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Experimental Analysis of the Internal Combustion Engine Parameter With Reference to Its Performance Using Karanja Oil in Different – Different Proportion with Diesel

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ABSTRACT-

Engine performances and emission traits of Karanja oil methyl ester combined with diesel had been completed on a variable compression diesel engine. In naw a days upcoming power crisis, vegetable oils have arise as a promising supply of fuel. They are being studied extensively due to their considerable availability, renewable nature and higher overall performance while utilized in engines. An experimental research turned into made to assess the overall performance and emission traits of a diesel engine the usage of unique blends of methyl ester of karanja with diesel. Karanja methyl ester turned into combined with diesel in proportions of 5%, 10%, 15%, 20%, 30%, 40%, 50% and 100% with the aid of using mass. The overall performance parameters had been observed to be very near that of diesel. The brake thermal and mechanical efficiencies had been higher than diesel for a few unique mixing ratios beneathneath positive loads. The emission traits had been additionally observed to be higher than diesel with ranges of carbon dioxide, carbon monoxide, nitric oxide and hydrocarbons decrease than natural diesel.

Keywords: IC engine, Diesel, Blends

I. Introduction

Fossil fuels are one of the foremost reassets of electricity withinside the international today. Their reputation may be accounted to smooth usability, availability and value effectiveness. But the restrained reserves of fossil fuels are a exquisite problem because of rapid depletion of the reserves because of boom in international demand. Fossil fuels are the foremost supply of atmospheric pollutants in today`s international. So, efforts are directly to locate opportunity reassets for this depleting electricity supply. Even aleven though new technology have arise that have made solar, wind or tidal electricity reassets effortlessly usable, nevertheless they're now no longer so famous because of issues in integration with current era and processes. So, efforts are being directed toward locating new electricity reassets which might be much like the fossil fuels in order that they may be used as direct substi- tutes. Diesel gas serves as a first-rate supply of electricity, especially withinside the transportation sector. During the World Exhibition in Paris in 1900, Rudolf Diesel become strolling his engine on 100% peanut oil. In 1911, he stated, `the diesel engine may be fed with vegetable oils and might assist appreciably withinside the improvement of agriculture of the countries, which use it` (Hall 1981). Studies have proven that vegetable oils may be utilized in diesel engines, as they're discovered to have homes near diesel gas (Vijaya Raju et al. 2000). It is being taken into consideration a step forward due to the provision of numerous sorts of oil seeds in large quantities (Agarwal 2007). Vegetable oils are renewable in nature and might generate possibilities for rural employment while used on huge scale (Ma and Hanna 1999). In the current years, severe efforts had been made via way of means of numerous researchers to apply distinct reassets of electricity as gas in current diesel engines. The use of hetero vegetable oils is restrained via way of means of a few damaging bodily prop- erties, specially their viscosity. Due to better viscosity, the directly vegetable oil reasons negative gas atomisation, incomplete combustion and carbon depo- sition at the injector and valve seats ensuing in severe engine fouling. It has been suggested that after direct injection engines are run with neat vegetable oil as gas, injectors get choked up after few hours main to negative gas atomisation, much less green combustion and dilution of lubricating oil via way of means of in part burnt vegetable oil (Peterson et al. 1992). One viable approach to triumph over the trouble of better viscosity is mixing of vegetable oil with diesel in right proportion, and the alternative approach is transesterification of oils to supply biodiesel. The esters of vegetable oils are popularly called biodiesel. It is the technique of reacting triglyceride with an alcohol withinside the presence of a catalyst to supply glycerol and fatty acid esters. In India, tries are being made for the use of non-fit for human consumption and under-exploited oils for the manufacturing of esters. Blending traditional diesel gas with esters (commonly methyl esters) of vegetable oils is currently the maximum not unusualplace shape of biodiesel. There had been severa reviews indicating that big emission reductions are accomplished with those blends. Several studies (Hamasaki et al. 2001) have proven that diesel and biodiesel blends lessen smoke opacity, particulates, unburnt hydrocarbons, carbon dioxide and carbon monoxide emissions, however nitrous monoxide emissions have barely increased. In this study, distinct propor- tions of karanja methyl ester (KME),

particularly
5%, 10%, 15%, 20%, 30%, 40% and 50% are combined with 95%, 90%, 85%, 80%, 70%, 60% and 50%, respec- tively, with diesel gas on mass foundation and investigated for its suitability as a gas withinside the diesel engine.

