

Review on Effect of Karanja Oil With Additives As Alternative Fuels in Diesel Engine

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Abstract - Biodiesel offers a very hopeful alternative fuel to diesel which is defined as methyl ester fatty acid from vegetable oils or animal fats. The present paper investigates the performance and emission characteristic of diesel engine running with karanja oil. The objective of the paper is to reduce higher viscosity of karanja oil by transesterification and to assess the emission and performance characteristics of diesel engine. The various proportions of biodiesel blended with diesel are B10, B20, B30 with methanol and diethyl ether as additives at varying load conditions at constant speed. Parameters such as brake specific fuel consumption, brake thermal efficiency, hydrocarbon emission, smoke, carbon monoxide emission are to be evaluated. Then, the results of biodiesel are compared with the diesel. CO, HC and exhaust smoke emissions reduce with increase in proportions of biodiesel blends. From the investigation it can be concluded that biodiesel can be used as an alternative to diesel in a diesel engine without any engine modifications.

IndexTerms - Biodiesel, Karanja oil, Transesterification, Combustion, Emissions.

I. INTRODUCTION

Biodiesel is a renewable fuel created from vegetables and animal fats that can be used in diesel engine with slight or no modification. Biodiesel can be used in its hygienic form (B100), but it may need engine modifications to avoid performance and maintenance troubles. Biodiesel is gaining more significance as an alternative fuel due to the reduction of petroleum resources and the price climb of petroleum goods. Most of the researchers carried out performance and emission tests of biodiesel fuel on diesel engine. Biodiesel is renewable, protected and non polluting source of energy to the environment.

Energy is the most essential requirement for human existence. Utilization of fossil fuels has highly increased and the use of these energy resources has main environmental impact as well. Diesel fuel is mainly used in transport, commercial, agriculture, domestic and industrial fields for the invention of mechanical energy and electricity. Among all the alternative fuels existing, bio-diesel attained from the vegetable oils and animal fatty acids promises to be more eco-friendly when it is compared to diesel fuel.

Finding appropriate sustainable fuel alternatives has turn into a high precedence for many countries. Also, it will play key role in a variety of industries in the near future. Biodiesel is one of the sustainable fuels that is a non-petroleum based fuel, consisting of alkyl esters resulting from either transesterification of triglycerides arrived from the vegetable oils or esterification of free fatty acids from animal fats with small chained alcohols. It has several advantages that include low emissions, non-toxic, biodegradable and improved lubricity.

II. TRANSESTERIFICATION

Transesterification process is the effect of triglyceride (fat/oil) with an alcohol in the occurrence of acidic, alkaline or lipase as a medium to form monoalkyl ester, that is biodiesel and glycerol. The occurrence of strong acid or base accelerates the reaction. The major reason of transesterification is to decrease the high viscosity of oil which is appropriate for diesel engine. It is one of the reversible reactions proceeds successfully by mixing the reactants, though the occurrence of catalyst accelerates the conversion. It is essential to note that the acid or base are not inspired by the transesterification reaction. Thus they are mentioned as catalysts but not reactants.

III. INVESTIGATION OF VARIOUS BIODIESEL

Biodiesel is gaining more significance as an alternative fuel due to the reduction of petroleum resources and the price climb of petroleum goods. Most of the researchers carried out performance and emission tests of biodiesel fuel on diesel engine. The efficiency and quality of Biodiesel fuel was found to be more important than petro diesel. For predicting the properties of Biodiesel, a variety of models were developed using various feed oils and blends. The quality of Biodiesel depends on the type of feed oils [17]. Some of the biodiesel surveyed are listed below

P.L.Naik et al. [1] Combustion and emission characteristics of diesel engine running with karanja biodiesel and its blends with diesel were analyzed and compared to standard diesel. Transesterification process is used for the preparation of

biodiesel, which reduces the viscosity of the oil. Various proportions of biodiesel analyzed are B10, B20, B30 and these results are compared with diesel. The results of B10 and B20 are similar to diesel. So, B20 and less than B20 can be used as a fuel to improve the performance and emission of the CI engine. Carbon monoxide and Hydrocarbon emissions decrease with increase in blend proportion of the biodiesel. Biodiesel use could preserve the environmental air quality by reducing harmful emissions released by regular diesel fuel.

C.V.Teixeria et al. [5] The biodiesel and diesel/biodiesel blends became alternatives to the diesel fuel. Though, pure biodiesels cannot be used in diesel engines due to technical problems, diesel/biodiesel blends have been employed in diesel engines. The experimental apparatus used an electric generator instead of a dynamometer to control the load on the engine. Engine is equipped with electric generator at 1500W, 3000W, 4500W. Various proportions of biodiesel used in the engine is from B10 to B100. B100 NO_x emissions are greater than diesel at 4500W of electric load. Specific fuel consumption increases with the amount of the palm oil on the blended fuel.

S.Imtenan et al. [14] This experimental evaluates the improvement of palm biodiesel-diesel blends with help of ethanol, n-butanol and diethyl ether. The use of additives improves the brake power, brake thermal efficiency and decrease in brake specific fuel consumption. To improve the 20% blend of palm biodiesel with diesel fuel (DP20) with help of three additives ethanol, n-butanol, diethyl ether.

