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Properties of Bio Diesel Blending with Diesel at Different Ratios

Shweta Chikkegoud, C. H. Biradar

Department of Automobile Engineering, Research Centre, PDA College of Engineering Kalaburgi, Karnataka, India
Professor, Department of Automobile Engineering, Research Centre, PDA College of Engineering Kalaburgi,
Karnataka, India

ABSTRACT: Biodiesel, a fuel alternative that is both biodegradable and nontoxic, has emerged as a viable contender to diesel fuel. Vegetable oils were shown to be promising feedstocks for biodiesel generation in this investigation. Biodiesel extraction from a variety of non-food oilseed crops has been studied intensively over the past few years. So, the purpose of this research is to conduct a thorough analysis of the features of biodiesel and biodiesel diesel blends as fuel options. Natural, non-edible Karanja oil (*Pongamia Pinnata*) abounds throughout India. A diesel engine's efficiency, emissions, and combustion properties were studied through experiments with various mixtures of methyl ester of *Pongamia Pinnata* and mineral diesel. Karanja methyl ester at mass fractions of 5%, 10%, 15%, 20%, 25%, 30%, 35% and 40% volume ratios blended with diesel to check the properties after blending. Low concentration blending given better properties when compare with high volume ratios.

KEYWORDS: Bio Diesel, *Pongamia Pinnata* oil, Bio-Blends, Diesel addition.

I. INTRODUCTION

A diesel engine may be modified to run on biodiesel if it is run on an alternative fuel. Biodiesel is a diesel fuel made from mono-alkyl esters of long-chain fatty acids, rather than petroleum [1]. Biodiesel is typically refined by reacting it with formaldehyde in the absence of a catalyst after being produced from vegetable oil or animal fat. In addition to lowering energy consumption and reliance on imported petroleum, biodiesel offers the potential to lower emissions of greenhouse gases and other pollutants. This would help maintain economic steadiness. Because of its potential to satisfy or even surpass demands in the event of a fuel shortage, biodiesel is one of the best options to replace the present fuel source. Biodiesel is able to significantly reduce emissions from a standard four-stroke compression-ignition engine, particularly those of unburned HC, CO, and NO_x. [2]. This is important for developing up with a novel approach to greener, more efficient alternatives to the current fuel industry. As a result of more complete combustion in the engine, the Brake Thermal Efficiency will rise when using biodiesel with a greater oxygen concentration. Reduced BSFC (Brake Specific Fuel Consumption) is desirable while searching for a replacement fuel, and this will help achieve that goal. More investigation into diesel-biodiesel blends is needed to aid in the resolution of the present fuel dilemma, as biodiesel plays a vital role in the overall emission of diesel engines by reducing hazardous emissions and increasing engine performance. CO emissions were determined to be 11-51% lower with biodiesel compared to the reference fuel. [3]. Particle number (PN) and particulate matter (PM) in biodiesels are being compared to those in conventional diesels. Although castor biodiesel was found to have higher CO emissions than diesel, it was shown to have lower PM and PN emissions when blended with diesel. The castor bean, often known as castor oil plant, is one of the most promising non-edible oil crops due to its low implementation and production costs and relative tolerance to hydric stress. The study found that using castor oil biodiesel had no impact on the engine's fuel injection and steadily increased NO_x emissions. [4]. Researchers have shown that the effect of biodiesel on NO_x emissions varies from engine to engine and application to application. Increasing the proportion of biodiesel in a blended fuel makes monitoring and assessing blended fuel property, a key indicator for evaluating engine performance results, better.

