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Investigation of Properties of Smart Biodiesel - An equal Proportional Blend of Various Biodiesels

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ABSTRACT : Biodiesel is fuel made from sustainable biological resources that is used in diesel engines. It is said that biodiesel made from edible and non-edible feedstocks, such as soy, mahua, palm, and jatropha, is a viable option for developing nations like India. In this study, four-cylinder diesel engines operating at different loads are used to manufacture, analyze, and compare blends of smart biodiesel in various proportions with the performance of diesel fuel. Prior to blending, the five biodiesel raw oils undergo esterification (methyl esters). Without changing the engine's design, the esterified oils in biodiesel blends improve engine performance and emission characteristics while meeting essential fuel requirements. The exhaust gas, brake thermal efficiency, SFC, Exhaust gas temperature, CO, CO2, NOx and HC were to be analysed.
Keywords: Diesel Engine, Smart Biodiesel, Diesel Fuel, Alternative Fuel

I. INTRODUCTION

The world has been working hard to lessen its reliance on fossil fuels for transportation and electricity generation for the last few decades. Among the suggested substitute fuels, biodiesel has drawn a lot of interest lately for diesel engines and may be able to help several nations cut back on their imports of oil. As a renewable and domestically produced energy source, biodiesel has numerous advantages over normal diesel. Furthermore, prior research has demonstrated a significant decrease in CO, unburned hydrocarbons, and particulate matter emissions when these alternative fuels are utilized in traditional diesel engines, earning them recognition as eco-friendly fuels. A variety of vegetable oils are used to make biodiesel, an alkyl (e.g., methyl, ethyl) ester of fatty acids. trans esterification of discarded cooking oil and animal fat. Furthermore, biodiesel has been applied to other purposes besides substituting fossil diesel. In an effort to reduce the usage of conventional diesel, biodiesel is thought to be a viable substitute. It is anticipated that mixing ethanol into gasoline will cut imports of petroleum fuel by as much as 20–30%. Additionally, because biodiesel can be made locally from a variety of agricultural products like sugar cane, molasses, or cassava root, its use can boost farmers' profits. Interest in using oxygenated compounds as diesel fuel additives to reduce emissions has increased as a result of the success of diesel-biodiesel blending. In addition, using Biodiesel in particular. Furthermore, using biodiesel—especially biodiesel made from biomass—can cut carbon dioxide emissions significantly. In addition to lowering possible future dangers related to climate change, this strategy has the added advantage of promoting economic growth. It is known as the "no regrets" policy. In general, no engine adjustments are needed to blend biodiesel with diesel. Phase separation from these may lead to fuel instability. There are two methods to prevent this separation: one is to add an emulsifier, which works to suspend tiny biodiesel droplets inside the diesel fuel; the other is to add a co-solvent, which functions as a bridging agent by molecular compatibility and bonding to create a homogenous blend. Moreover, the blend's low cetane number makes burning it challenging. Furthermore, the blend has a low cetane number, which makes it challenging for diesel engines using compression ignition technology to burn. Consequently, several investigations have been conducted to enhance the solubility of ethanol in diesel and to raise the blends' cetane number. Numerous studies have been conducted on the production and application of biodiesel.

It has significantly increased the amount of biodiesel that can be made in India using raw resources, particularly palm, karanja, soya and mahua oils. When environmental factors are taken into account, the production and use of fuel comprising ethanol and biodiesel—both of which may be produced in India—is the more desirable method. Consequently, the goal of this study was concentrated on. Therefore, the main goal of this study was to investigate how five different biodiesels—palm oil methyl esters, mahua oil methyl esters, jatropha biodiesel, karanja oil methyl ester, and soya bean oil methyl ester—can be added to diesel blends to stabilize the biodiesel. A comparison was made between the basic fuel properties of diesel and biodiesel-diesel, including cetane index, density, calorific value, flash point, pour point, emissions, and phase stability at various temperatures and component concentrations.

II. LITERATURESURVEY

Kazi Mostafijur Rahman et al.(2010) [1]This study was conducted because there are more cars and engines on the road. However, the energy sources that these engines use are finite and gradually getting less. This circumstance prompts the search for a diesel engine's substitute fuel. An alternative fuel for diesel engines is biodiesel. Biodiesel is an ester of vegetable oil and animal fats. The possibility of producing biodiesel from jatropha oil is examined in this work. According to the research paper's findings, biodiesel is a good replacement for diesel fuel derived from petroleum. Its benefits include decreased global warming, increased cetane number, cleaner emissions (apart from NOx), better lubrication, and better rural development. There is potential for jatropha oil as a substitute energy source.