II. Materials and Methods

Biodiesel may be produced with the aid of using a number of esterification technologies. The oils and fat are filtered and pre- processed to put off water and contaminants. If unfastened fatty acids are present, they may be eliminated or converted into biodiesel the usage of unique pre-remedy technologies. Non-fit to be eaten oils like karanja oil having acid values greater than 3.zero had been esterified accompanied with the aid of using transesterification. Esterification is the response of an acid with an alcohol withinside the presence of a catalyst to shape an ester. Transesterification then again is the displacement of the alcohol from an ester with the aid of using any other alcohol in a procedure much like hydrolysis, besides that an alcohol is used in preference to water. This response cleavage of an ester with the aid of using an alcohol is greater in particular known as alcoholysis. In the case of esterifica- tion processes, the karanja oil is preheated at extraordinary temperatures after which the answer of sulphuric acid and methanol is introduced to the oil and stirred contin- uously at extraordinary temperatures. Esterification is sustained until the acid cost decreased and remained constant (among zero.1 and zero.5). Then the heating turned into stopped and the goods had been cooled. The unreacted methanol turned into separated with the aid of using distillation. The closing product turned into in addition used for transesterification to gain methyl esters. The karanja oil turned into transformed to methyl ester with the aid of using transesterification. The fatty acid composition of karanja oil is given in Table 1. Karanja oil incorporates 10–20% saturated acids (palmitic, stearic and lignoceric) and 55–90% unsaturated acids (oleic and linoleic). The bodily houses of KME are in comparison with diesel gasoline and are given in Table 2.

Table 1. Fatty and unsaturated acids in karanja oil (Raheman and Phadatare 2004)

Sr.No	Acid	%
1	Palmitic acid $C_{16:0}$	3.8-8.2
2	Stearic acid $C_{18:0}$	2.6-8.5
3	Lignoceric acid $C_{24:0}$	1.3-3.8
4	Oleic acid $C_{18:1}$	46.20-78.00
5	Linoleic acid $C_{18:2}$	9.5-20.5

Table 2. Comparison of KME with diesel (Ganesan 2008).

Sr. No	Property	Karanja oil	KME	Diesel
1	Specific gravity	1.33	1.2	1.00
2	Viscosity (cst) at 40°C	42.8	22.5	32.87
3	Flash point (°C)	235	207	80
4	Cloud point (°C)	–	15	7.2
5	Pour point (°C)	8	8	4.1

III. Experimental setup

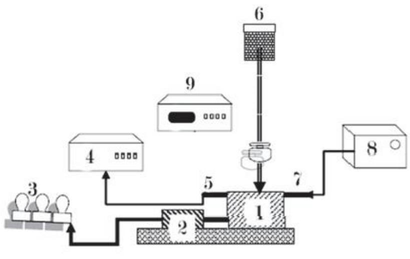

Figure:1 Line Diagram of experiment setup

Figure 1 shows the schematic diagram of the experi- mental setup. The specification of the engine is given as:

1.Single cylinder 4S diesel engine
2. Dynamometer
3. Resistance load
4. Gas analyser
5. Exhaust manifold
6. Fuel tank
7. Inlet manifold
8. Air drum
9. Control system

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 (EGT). Emissions such as unburnt hydrocarbon (HC), carbon monoxide (CO) and nitric oxide (NO) were measured by an AVL 444 exhaust gas analyser.

Combustion analysis became completed by a Kistler-make quartz piezoelectric stress transducer (Model Type 5395A) set up at the cylinder head withinside the general position. Kistler stress transducer has the benefit of top frequency reaction and linear running range. A non-stop circulate of air became maintained for cooling the transducer via way of the use of fins to hold the desired temperature. Combustion parameters consisting of mechanical efficiency, brake thermal efficiency (BTE), brake particular gasoline consumption, ignition delay, and most charge of warmth launch and emission parameters like exhaust fueloline concentrations and temperature had been evaluated. The experiments had been completed via way of the use of diverse blends of KME (KME5,10,15,20,30,40,50,100) with diesel at one of a kind load situations at the engine retaining all of the impartial variables same. The engine overall performance check became accomplished two times for all blends besides the KME100 and common became taken and emission readings had been taken three times for which common became calculated

Table 3. Test engine specifications.