II. LITERATURE REVIEW

Akhihero ET [5] The effects of different blend percentages on the fuel properties of almond biodiesel will be investigated. Gas Chromatography Mass Spectrometer readings were taken to characterize the biodiesel's characteristics such as flash point, cloud point, pour point, viscosity, saponification value, peroxide value, acid value, iodine value, density, and specific gravity (GCMS). Blends of biodiesel with diesel fuel at 20%, 30%, and 50% yielded biodiesel with characteristics closest to those specified by the ASTM standard. **Deepak Kumar, T et al [6]** Potential and future applications of biodiesel are investigated, and recommendations for optimal blending, improved engine performance, and pollution control are made using a set compression ratio. **E.T. Akhihero [7]** Potential and future applications of biodiesel are evaluated, and recommendations for optimal blending, improved engine performance, and pollution control are made using a set compression ratio. **Guirong Wu [8]** Impact on engine performance, combustion efficiency, exhaust emissions, vibration, modulation index, and compatibility are among the numerous aspects of diesel engines that are examined in this study. Without any additional adjustments, biodiesel can be used in car engines to enhance combustion quality and decrease emissions. **Husam Al-Mashhadani [9]** Biofuels such as ethanol and biodiesel are produced from plants and animals and can be used in internal combustion engines either on their own or in blends with fossil fuels. Various biofuel mixes currently being researched and developed compare the pros and cons of spark-ignition and compression-ignition engines. **M. A. Hazrat et al [10]** The mechanisms involved in biodiesel CFP and the parameters that initiate and regulate the crystallization process are the focus of this investigation. Biodiesels are a type of renewable fuel that can be made from a wide variety of feedstocks and processing methods. Some nations have recognized it as an acceptable diesel fuel alternative. Although its many advantages, biodiesel's cold flow properties (CFP) are much less desirable than those of petro-diesel. **M. Sivakumar, et al [11]** As fossil fuels become scarcer and the environment degrades, researchers are interested in biodiesel and its blends. Also revealed were the effects of biodiesel derived from non-edible panama oil and its blends on a single-cylinder compression-ignition diesel engine's efficiency, combustion, and emissions. Different biodiesel to diesel ratios were tested under different loads. **Medhat Elkelawy et al [12]** As renewable fuel supplies are readily available, environmentally acceptable, and competitive, they will eventually replace fossil diesel fuel. Even in diesel engines, alternative fuels perform admirably as fuel. Using alternative fuels instead of just fossil diesel can reduce emissions across the board by lowering the temperature of combustion. One of the blends used to power diesel engines is biodiesel, an oxygenated fuel. **Mohamed Al-Dawody et al [13]** Experiments were conducted to see how different concentrations of the third-generation biodiesel spiraling algal methyl ester affected diesel engine performance (SAME). The typical range for the percentage of SAME in Iraqi diesel is between 10% and 30% by volume. A single-cylinder diesel engine's compression ratio and load were tinkered with in an experimental environment. **Obed Majeed Ali et al [14]** Biodiesel and mineral diesel blends (up to 20%) are being adapted for commercial diesel engines in several regions. Unfortunately, the fuel's characteristics degrade with high mixing ratios. Pure biodiesel and blended fuel at high blending percentages utilizing various chemical additions were explored. Several experiments' data were evaluated to establish a pattern between fuel attributes, engine performance, and emissions with and without various chemical additives. Many different chemical additives are effective in enhancing biodiesel fuel performance. **Oseh, J. O et al [15]** Recent studies have examined the impact of blending ratios on the properties of castor and sunflower biodiesel since almond oil is better suited to producing biodiesel because it requires less time and cost. A substantial antioxidant content or cold flow improver is needed for biodiesel to be produced from most vegetable oils. **Rajendra Pawar et al [16]** The development of efficient technologies for isolating biodiesel from competing oils has been a central focus of recent biofuels study. Using pure biodiesel or biodiesel blended with additives from different feedstocks can have varying effects on the engine's properties, combustion, performance, and emissions. This study demonstrates why biodiesel is relevant today. **Sabapathy SP et al [17]** From the best methods for producing it to the impact of additives on its combustion behavior, this study covered it everything. MINITAB-17 software and the Taguchi approach were used to verify the optimal yield condition. Moreover, 5% diethyl ether (DEE) and 2000 ppm Butyrate hydroxyl toluene (BHT) were tested as potential additions. **Sharad D. Patil [18]** The purpose of this research is to learn how different biodiesel blends influence the efficiency, combustion, and emissions of a VCR engine. Global, careless consumption of fossil fuels has resulted in



pollution, inflated prices, and depleted oil reserves. Researchers are looking into using biodiesel in CI engines because of their concern for the environment. **Swati Agarwal [19]** The results of numerous tests with Nano additives in diesel and jojoba biodiesel blends are given here. Diesel/biodiesel blends have grown in popularity as a result of the economic and environmental advantages they offer when used in a diesel engine. Jojoba biodiesel, which has negative effects on power, is gaining popularity as a replacement for conventional diesel. **Yanhui Zhang et al [20]** Biodiesel is an alternative fuel made from renewable materials like vegetable oils, animal fats, or recycled grease that can be used in conventional diesel engines. Biodiesel satisfies the Renewable Fuel Standard's (RFS) demands for biomass-based diesel and advanced biofuels in general. Green diesel, or renewable diesel, is not the same thing as biodiesel.

III. METHODOLOGY

- Identify the best Karanja biodiesel and examine its properties in comparison to pure diesel.
- In a diesel engine, pay attention to all the parameters that need to be controlled.