Somnuek Jaroonjitsathian et al. (2011) [2] This research paper examines the combustion, performance, and emissions of biodiesel. The different sources of biodiesel and engine technologies complicate the conclusion of how the combustion of biodiesel affects the response of a diesel engine, particularly in the case of a transient application. Some biodiesel users consistently assert that even a 5.5% v/v biodiesel component in diesel fuel causes poor engine driveability. However, a few publications discuss how advanced common-rail DI engines have low sensitivity when it comes to diesel fuel ignition delay.According to the research paper's conclusion, the study's use of a blend of biodiesel in DI engines was entirely environmentally friendly.

P. Venkateswara Rao et al. (2012) [3]IAccording to the statement, a study was conducted to assess the impact of adding triacetin (T) to biodiesel on the performance and combustion characteristics of direct injection diesel engines. Knocking is typically audible to some degree when using clean biodiesel and diesel fuel. To mitigate this issue and lower tail pipe emissions, biodiesel can be fortified with Triacetin [$C_9H_{14}O_6$] additive. Petro-diesel, biodiesel, and additive blends of biodiesel were used in a comparative study on engine performance. In order to optimize engine efficiency and exhaust emissions, coconut oil methyl ester (COME) was added to neat diesel at different volume percentages for all load ranges. Out of all the blend fuels tested, the combination of 10% Triacetin and biodieseldemonstrates promising outcomes. According to the findings and conclusion of this study, triacetin is soluble in mineral oils, aromatic compounds, and biodiesel. An experiment was conducted to determine whether the oxygenated compound, which also functions as an anti-knocking agent for gasoline engines, could be used with biodiesel additives.

Kasireddy Sravani et al. (2016) [4] It was mentioned that the primary causes of the growing urbanization, the depletion of petroleum products caused by driving, and the rise in exhaust gas emissions were the main drivers behind the investigation into the use of alternative fuels in internal combustion engines. The environment is seriously harmed by engine emissions. In order to address this issue, the government had to impose stringent rules requiring engine manufacturers and consumers to adhere to emission standards. In this sense, alternative fuels emerged as a result of numerous researchers' varied investigations. The discussion concluded with suggestions for improving engine performance, efficiency, and the ability to save conventional fuel.

S.M.A. Ibrahim et al. (2012) [5] which was published on Jatropha biodiesel fuel blends are combined with diesel fuel at volumetric percentages of 20, 40, 70%, and 100% and burned in a diesel engine to examine emission and engine performance. A four-stroke, single-cylinder, water-cooled diesel engine was used for these tests, running at 1500 rpm at various loads. According to this study, diesel-biodiesel blends (B20, B40, B70, and B100) have higher specific fuel consumption, exhaust temperatures, and air-fuel ratios than diesel fuel. The findings indicate that diesel-biodiesel has lower volumetric and thermal efficiency than diesel fuel. According to the research, diesel-biodiesel blends have lower CO2, CO, and HC levels than diesel fuel. Emissions of O2 and NOx increased.

L.Karikalan et al. (2013) [6] from which vegetable oil was produced. Among the various alternative fuels intended to increase the efficiency of petroleum, the adaptability, and the cleanliness of diesel engines is vegetable oil. In this paper, diesel fuel and biodiesel blends of Jatropha, Pongamia, and Neem (J20D80, P20D80, and N20D80) were used in comparative experiments to measure the emission levels of carbon monoxide, hydrocarbons, carbon dioxide, and oxides of nitrogen on diesel engines using SCR technique. The emission characteristics were then analyzed. The experiment's findings demonstrate that, should petroleum deposits become more scarce in the near future, vegetable oil and its blends could make excellent diesel engine replacement fuels. A better economy, a favorable effect on the environment, and other interests are all benefited by smart technologies.and governmentalpolicies. Before beginning to use vegetable oils extensively in internal combustion engines, it is necessary to ensure their continuous availability. Vegetable oil produced domestically will contribute to a decrease in expensive petroleum imports, and the growth of the biodiesel sector based on vegetable oil will support the rural agricultural economies of agriculturally oriented nations like India. According to the findings and conclusions, which demonstrate that a range of emission control technologies have been in use for 15 years to control NOx, CO, NMHC, and PM emissions from stationary IC engines. Significant reductions in CO and HC are possible with oxidation catalysts, and over 90% of the NOx emissions from diesel engines can be eliminated with SCR. Moreover, draw the conclusion that blending diesel and biodiesel effectively.