Sr.No	Engine Pairameter	Specification
1	Type of engine	Four-stroke, single-cylinder
2	Speed	1500
3	Bore	87.5
4	Stroke	110mm
5	Compression ratio	17.5

IV.Results and discussion

Performance parameters

4.1 Brake thermal efficiency

Figure 2 shows the variation of the BTE with respect to load for diesel fuel and KME–diesel fuel blends. It can be observed from the figure that KME100 shows higher BTEs at all load conditions compared to that of diesel fuel. Almost all blends show slightly better BTE than diesel at higher load conditions. The higher thermal efficiencies may be due to the additional lubricity provided by the fuel blends (Ganesan 2008). Raheman and Phadatare (2004) also report higher BTE for the 20% and 40% blends while the higher blends reported lower values of BTE due to low calorific value and higher fuel consumption.

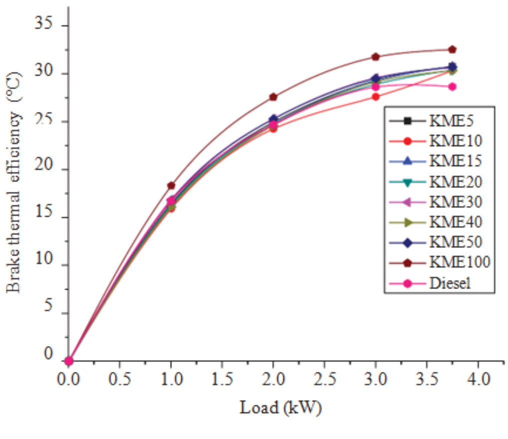

Figure.2 Variation of BTE with load.

4.2 Brake specific energy consumption

Figure 3 shows the variation of the brake specific energy consumption (BSEC) with load. When two different fuels of different heating values are blended together, the fuel consumption may not be reliable, since the heating value and density of the two fuels are different. In such cases, the BSEC will give more reliable values (Bajpai and Das 2010). The BSEC was determined for KME–diesel fuel blends as the product of the specific fuel consumption and the calorific value. It can be observed from the figure that the BSEC for KME30 is lower compared to that of diesel fuel. The availability of the oxygen in the KME–diesel fuel blend may be the reason for the lower BSEC.

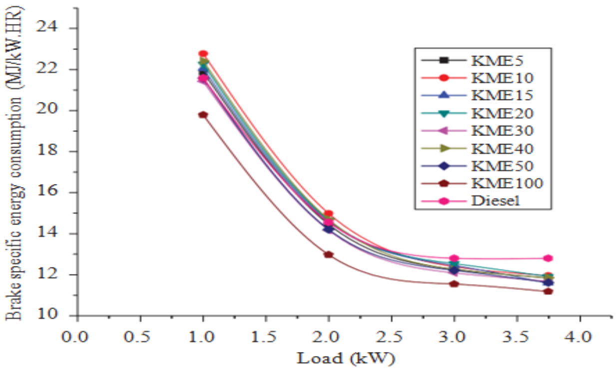

Figure.3 Variation of BSEC with load.

4.3 Exhaust gas temperature:

The EGT of an engine is an indication of the conversion of heat into work. Figure 4 shows the variation of the EGT with load for the fuel blends. EGT for KME100 is the highest. This is due to the poor combustion characteristics of the karanja oil because of its high viscosity. The combustion charac- teristics of the blends were improved by increasing the proportion of diesel fuel in the K/D blend. For the diesel fuel, the EGT is the lowest among all the tested fuels. The EGT rises from 135°C at no load to 347°C at full load for KME100, while for KME20 the EGT rises from 136°C at no load to 339°C at full load The higher exhaust temperature with blends con- taining above 50 vol%. of karanja oil is indicative of the lower thermal efficiencies of the engine. At lower thermal efficiency, less energy input in the fuel is converted to work, thereby increasing exhaust temper- ature. The results of the studies on bio-oil blends by Prakash *et al*. (2011) agree with our results while Raheman and Phadatare (2004) report little variation in temperature for all the fuels.

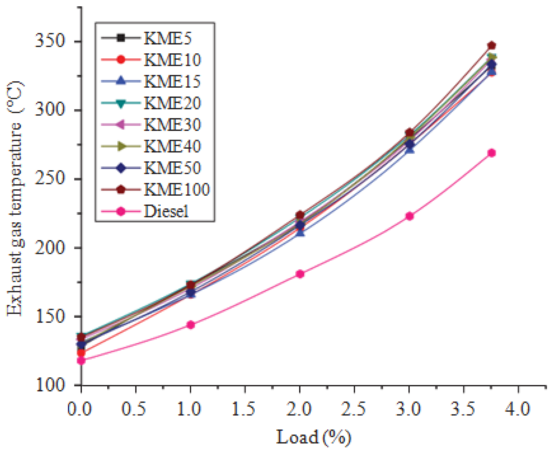

Figure.4 Variation of EGT with load.