3.1 Karanja (Pongamia Pinnata oil):

The karanja biodiesel utilized in this research can be purchased commercially and is certified to meet the requirements of ASTM-D-6751. Figure- shows the procedures that must be followed to make biodiesel. Processing karanja seeds in an oil expeller produces a byproduct called "cake." After being filtered, the oil is fed into a chemical reactor where it is combined with methanol in the presence of a catalyst. Here, the esterification process takes place, which involves the separation of fatty acids. Biodiesel is the final product. Excess methanol is distilled back into a usable form, and byproduct glycerin is taken.

3.2 Properties of Crude Pongamia Oil:

Pongamia oil is made from the Pongamia tree by expeller pressing, cold pressing, or solvent extracting the seeds. Colors from brown to yellowish orange can be seen in the oil. Although it is used in many conventional therapies, it is poisonous and can cause stomach upset if ingested. Pongamia oil can be used as an insect repellent and as an antiseptic. The unpleasant flavor and odor are due to the high concentration of triglycerides and the presence of bitter flavonoid chemicals such as Karanja, pongamol, tannin, and Karanja chromene. In comparison to hydrocarbon fuels, vegetable oils are projected to have significantly different fuel qualities due to the enormous size of vegetable oil molecules and the presence of oxygen. Extracted crude oil first processes to a yellowish reddish-brown tint but eventually darkens as it sits in storage. Solvent extraction results in higher-quality oil than more traditional processes. The iodine number is a useful measure of the degree of unsaturation in fats and oils. Higher iodine value was indicative of a greater proportion of unsaturated fats and oils. The oxidation of fatty acids and their The physicochemical features of Pongamia pinnata simple.

Table 1: Fatty acid composition of Pongamia oil

Fatty acid composition of pongamia oil	Percentage (%)
Palmitic acid(C16)	10.12
Stearic acid(C18)	6.9
Oleic acid(C18:1)	50.26
Linoleic acid(C18:2)	17.12
Eicosanoic acid(C20)	1.31
Dasocasanoic acid(C22)	1.42
Tetracasanoic acid(C24)	1.12

Table 2: Physical-Chemical properties of Pongamia pinnata bio- oil after treatment

Property	Pongamia oil methyl ester	Petroleum diesel
Viscosity(cst)(30 ⁰ C)	5.51	3.60
Specific Gravity (15 ⁰ C/4 ⁰ C)	0.917	0.841
Solidifying point (⁰ C)	2	0.14
Cetane value	51	47.8
Flash point (⁰ C)	110	80
Carbon Residue (%)	0.64	0.05
Distillation (C)	284-295	350
Sulphur (%)	0.13-0.16	1.0
Acid value	1.0-38.2	-
Saponification Value	188-198	-
Iodine Value	90.8-112.5	-
Refractive Index (30 ⁰ C)	1.47	-

3.3 Experimental process:

The engine's responsiveness to different fuel mixes was tested using diesel with 5%, 10%, 15%, 20%, 30%, and 40% Pongamia pinnata oil proportions. The procedure for the experiment entails the following steps.

- Prepare the engine, cooling systems, and lubrication systems for testing by warming up the engine for 20 minutes
- Reduce the dynamometer's load until the engine's revolutions per minute (RPM) drop to 2,000, 1,600, 1,200, and 800. This tactic involved keeping the same air-to-fuel ratio regardless of the engine speed. In all experiments, the injection time was the same because the engine wasn't tweaked, but the delay time changed according to the fuel.
- At each speed, monitor torque, fuel consumption (g), and toxic gas emissions.
- The other blend fuel ratio should be used for testing. The engine must first be completely emptied of all remaining fuel before the new fuel blend can be added. A new filter must be installed before testing another biodiesel blend ratio.
- Experiments were repeated three times and averages were used.

**Figure:1 Experimental setup****3.4 Blends preparation process:**

Karanja oil and milk scum oil have been heated at a high temperature of around 120°C for about an hour. Free fatty acid levels in the oil are measured (FFA). Due to the slightly elevated FFA levels, a two-step transesterification method is used to transform the inedible blended oil into its methyl ester. Oil's FFA value is lowered to around 2% in the first step through acid catalyzed esterification. The first-stage products are converted to their mono-esters and glycerol by an alkaline-catalyzed transesterification process in the second step. Acid esterification entails heating 1 liter of blended oil to around 50 °C, then adding 150 ml of methanol and 2% H₂SO₄ to the oil while stirring constantly at 65 °C for around 1.5 hours. After the reaction is complete, the solution is let to settle in a separating funnel for a full day. Stacks begin to take shape. The top layer consists of the surplus alcohol, sulphuric acid, and contaminants that must be filtered out. In the next phase, we'll use the bottom layer (alkaline esterification). The first-step, lower-layer product is reheated to 65°C to 70°C in the alkaline catalyzed

esterification. NaOH (6.5 g) concentrated in methanol (150 ml) is added to the mixture and the whole thing is agitated for 1.5 hours. A 24-hour period of settling follows the conclusion of the reaction. Glycerin sinks to the bottom while the mixed oil that has been polymerized floats to the top. Separation and a warm water wash are used to purify this esterified composition of oil. The final product is heated to 120 °C for 30 minutes, after which it is cooled to room temperature. Biodiesel is then generated in a blended form (karanja + scum).