H. M. DHARMADHIKARI et al. (2011) [7] It was mentioned that experimental work was done for the current study to examine the emissions characteristics and engine performance of a single-cylinder compression ignition DI engine running on blends of mineral diesel and biodiesel at various injection pressures. Within the range of 180 to 220 bars, 200 bars was found to be the ideal injection pressure. Break specific fuel consumption and brake thermal efficiency were the performance parameters that were evaluated, and the emissions that were measured included carbon monoxide (CO), carbon dioxide (CO2), hydrocarbon (HC), and oxides of nitrogen (NOx). The outcomes of an experimental study comparing diesel and biodiesel blends are contrasted. and comparisons between diesel and blended biodiesel for use in DI engines.

Gaurav Dwivedi et al. (2011) [8] To prevent soil erosion, ponagamia Pinnata trees are typically planted alongside roads, highways, and canals. India is home to billions of trees. There will be a few million tons of oil available for lighting the lamps in rural areas if the seeds that fall by the side of the road are gathered and oil is extracted by village-level expellers. According to reports and analyses, air/cooled exhaust gases can fill a transfer port completely or partially, scavenging burned products and preventing the loss of fresh air-fuel ratio (A/F) mixture during the process. As a result, it improves the use of particular fuels and lowers emissions of hydrocarbons. The following list of pognamia biodiesel properties is also gathered from this research paper.

Table-1. Fuel properties of pongamia oil methylester.

Property	*Pongamiaoilmethylester*
Viscosity(cst) (30°C)52.6	*5.51*
Specificgravity(15°C/4°C)	*0.917*
SolidifyingPoint(°C)	*2*
CetaneValue	*51*
FlashPoint(°C)	*110*
CarbonResidue(%)	*0.64*
Distillation(°C)	*284–295*
Sulfur(%)	*0.13-0.16*
AcidValue	*1.0-38.2*
SaponificationValue	*188–198*
IodineValue	*90.8-112.5*
RefractiveIndex(30°C)	*1.47*

Bobade S.N et al. (2012) [9] It was predicated on the production of biodiesel, or fatty acid methyl ester, which is produced by transesterification from triglycerides and has garnered a lot of interest as a nontoxic, renewable, and biodegradable fuel over the last ten years. A number of methods have been developed for producing biodiesel fuel, one of which is transesterification, which uses alkali as a catalyst to convert triglycerides to their corresponding methyl ester at a high rate in a short amount of time. As a result, this procedure is widely used in many nations to produce biodiesel fuel.This study comes to the conclusion that karanja biodiesel has good qualities and can be used in diesel engines that use both blended diesel and B100. The following list of properties for karanja biodiesel is also gathered from this research paper.

Table-2. Properties of karanja biodiesel

Density,gm/cc	*860*
KinematicViscosity @40°C,Cst	*4.78*
Acid value,mgKOH/gm	*0.42*
Freeglycerinewt%	*0.015*
Cloud point°C	*6*
Flashpoint °C	*144*
Cetanenumber	*41.7*
Calorificvalue,Kcal/KG	*3700*
Iodinevalue	*91*
Saponificationvalue	*187*
Moisture %	*0.02*
Carbonresidue %	*0.005*
Ash content wt%	*0.005*

K.P. Prajapati et al, (2015) [10] This study reports that mahua trees are native to India, thrive there even in draughty conditions, and are widespread throughout the country. In rural areas, a few million tons of oil can be used to light lamps if fallen seeds are gathered and oil is extracted by village-level expellers. Mahua oil is recognized as non-edible in our country, despite the fact that it is used exclusively to make ghee in some other countries. This study examined the measurement characteristics of Mahua biodiesel. This study demonstrates the benefits of utilizing mahua biodiesel in diesel engines and lists some of its features. The following list of mahua biodiesel properties is also gathered from this research paper.