B.De et al. [20] The fitness of raw palm oil using preheated in the temperature series of 90° C as a fuel has been offered in this study. The experiments were carried out at constant speed of 1500 rpm with full load and at compression ratios of 16:1, 17:1, 18:1, 19:1 and 20:1. Emission parameters such as CO, CO₂, HC and EGT are discussed with dissimilar compression ratio (16:1 to 20:1) of different blends at full load conditions. The experimental result proves that lower percentages of preheated palm oil can be used as diesel fuel. Significant reduction in CO and HC for all blends at high compression ratio at full loads.

S.Naga Sarada et al. [6] To improve the combustion characteristics of cotton seed oil in an unmodified engine and the effect of increase in injection pressure was studied. Tests were conducted with cotton seed oil and compared with diesel. Quieter operation of the engine is observed during the usage of cotton seed oil. Increased injection pressure has a significant effect on enhancing engine performance and reducing the emissions. Performance of engine with cotton seed oil is approximately similar to the engine running with diesel.

S.Ganesan et al. [7] Combination of diesel, castor oil and ethanol to analysis the performance of CI engine. Castor oil has the potential to reduce the height of pollution and the height of global warming. The exhaust gas temperature and brake thermal efficiency for castor oil with ethanol is very low. It has lower value of NO and un burnt hydrocarbon. It is observed that the fuel consumption for castor oil with ethanol is lesser at no load state and almost similar at other brake power when it is compared to pure diesel.

Niraj S.Topare et al. [9] Algae are usually microscopic organisms thought of as simple aquatic plants which do not have stems, roots or leaves and have primitive methods of reproduction. Aquatic algae are found in both clean and sea waters. To investigate the fuel properties of algae oil & production of biodiesel from algae oil. Biodiesel production is done by transesterification process. Various proportions used in the analysis are 20% biodiesel & 80 % diesel and 50 % biodiesel & 50% diesel. Percentage of oxygen present in the biodiesel is very higher than the diesel.

S.Murugan et al. [10] It is used to reprocess the tyres into fuel, gas, solid residue, oil which cannot be used in tyre manufacturing. Engine running with low & high concentration blends were studied and compared with diesel fuel. Aimed to modify the fuel to decrease viscosity and sulphur content of the crude pyrolysis oil. Distilled tyre pyrolysis oil [DTPO] results in higher hydrocarbon emission compared to the diesel. Brake thermal efficiency increases with increase in proportion of DTPO blends but lesser than diesel fuel. In order to prevent waste rubber and unnecessary automobile tyres from damaging the environment and it is highly attractive to recycle this material in a useful manner [11].

Syarifah Yunus et al. [15] The engine emissions of CO, CO₂ & NO_x of diesel and biodiesel blended were evaluated at varying load conditions which were 0.13, 0.15, 0.17, 0.19, 0.21 KW. Five fuel samples designation of different composition are diesel fuel, 5%, 10%, 15%, 20% of blended jatropa-palm biodiesel with diesel fuel. The emissions parameters CO, CO₂, NO_x of transesterificated jatropa-palm blended biodiesel are compared to diesel fuel. The emission formed by biodiesel blends is much superior than the diesel fuel, due to higher oxygen content in the biodiesel composition.

Gaurav Paul et al. [18] The numerical and experimental analysis [18] on the performance and emission characteristics of a diesel engine mixed with various blends of biodiesel. Jatropa oil used in the conventional diesel engine decreases its brake thermal efficiency and torque and the brake specific fuel consumption increases with the increase in percentage of biodiesel. NO_x emission increases while compared to diesel. This is due to increase in temperature and higher oxygen substance obtained due to total combustion of biodiesel.

S.Nagaraja et al. [19] Experimental study is carried out on an I.C engine, single cylinder four stroke VCR direct injection diesel engine to examine the emission and performance characteristics of diesel, jatropa oil and jatropa oil-diesel blended fuels with different blended rates. The results are recorded for the compression ratio of 16, 17 and 18 changing the load from

idle to rated load of 3.7 kW. The main purpose of the present study is to reduce the viscosity of jatropha oil by blending with diesel and to estimate the engine performance and emission characteristics without any modifications. Enhance in compression ratio improves the performance of the engine (Brake thermal efficiency). If jatropha oil blends increases, then the EGT, NO_x, CO emissions increases and thermal efficiency decreases.

A.M.Liaquat et al. [16] Coconut biodiesel is used to determine the suitability of using coconut biodiesel (CB5 & CB15) on CI engine and to compare the results with diesel fuel in terms of sound level, exhaust emission and performance. The engine is coupled with eddy current dynamometer which is operated at maximum power of 20KW at the speed of 2450 to 10000 rpm. Brake power, engine torque for biodiesel blends were decreased compared to diesel fuel, due to their lower heating values. Exhaust gas emissions, CO and HC emissions were reduced whereas, NO_x and CO₂ emissions were increased for CB5 & CB15 compared to diesel fuel.