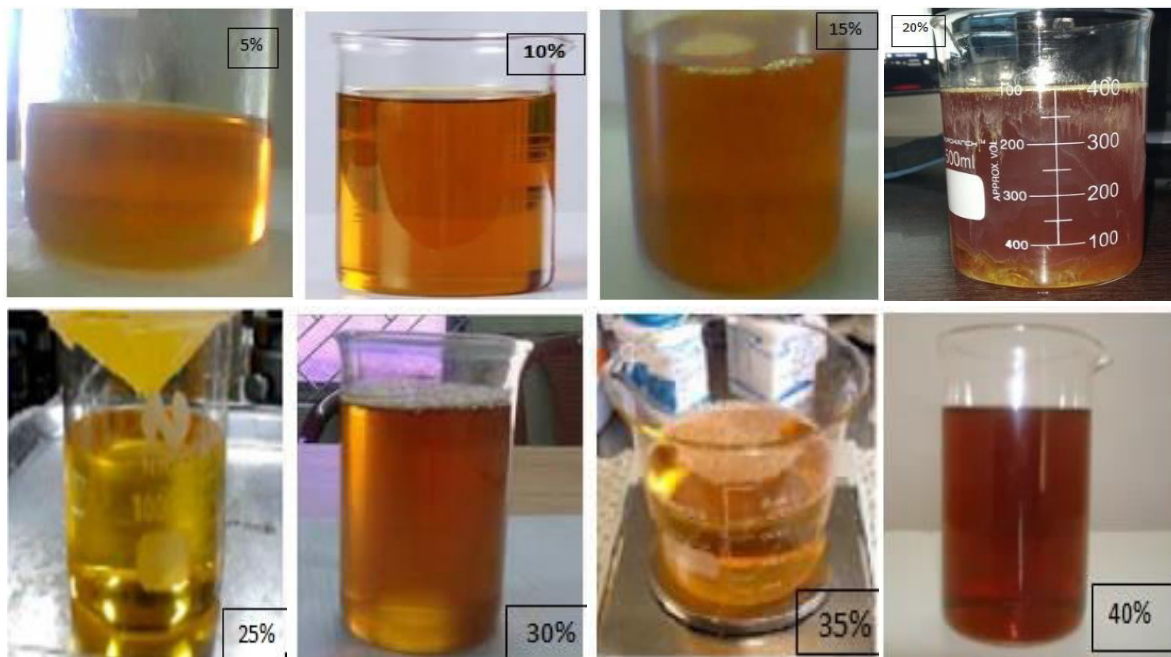


Figure 2: Pongamia pinnata oil different mix proportions

IV. RESULTS AND DISCUSSIONS

Experiments have been carried out by blending diesel with different proportions of bio-oil to check the various properties after blending. The properties obtained after blending have been given below in table 3 for the further comparison of bio-oil properties and testing in engine

Table 3: Investigation fuel combinations Different fuel combinations were explored

Particular	Density (kg/m ³)	Kinematic viscosity	Calorific value (KJ/Kg)	Flash point(°C)	Fire point (°C)
KB 5%	0.846	2.945	43.90	80.3	110
KB 10%	0.846	3.020	43.82	84.7	122
KB 15%	0.801	3.21	42.23	92.5	131
KB 20%	0.780	3.39	42.11	93	140
KB 25%	0.779	4.10	42.05	93.8	148
KB 30%	0.780	4.05	38.28	95	152
KB 35%	0.749	4.23	38.05	98	159
KB 40%	0.749	4.63	37.85	98	164

Tests has been conducted after blending of different ratios with diesel the obtained properties of pinnata bio-oil shows near result of flash point of diesel with low volume blend.

V. CONCLUSIONS

Pyrolytic processed bio oil having good properties when compared with crude oil, blend result showing that the fire point increased with blend volume improvement. The flash point of diesel lies between 60⁰ to 80⁰ C, the flash point of bio oil increased slightly. The kinematic viscosity is more when compared with diesel, on that basis fire point increased drastically for volume ratios more than 20%. Finally experiment of blending given positive results when compare with other bio-blends like jathropa which is having 170⁰C.

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