ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

# Characteristics of a Diesel Engine by Using Biodiesel Extracted From Karanja Oil and Overall Performance and Emission Analysis

**Bobbara Someswara Rao**
**Assistant Professor**
**Department of Mechanical Engineering**

*Abstract*

***The depleting reserves of petroleum and environmental troubles have brought about the look for extra environmental-friendly and renewable fuels. Biodiesel acquired from numerous renewable resources has been identified as one of the alternative gas due to its biodegradability, high cetane no, no sulphur emissions and occasional volatility. Biodiesel derived from non suitable for eating feed stocks including karanja oil are reported to be feasible choices for developing nations together with India wherein intake and cost of fit to be eaten oil may be very excessive .The purpose of gift work is to optimize the biodiesel production from karanja oil through transesterification technique. The foremost conditions for optimum yield have been obtained at molar ratio of 8:1 for acid esterification and 9:1 molar ratio for alkaline esterification, zero.5wt% catalyst KOH using mechanical stirrer. The diverse overall performance and emission parameters like brake electricity (BP), particular fuel intake(SFC), brake thermal efficiency (BTE), CO emissions, CO2 emissions, HC emissions, NOx emissions were evaluated at specific hundreds in a 4 stroke, single cylinder, water cooled, diesel engine. those performance and emission parameters of diesel gasoline were as compared with that of B10, B20, B30, B40 and B50.***

***The overall performance parameters of B30 combo were just like the ones of diesel. It become discovered that CO2, HC and CO emissions decreases because the combination content increases whereas the NOx emissions increases because the combination content material will increase.***

*Keywords:* ***Emission Characteristics, Diesel Engine, Biodiesel, Karanja Oil***

## Introduction

Due to shortage and growing charges of traditional fossil fuels, biodiesel as a gas has grown to be more attractive fuel. Professionals recommended that present day oil and gas reserves could generally tend to ultimate handiest for few decades. To fulfil the rising energy demand and update reducing oil reserves renewable gas like biodiesel is inside the leading edge of other technology. Biodiesel has proved to be a possible alternative for diesel in compression ignition engine. Biodiesel burns like petroleum diesel because it involves regulated pollution. Diesel gas can be changed by biodiesel made from vegetable oils (Bobade et al., 2012). Biodiesel is now particularly being made from soybean, rapeseed, and palm oils. In evolved nations, there may be a growing trend towards the usage of current technologies and efficient bioenergy conversion the usage of more than a few biofuels, which can be becoming value clever competitive with fossil fuels oils (Sahoo and Das, 2009). India enjoys a few special benefits in taking on plantation of tree-borne oil seeds for production of bio diesel due to vast unutilized land. The use of biodiesel results in substantial reduction of un-burnt carbon monoxide and particulate matters.

It has almost no sulphur, no aromatics and more oxygen content, which helps it to burn fully. Its higher cetane number improves the combustion (Sharma et al., 2010). Sunflower and rapeseed are the raw materials used in Europe whereas soybean is used in USA. Thailand uses palm oil, Ireland uses frying oil and animal fats (Bobade et al., 2012). In India vast research has been done on biodiesel from jatropha oil. It is proposed to use non-edible oil for making biodiesel, as consumption from edible oil is very high in India (Mamilla et al., 2011).

## Technical Specifications of the Engine

In this work experiments were conducted on 4 stroke, single cylinder, C.I engine (Kirloskar Oil Engineers Ltd., India) of maximum power-3.68 KW with AVL smoke meter. The experimental setup is show in figure 1

Figure 1 The experimental setup

## Materials and Method

In the present work engine tests were conducted with karanja bio Diesel blends (B10, B20, B30, B40 and B50) in comparison to diesel separately to evaluate performance and emission characteristics. Karanja oil is extracted from the seeds of karanja tree (Sahoo and Das, 2009). Karanja tree is a medium sized tree and is found almost throughout India. The tree is wonderful tree almost like neem tree and drought resistant (Kesari et al., 2010).It is found mainly in the Western Ghats in India, Australia and some regions of Eastern Asia. Its cake is used as pesticide and fertilizer. The seeds contain 30-40% oil that can be processed to produce a high quality biodiesel fuel, usable in a standard diesel engine (Thiruvengadaravi et al., 2012). The various properties of the karanja bio diesels are presented in table 1.