Table-3. Properties of Mahua Biodiesel

Specificgravity	*0.86*
Iodinevalue(g/100g)	*12.82*
Freefattyacidcontent(%)	*0.0002*
Kinematicviscosity(cst)	*4.8*
Sulfurcontent(mg/kg)	*20*
Acidvalue(mgKOH/g)	*4.67*
Cetanenumber	*65*
Flashpoint	*125*
Saponificationnumber(mg/KOH)	*82.98*
Ethanolcontent(%)	*1.13*
Cloudpoint(°C)	*7*

Auwal Aliyu et al. (2003) [11] This work focuses on using a transesterification reaction catalyzed by NaOH to produce biodiesel from waste soybean oil. There have been measurements made of a number of the waste soybean oil's and the biodiesel's properties. It was discovered that the waste soybean oil had higher densities, kinematic viscosities, cloud points, and flash points than the biodiesel that was produced. The transesterification process increases the waste soybean oil's combustibility because the measured cetane number of the generated biodiesel is higher than that of the waste oil. The experimental investigation on diesel engines using blends of soya bean biodiesel, as well as performance and emission test analyses, are made clear in this research paper. Thus, it is much better to use this biodiesel in diesel engines. Additionally gather from this study report. Also collect from this research paper soya bean biodiesel property are asgivenbelow.

Table-4. Properties of soybean oil biodiesel

Densityat20°C,g/cm³	*0860*
Kinematicviscosityat20°C,mm²/s	*4.1*
Cloud point,°C	*2*
Flashpoint, °C	*178*
Cetanenumber	*46*

R.K. Singh et al. (2009) [12] In developing nations, biodiesel has gained popularity recently, and significant efforts to produce it have increased, particularly with the goal of strengthening the rural economy. Jatropha curcas Linn. is the subject of the current study. To determine whether they are suitable for use as petro-diesel, non-edible seed oil and its methyl ester have been selected. Experiments have been conducted to determine the various characteristics of jatropha oil. The following list of properties for jatropha biodiesel is also gathered from this research paper.

Table-5. Properties of jatropha biodiesel

Density at15°C,kg/m³	*880*
Viscosity at40°C,mm²/s	*4.84*
Flashpoint, °C	*162*
Pourpoint, °C	*-6*
Water content,%	*Nil*
Ashcontent,%	*Nil*
Carbonresidue,%	*0.025*
Sulphur content,%	*Nil*
Acid value, mgKOH/g	*0.24*
Iodinevalue	*104*
Saponificationvalue	*190*
Calorificvalue, MJ/kg	*37.20*
Cetanenumber	*51.6*

Sumedh Ingle et al [13] Every day, more and more people are becoming aware of biodiesel due to its fuel's qualities and compatibility with diesel fuel derived from petroleum. Thus, the potential and advantages of using palm oil methyl esters as engine fuel are examined in this paper. Tests were carried out in the current study on a four-stroke, single-cylinder D.I. diesel engine using diesel and different biodiesel blends at different preheating temperatures. Performance and emission test results are compared between neat diesel and different blends of palm oil biodiesel. The following list of palm biodiesel properties was also gathered from these research papers.

Table-6. Properties of palmoil biodiesel

Viscosityat40°C, mm2/s	*4.1*
Densityat15°C,kg/m³	*875.1*
FlashPoint	*175°C*
PourPoint	*-12°C*
Cloud Point	*NotApplicable*
Specificgravity@15°C	*0.8722*
CalorificValue,kJ/kg	*37254*
Visualappearance	*DarkBrownliquid*
Ash content	*0.001%*
Cetanenumber	*52*

III. CONCLUSION

In the literature review mentioned above, various biodiesel properties, including edible and non-edible oil, are analyzed and observed. All of the biodiesel with good qualities has been gathered and blended with other biodiesels to create intelligent biodiesel. The properties of diesel and smart biodiesel are compared. It is discovered that blending biodiesel according to its qualities results in smart biodiesel properties. Based on the literature reviewed above, it can be concluded that the performance and emission characteristics of internal combustion engines are directly impacted by the type of biodiesel used in the exhaust system. The temperature of the automotive exhaust system must be regulated to enhance engine performance. For this reason, biofuel is chosen as a fuel because it is both affordable and environmentally friendly. In the end, I have chosen five different types of biodiesels: jatropha biodiesel, methyl ester from palm oil, methyl ester from mahua oil, methyl ester from soy bean oil, and methyl ester from karanja oil. All of the biodiesel is blended at the same percentage, and the new biodiesel's properties are measured and shown in the table below.

Table-7. Properties of smart biodiesel

Viscosityat40°C,cst	*45*
Densityat15°C,gm/cc	*0.8772*
FlashPoint	*74°C*
CalorificValue,kcal/kg	*9193*
Visualappearance	*DarkBrownliquid*
Sulphurcontent	*1.76%*
Cetanenumber	*49*
Carboncontent	*N.D*
Firepoint	*76°C*

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