4.4 Mechanical efficiency

The mechanical efficiency of the fuel mixtures is plotted in Figure 5. It can be seen that the mechanical efficiency for KME30 is better than diesel fuel at lower load conditions.

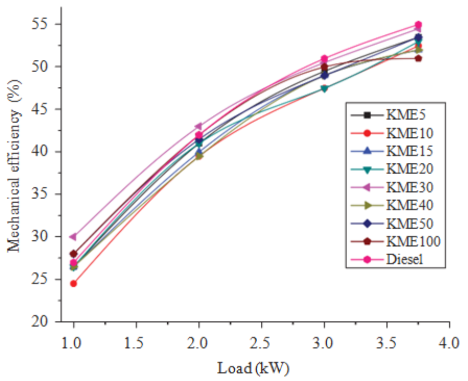

Figure.5. Variation of mechanical efficiency with load.

4.5 Emission parameters:

4.5.1 Nitric oxide

Figure 6 shows the trend of nitric oxide emission with different blends at different loads. A majority (about 90%) of the nitrogen in the exhaust is in the form of nitric oxide. Temperature and oxygen are the two important factors which support the formation of nitric oxide (Mukunda 2009).

The biodiesel blends have lower calorific value than diesel, thus resulting in higher fuel consumption. This increase of fuel in the fuel–air mixture causes a drop in the percentage of oxygen in the mixture. The burning of the excess fuel also causes a decrease in residual unreacted oxygen in the combustion chamber. So this drop in oxygen availability could be the reason for the decrease in nitric oxide formation. Raheman and Phadatare (2004) and Sureshkumar et al. (2008) also reported a decrease in nitric oxide formation while Nabi et al. (2009) reported a slightly higher NOx with karanja biodiesel. Banapurmatha et al. (2008) reported that nitric oxide emission was reduced with the change in injection timing for certain biodiesels.

4.5.2 Carbon monoxide:

Emission of carbon monoxide is a sign of incomplete combustion of fuel. The emission of carbon monoxide (CO) for various blends at different loads can be seen in Figure 7. The emissions are slightly lower for almost all blends. This can be attributed to the presence of oxygen in the fuel which results in better combustion characteristics of the fuel. At higher load, higher temperature in the combustion chamber results in better and complete combustion of fuel leading to very low production of carbon monoxide.
This result agrees with findings of Raheman and Phadatare (2004) , Sureshkumar et al. (2008) and Nabi et al. (2009). However, Prakash et al. (2011) report a slight increase in CO emission in engine testing with wood pyrolysis oil blends.

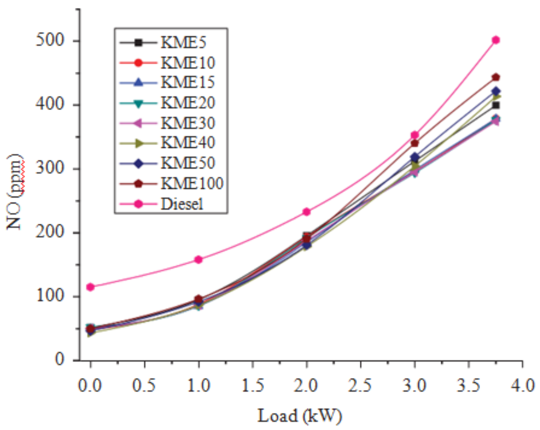

Figure.6. Variation of nitric oxide emission with load

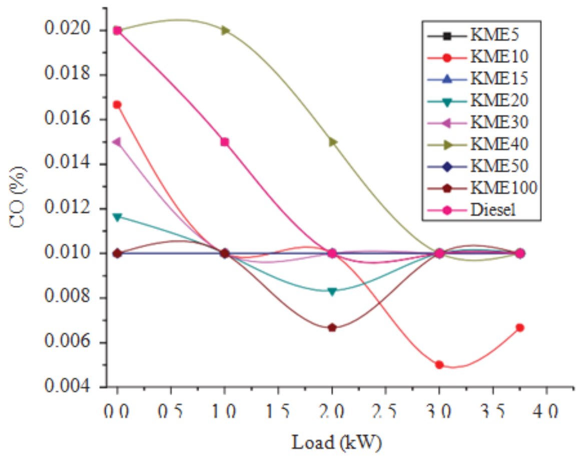

Figure.7. Variation of carbon monoxide emission with load

4.5.3 Carbon dioxide:

Figure 8 illustrates the variation of carbon dioxide emission for various blends at varying loads. The carbon dioxide (CO2) emission for the blends is lower than diesel for almost all loads and blends.