IV. Investigation of Karanja oil

AR.Manickam et al. [2] Experimental investigations in diesel engine to optimize the parameters for successful use of biodiesel in engine like the result of injection parameters on performance and emission characteristics of karanja methyl ester diesel blend. In this study, they are aimed to improve the performance, emission characteristics of a diesel engine running on biodiesel with addition of 10% and 15% diethyl ether at different load conditions. Transesterification process is used for the preparation of biodiesel, which reduces the viscosity of the oil. Break thermal efficiency is slightly improved and exhaust emissions are considerably reduced. Brake specific fuel consumption slightly decreased as compared with biodiesel at full load condition.

R.Senthilkumar et al. [3] The performance, combustion and emission activities of the engine fuelled with KOMETPO (Karanja oil methyl ester tyre pyrolysis) blends are compared with those of diesel and karanja oil with tyre pyrolysis technique. In this paper, they are aimed to evaluate the effect of TPO blended with KOME in five dissimilar percentages of fuels on the performance, combustion and emission characteristics of a diesel engine. Nitric oxide emission was higher for KOMETPO 80 and gives the best results compared to further blends and diesel.

Siddalingappa R. Hotti [4] Karanja is a non edible oil medium sized tree with high production potential. The objective of this study is to investigate performance and combustion characteristics of diesel engine running on karanja oil (K100) and its blend K10, K15 and K20.

Table 1. Properties of Karanja oil compared with diesel

S.No	Properties	Diesel	Karanja Oil
1.	Viscosity (mm ² /s)	2.87	54.14
2.	Density (gm/cc)	0.850	0.930
3.	Calorific Value (KJ/kg)	44,019	36,740
4.	Flash Point (°C)	76	Greater than 200
5.	Carbon Residue (w/w)	-	1.6

Higher amount of carbon residue may leads to deposit of carbon in the combustion chamber and high viscosity were found. Thermal efficiency of K15 was well comparable with that of diesel. K15 was found to be most favorable blend.

N.Stalin et al. [8] Performance of IC engine using karanja oil as biodiesel with different blending ratios has evaluated. Parameters like fuel consumption, torque, speed of engine were measured at dissimilar loads for pure diesel and various combinations of fuel (B5, B10, B15, B20, B40, B60, B80, B100). When the load of the engine increases, brake specific fuel consumption decreases at 70% load. During increase in load of the engine, the brake power increases automatically with biodiesel. The price of dual fuel B40 can be reduced than the diesel, and it is used in diesel engines without any modifications.

Avinash Kumar et al. [12] Experimental investigations of DIC engine based on the emission, performance and combustion characteristics of Karanja oil blends. Theme is aimed at exploring scientific possibility of using karanja oil blends in direct injection compression ignition engine without any engine hardware alteration. Karanja oil used in the analysis was characterized for its calorific value, viscosity, density and flash point. Viscosity was measured by kinematic viscometer. Smoke ability was lesser for lower karanja oil blends compared to diesel. Lower concentration blends can be used as alternate fuels to enlarge mineral diesel supplies.

K.Nantha Gopal et al. [13] Biodiesel from pongamia oil is prepared (PME 100) and tested on a diesel engine for dissimilar blends such as PME 20, PME 40, PME 60 and PME 80. Comparison of the pongamia oil is made with diesel operation. The main aim of this study is to compare the fuel properties of the methyl esters of pongamia oil with diesel and to examine the performance, combustion and emission features of the DI diesel engine running on biodiesel. Diesel engine can

perform suitably with pongamia oil methyl esters and their various blends without any engine alterations. The specific fuel consumption increases with boost in percentage of biodiesel in the biodiesel blends due of the lower heating value of biodiesel.

V. CONCLUSION AND FUTURE SCOPE

- From this survey, it is found that various fuels extracted from bio oils like karanja oil, palm oil, cotton seed oil, castor oil, algae oil, tyre pyrolysis oil, jatropha oil and coconut oil are used in the diesel engine.
- Biodiesel use could preserve the environmental air quality by decreasing harmful emissions released by regular diesel fuel.
- Smoke capacity was lower for lower karanja oil blends compared to diesel.
- Increase in compression ratio, improves the performance of the engine (Brake thermal efficiency) with karanja oil as biodiesel.
- If the biodiesel blends increases, then it will results in increase of emission parameters like NO_x, CO and exhaust gas temperature.
- Brake thermal efficiency increases with increase in additive percentage of the biodiesel compared with pure diesel.
- Brake specific fuel consumption is found highest for pure biodiesel at all varying loads because of high volatility, low heat content and high viscosity.

Further investigations have to be made, based on the effect of compression ratio over the emission and performance characteristics of variable compression ratio engine fueled with karanja oil. By increasing the compression ratio, the engine performances are varied and it is compared with standard diesel. While increasing the compression ratio of the engine the mechanical efficiency was improved at full load condition. This may lead to better thermal efficiency of the engine. The karanja oil blends when used as fuel, results in reduction of carbon monoxide & hydrocarbon emissions and increase in nitrogen oxides emissions.

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