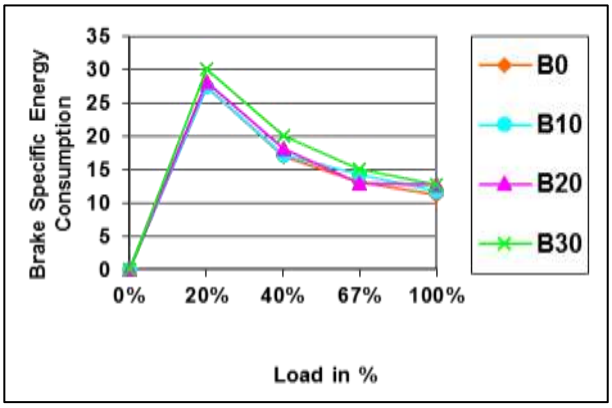

Fig. VI.V: Variation of Brake Specific energy consumption with % of load

VII. CONCLUSION

On the basis of the observations and the results of the experimental investigations on a single cylinder, four strokes, constant speed, stationary, water cooled, CI engine, run on KME-Diesel blend (with and without preheating) and Diesel fuel at different load conditions, the following conclusions may be drawn from the present study:

For the above KME-Diesel blend (PB20) with preheating at 60˚C is found to be the optimum blend, as the highest brake thermal efficiency and lowest brake specific fuel consumption are observed at lower load conditions.

It can be observed from the figure that, PB20 shows higher brake thermal efficiency at lower load conditions compared to that of diesel fuel. The higher thermal efficiencies may be due to the additional lubricity provided by the fuel blends. Almost all blends show, the BTE is very close to that of diesel at lower load conditions

From all these observations, it is recommended that the blends of karanja methyl ester with diesel up to 20% by volume with preheating at 60˚C is a replacement to diesel fuel for running the diesel engine without sacrificing the power output.

REFERENCES

[1] Prof. Vimal V Prajapati, Dr. Ratnesh Shukla, Dr. Tushar M. Patel and Dr. Radhashyam Giri Performance and Emission Analysis of Diesel Engine Fuelled with Karanja oil and Diesel, ISSN 2250-3234 Volume 7, Number 1 (2017), pp. 15-29 © Research India Publications.

[2] Papade Chetan, Metkari Sandeep Emission Analysis of C.I. Engine using Karanja oil and its blends. International Journal of Engineering Trends and Technology (IJETT) – Volume-43 Number-6 -January 2017.

[3] P. L. Navaneetha Krishnan M. Jibin M. Manikandaprabhu S. Manikumar S. Manojkumar, Performance Analysis of CI Engine using Pungam Biodiesel as an Alternative Fuel, International Journal for Scientific Research & Development| Vol. 5, Issue 01, 2017

[4] Jerry Performance and Emission Test on Karanja Oil in Diesel Engine, International Journal of Engineering Science and Computing, September 2016, Volume 6 Issue No. 9.
[5] Venkateswara Rao P. PERFORMANCE ANALYSIS OF C I ENGINE FUELLED WITH DIESEL - BIODIESEL (METHYL/ETHYL ESTERS) BLEND OF NON-EDIBLE OIL, [Rao *, Vol.4 (Iss.7): July, 2016] ISSN- 2350-0530(O) ISSN- 2394-3629(P)
[6] Raghavendra Prasada S.A, K V Suresh, Pongamia Pinnata (karanja) Biodiesel as an Alternative fuel for Diesel Engine, ISSN 2320–3927 An International Journal 2014; 4(4): 52-61
[7] P. L. Naik, D. C. Katpatal, Performance Analysis of CI Engine using Pongamia Pinnata (Karanja) Biodiesel as an Alternative Fuel, International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064, 2013
[8] Ganeshan .V, Internal burning motors, Tata Mc-Graw Hill
[9] Owen K Coley T. (1995), Automotive energizes reference book,2nd version, warrendale, PA, Society of Automotive Engineers.
[10] www.wikipedia/LPG
[11] www.1eere.energy.gov/vehiclesandfuels/pdfs/nuts and bolts/jtb_diesel_engine.pdf .
[12] www.elsevier.com/find/fuel

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