Table 1 Properties of the karanja bio diesels

| Properties | Karanja Biodiesel | Diesel |
|---|---|---|
| Viscosity(at 40 °C) | 6.2 | 3.8 |
| Density kg/m$^2$ | .860 | .830 |
| Sulphated ash content | - | .001 |
| Specific gravity | .87 | .85 |
| Calorific value (KJ/kg) | 40840 | 42800 |
| Flash point | 235 | 56 |

## Results and Discussion

### Variation of brake power with load

Figure 1 shows the variation of brake power with load for diesel and blends of biodiesel. It can be observed from the figure than brake power of all biodiesel blends remains same to diesel. Variations of load for different blends and diesel at all values of brake powers are within a very narrow range. Diesel shows better brake power than all biodiesel blends.

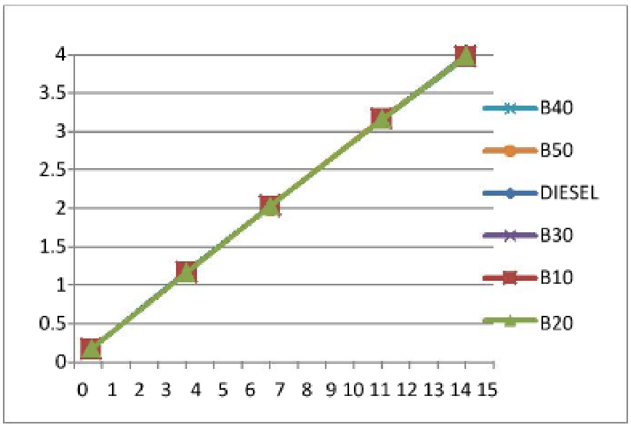


Figure 1 Brake power (kW) with load Load (kg)

### Specific Fuel Consumption (SFC)

Figure 2 show the variation of specific fuel consumption of diesel and biodiesel blends at different loads. 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. The specific fuel consumption (SFC) will give more reliable value (Sharma et al.,2014).It can be observed from the figure that at higher load the SFC for B30 blend is lower to diesel. The fuel consumption is found to be higher than diesel at all loads when the concentration of the

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

karanja oil in the blend is more than 30% because of the lower heating value and high density of the blends. Higher concentration of the karanja oil in the blends increases viscosity which further increases the specific fuel consumption.

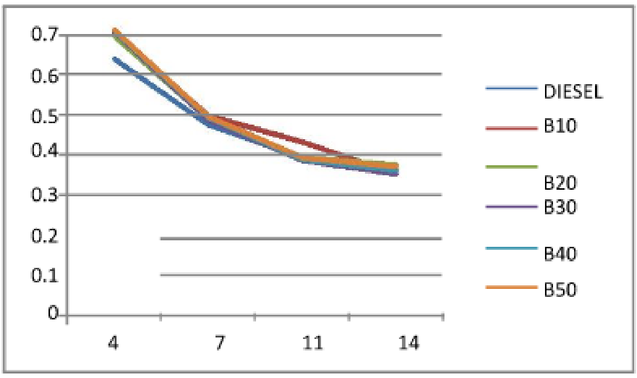


**Figure 2 Specific fuel consumption (kg/kwh) v/s Load Load (kg)**

### Brake Thermal Energy

Figure 3 show the variation of brake thermal efficiency of diesel and biodiesel blends at different loads. It can be observed from the figure that, KME30 shows higher brake thermal efficiencies 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 and also report higher BTE for the 20% & 40% blends while the higher blends reported lower values of BTE due to low calorific value and higher fuel consumption (Lohith et al., 2012).

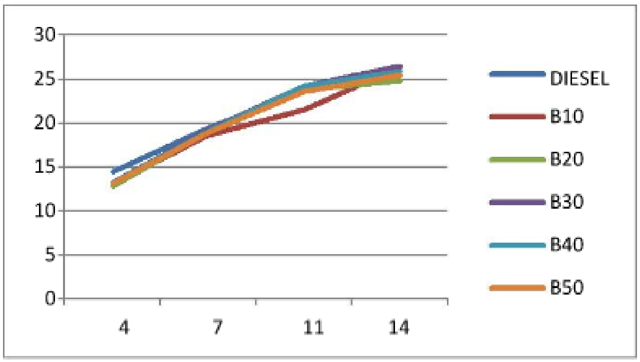


**Figure 3 Brake thermal efficiency (%) v/s Load Load (kg)**

### Hydrocarbon emission (HC)

Figure 4 show the variation of HC emission with different blends at different loads. Biodiesel blends give lower HC emission as compared to diesel. Due to better combustion of the biodiesel inside the combustion chamber and the availability of the excess oxygen content in the biodiesel blends as compared to diesel. HC emission of biodiesel is lower than diesel due to better combustion of biodiesel (Singh et al., 2013).