Carbon dioxide is formed on complete combustion of the fuel in oxygen. Here, carbon dioxide formation is less due to the fact that biodiesel in general is a low- carbon fuel and has a lower elemental carbon to hydrogen ratio than diesel fuel (Sureshkumar et al. 2008). The emissions for pure diesel and the blends are almost the same at moderate values of loading.

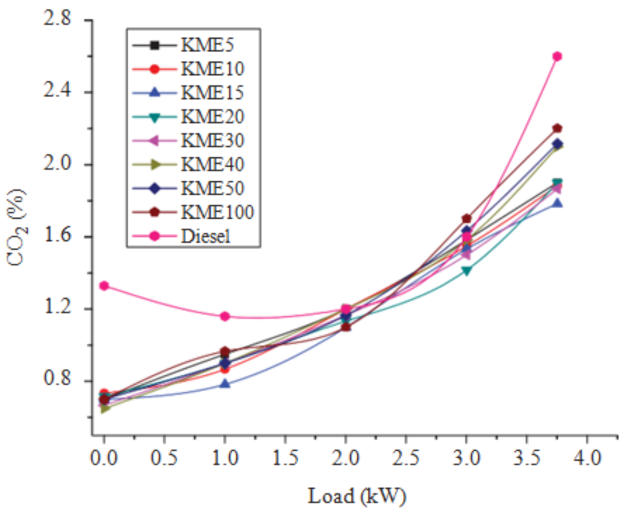

Figure 8. Variation of carbon dioxide emission with load

4.5.4 Hydrocarbons:

Figure 9 shows the variation of hydrocarbon (HC) exhaust for different blends at varying loads.

Hydrocarbon exhaust is a result of incomplete burning of the carbon compounds in the fuel. All the blends have lower values than diesel owing to higher com- bustion chamber temperature which helps better combustion.

The higher cetane number of the fuel helps in achieving better combustion properties and the pres- ence of oxygen in the fuel also helps decrease hydro- carbon emission. Sureshkumar et al. (2008) and Sahoo et al. (2009) also report the reduction in HC emissions with biodiesel.

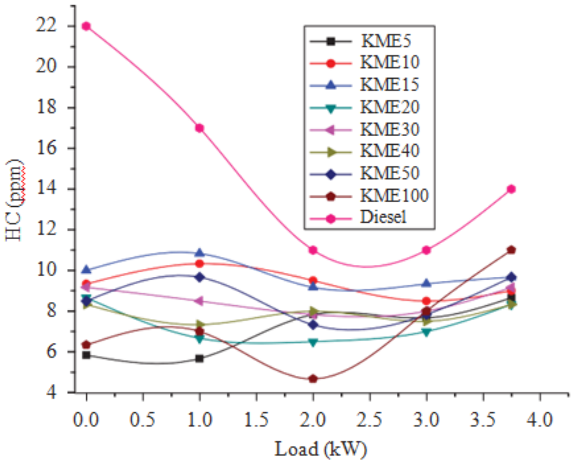

Figure 9. Variation of unburnt hydrocarbon emission with load.

V.Conclusion

KME seems to have a potential for use as alternative fuel in diesel engines. Blending of KME with diesel decreases the viscosity considerably. The BTE of the engine with KME–diesel blend was marginally better than that achieved with neat diesel fuel. BSEC is lower for KME–diesel blends than diesel at all load- ings. The EGT is found to increase with the concen- tration of KME in the fuel blend due to coarse fuel spray formation and delayed combustion. The mechanical efficiency achieved with KME30 is higher than diesel at lower loading conditions. At higher loads, the mechanical efficiency of certain blends is almost equal to that of diesel. The emission character- istics of all the biodiesel blends are better than pure diesel in all respects. KME30 can be accepted as a suitable fuel for use in standard diesel engines to get better performance with reduced emissions. KME can be used as a clean and better fuel replacement for the fossil fuels.

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