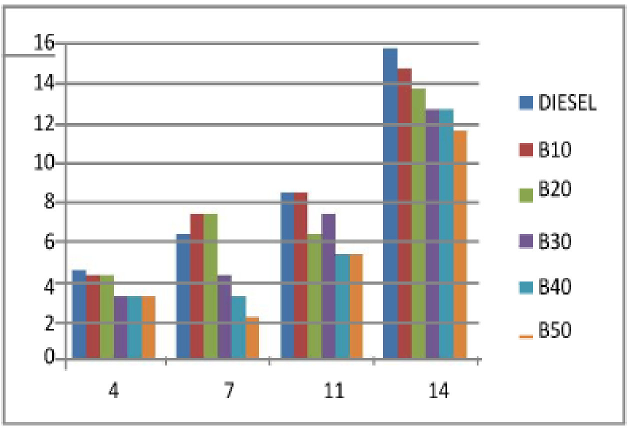


**Figure 4 HC emission (ppm) v/s Load Load (kg)**

### Nitrous oxides emission (NOx)

Figure 5 show the variation of NOx emission with different blends at different loads. About 90% nitrogen in the exhaust is in the form of nitric oxide. The three important factor which support the formation of nitric oxide such as oxygen concentration, combustion temperature and retention time (Nabi et al., 2009). These three conditions are attained in biodiesel combustion very rapidly as compared to diesel. NOx formations for biodiesel blends are always greater than diesel. At higher loads, more fuel is burnt and higher temperature of the exhaust gases which result in higher production of nitric oxide. Anything which causes combustion temperatures to rise will also cause NOx emissions to rise. Misfire can also cause NOx to rise because of the increase in oxygen that it causes in the catalytic converter feed gas. NOx is more likely to cause respiratory problems such as asthma and coughing (Lohith et al., 2012).

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

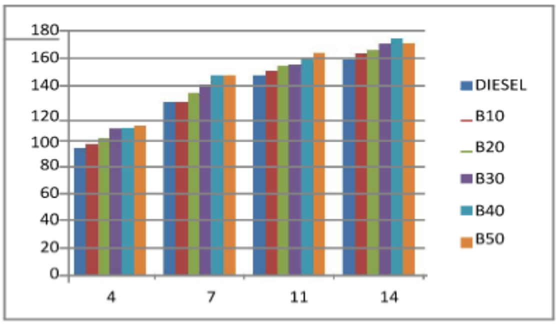


**Figure 5 Nitrous oxide (ppm) v/s Load Load (kg)**

### Carbon Dioxide emission (CO2)

Figure 6 show the variation of Carbon Dioxide emission with different blends at different loads. Carbon dioxide is a by-product of efficient and complete combustion. Carbon dioxide levels are affected by air/fuel ratio, spark timing and any other factor which affect the combustion efficiency. At all loads biodiesel blends give less CO2 as compared to diesel. The CO2 emission increases with increase in load due to higher fuel entry as the load increases. Biofuels contain low carbon content as compared to diesel due to this CO2 emission are also low. At full load of 10 kg, CO2 emission was increased by about 31.88% as compression ratio increases from 14 to 18 (Deore et al., 2013).

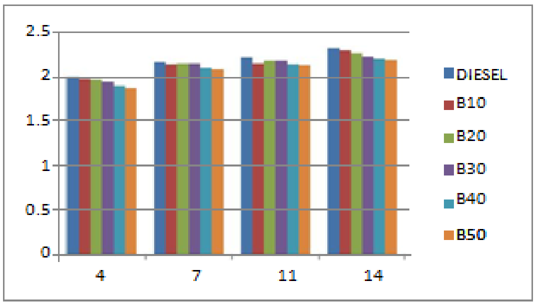


**Figure 6 Carbon dioxide (ppm) v/s Load Load (kg)**

### Carbon monoxide emission (CO)

Figure 7 show the variation of carbon monoxide emission with different blends at different loads. Biodiesel blends give less carbon monoxide as compared to diesel due to complete combustion. With increases the percentage of biodiesel blend, carbon monoxide decreases. The more amount of oxygen content of biodiesels result in complete combustion of the fuel and supplies the necessary oxygen to convert CO to CO2. All blends and diesel shows sudden increase in CO emissions at 14 nm load. Samantary et al., reported that minimum and maximum CO produced were 0.005%, 0.016% resulting in a reduction of approximately 92% and 75% as compared to diesel.

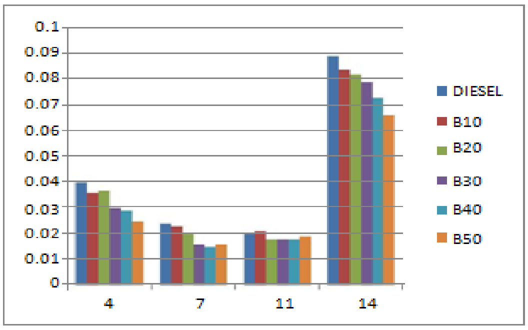


**Figure 7 Carbonmonoxide (ppm) v/s Load Load (kg)**

### Conclusions

Within the present day research it's far located that the karanja biodiesel can be used as a partial replacement for diesel without any engine amendment to lessen the effect on transportation and also reduce the dependency on crude oil imports, and also provide employments in agricultural field. the subsequent conclusions are drawn from this investigation

- The fuel properties like viscosity , density ,flash point, calorific value and ash content of the biodiesel compare well with accepted biodiesel standards i.e. ASTM
- The brake thermal efficiency of the engine depends majorly on the heating value and viscosity.
- The Specific Fuel Consumption of biodiesel blends is higher than the diesel.
- The Hydrocarbon emissions are less than diesel fuel as compared with biodiesel
- The NOx emissions increase with the higher temperatures in the chamber. NOx emission is low for diesel.
- The CO2 emissions are lower for biodiesel blends as compared with diesel.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

- The CO emissions are lower for biodiesel blends as compared with diesel.

The above investigations suggest that blend of karanja bio diesel blend– B30 is the optimum blend which can produce better values with Pure Diesel for Diesel engines as far as performance and emissions were considered. So that it can be used as alternative to diesel. Further studies can be done with certain additives to improve the emission characteristics

## References

[1]. Reddy M.H., Reddy K.V. and Reddy P.N., Experimental analysis of karanja oil methyl ester for compression ignition engines with THERMOL-D additive, International Journal of Scientific &Engineering Research, Vol. 4, Issue 10, pp. 377-382, 2013.

[2]. Eijck J.V., Romijn H., Prospects for jatropha biofuels in Tanzania: an analysis with strategic niche management, Energy Policy 36, pp. 311–325, 2007.

[3]. Bajpai S. and Das L.M., Experimental investigation of an IC engine operating with alkyl esters of jatropha, karanja and castor seed oil, Energy Procedia 54 ,pp. 701-717,2014

[4]. Sharma V and A.K Gupta, Biodiesel production from karanja oil, Journal of Scientific and Industrial Research, Vol. 63, pp.39-47, 2004.

[5]. Kulkarni P.S., Sharanappa G and Ramesh, Mahua (maduca indica) as a source of biodiesel in India, International Journal of Scientific & Engineering Research, Volume 4, Issue 7, pp.2319-2329,2013.

[6]. Lohith N., Suresh R.and Yathish K.V., Experimental investigation of compressed ignition engine using karanja oil methyl ester as alternative fuel, Vol. 2, Issue 4, pp. 1172-1180, 2012.

[7]. Krishna R., Bandewar A.G. and Dongare V.K., Experimental Investigations of blending diethyl ether in karanja vegetable oil using a multi-cylinder diesel engine, International Journal of Research and Innovative Technology ,Volume 1, Issue 5, 2014.

[8]. Ekanath R. D. and Ramchandra S. J., Effect of Compression Ratio on Energy and Emission Performance of Single Cylinder Diesel Engine Fueled with Jatropha and Karanja Biodiesel, International Journal of Thermodynamics, Vol. 16, No. 3, pp. 132-144, 2013.

[9]. Sharma R.B., Pal A. and Sharaf J., Experimental investigation of biodiesel obtained from waste cooking oil and its blends with diesel on single cylinder engine, Journal of Engineering Research and Applications, Vol. 4, Issue 1, pp.193-200,2014.

[10]. Amarnath H.K., Prabhakaran P., Bhat S.A. and Paatil R., A comparative experimental study between the biodiesel of karanja, jatropha and palm oils based on their performance and emissions in a four stroke diesel engine. ARPN Journal of Engineering and Applied Sciences, Vol. 7, No. 4, pp. 407 – 414, 2012.

[11]. Sayyed S.R. , Uttarwar L., Sheetal P. and Suryawanshi R., Effect of acid and iodine value of karanja oil methyl ester and its statistical correlation with gross calorific value , International Journal of Research in Engineering and Technology,Vol.2,Issue 11,pp.680-685,2013.

[12]. Gupta A.K., Gehlot D. and Mishra A., Optimum fuel injection timing of direct injection CI engine operated on karanja oil investigation, International journal of innovation in engineering research and management, Vol. 1, Issue 2, pp. 1-9, 2014.

[13]. Sharma Y.C. and Singh B., A hybrid feedstock for a very efficient preparation of biodiesel, International Journal of Engineering 1273, 2010.