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An Enhancement in Finding the Characteristics of CI Engine with Methyl Ester Mango seed Biodiesel as Blends-A Review

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Abstract:

Biodiesel is a low-emissions diesel substitute fuel made from renewable resources like vegetable oils. India is not self-sufficient in petroleum and has to import about two third of its requirements to introduce one of the solutions to the current oil crisis and toward off any future energy and economic crunch is to explore the feasibility of substitution of diesel with an alternative fuel which can be produced in the country on a massive scale to commercial utilization. B20 (20% of biodiesel blended with 80% of conventional diesel) is a very popular biodiesel blend that can be used directly in diesel engines without any major engine modification. Biodiesel blends, in general, reduce the brake thermal efficiency slightly and lower PM, HC, COx emissions as compared to conventional diesel fuel.the fuel consumption and the emission characteristic of a twin cylinder diesel engine that are using Mango seed oil blended with Ethanol & compared to usage of ordinary diesel that are available in the market. This paper describes the setups and the procedures for the experiment which is to analyse the emission characteristics and fuel consumption of diesel engine due to usage of the both fuels.Diesel engine is able to run with Mango seed oil blended with Ethanol but the engine needs to run by using diesel fuel first, then followed by Ethanol and finished with diesel fuel as the last fuel usage before the engine turned off. The performance of the engine using Mango seed oil blended with ethanol as fuel compared to the performance of engine with diesel fuel.

Keywords **— Biodiesel, emissions, mango seed oil, Emissions**.

1.0 INTRODUCTION:

The automobile pollution has severe influence on climatic changes and urban pollution because of the largely increased numbers of automobiles and depends completely on the fossil fuels. The combustion of fuel in IC engine is quite fast but the time needed to get a proper air/fuel mixture depends mainly on the nature of fuel and the method of its introduction into the combustion chamber. The combustion process in the cylinder should take as little time as possible with the release of maximum heat energy during the period of operation. Longer operation results in the formation of deposits which in combination with other combustion products may cause excessive wear and corrosion of cylinder, piston and piston rings. The combustion product should not be toxic when exhausted to the atmosphere. These requirements can be satisfied using a number of liquid and gaseous fuels. The biodiesel from nonedible sources like Jatropha, Mango, Mahua, Neemetc meets the above engine performance requirement and therefore can offer perfect viable alternative to diesel oil in India.. Main issues related to biofuel usage are efficiency of the system technology, negative environmental impact and energy supply security. The chemical properties of the biodiesel long chain hydro carbons, oxygen content, sculpture content varies from conventional fuel. In connection to exhaust emissions from diesel engine the use of biodiesel reduces Carbon monoxide and hydrocarbon emissions. Many technical papers revealed that the application of bio diesel in diesel engine is suitable for better performance, combustion and emission properties. However more disadvantages of using biodiesel are high viscosity, low volatility and aromatic contents when compared to that of conventional fuel.

Preparation of Bio-Diesel:

Mango seed oil is produced from mango seed which is commercially available in market. Generally it is used in soap industry and cosmetic industry. The mango seed is dried in room temperature and the shell is removed and subjected to crusher to crush the mango seed and finally oil is derived. Mango seed oil is slight yellowish in colour, sticky volatile and combustible mixture of hydrocarbons. Preparation of biodiesel from mango seed oil is done by trans esterification. It is the process of using methanol (CH3OH) in the presence of catalyst (potassium KOH) to chemically brake the molecules of raw mango seed oil into ester and glycerol. This process reacts with the oil mixed with alcohol to remove the glycerin, a byproduct of biodiesel production. The methyl ester of mango seed oil is mixed well with 1,4dioxane with the help of a mechanical stirrer. The stirring takes place at 1500 rpm for about 15min and there is no separation is observed and it becomes a homogeneous mixture.

Characteristics of CI engine fuels:

Mango seed oil is native to a number of countries including India, Malaysia, Indonesia, Taiwan, Bangladesh, Sri Lanka and Myanmar. It has also been naturalized in parts of eastern Africa, northern Australia and Florida. Mango seed oil has a varied habitat distribution and can grow in a wide range of conditions. Mango oil, a.k.a. mango kernel fat, or, mango butter, is an oil fraction obtained during the processing of mango butter.. The oil is semi-solid at room temperatures, but melts on contact with skin, making it appealing for baby creams, suncare balms, hair products, and other moisturizing products. The oil is a soft yellow color with a melting point of 32-42 °C. A large green tree, valued mainly for its fruits, both green and ripe. It can grow up to 15–30 meters (49–98 ft) tall. The tree grows best in well-drained sandy loam; it does not grow well in heavy wet soils. The optimal pH of the soil should be between 5.2 and 7.5

Bio diesel advantages:

- Biodiesel has some clear advantages over SVO:
- It works in any diesel engine, without any conversion or modifications to the engine or the fuel system.
- It also has better cold-weather properties than SVO (but not as good as petro-diesel)
- Unlike SVO, it's backed by many long-term tests in many countries, including millions of miles on the road.

Objectives:

The objective of the present study is the preparation of biodiesel from mango seed oil;

- The performance,emission and combustion characteristics of a diesel engine using biodiesel and its various blends are studied.
- To study the engine performance and emissions of a diesel engine operating on Biodiesel- blends of mango seed.
- To study the results with those operating on neat biodiesel and methyl ester mango seed.

Scope of the project:

The process involved evaluating the potential for biofuel production and impact on employment, agricultural production, environment, trade and economic growth, and the potential bottlenecks that need to be addressed. The findings of the project were overwhelming in terms of the potential and keenness to develop biofuels in the region and in order to decrease the hazardous emissions of the engines and to improve the combustion and thermal

efficiency mango oil has been chosen as biodiesel.

3.0 Literature review:

[1] S. Savariraj , T. Ganapathy (2013)process and blended with 2.5 %, 5%, 7%, and 10% of fuel additives blended with bio diesel. The optimum blend ratio of fuel additives was identified and 10% of additives show better performance than others. The experiment was conducted in a single cylinder DI diesel engine coupled with eddy current dynamometer. From the experimental investigation it is found that, viscosity has been reduced up to 0.5% and it shows marginal increase in calorific valueconcluded that based on the performance and exhaust emission for different concentration of the fuel additives with biodiesel. The addition of fuel additive to reduce viscosity up to 0.5% and marginal increased calorific value of biodiesel The NOx level reduce by use of additives blended biodiesel with respective diesel fuel.

[2] Mani KunjanJeyaJeevahan,(2017) In this work, biodiesel blends (B10, B20, B30, B40, and B50) are produced from mango seed oil and the emissions are analyzed for different load conditions in a four stroke diesel engine. The results are compared with conventional diesel to analyze whether biodiesel could be used as an alternative fuel in place of conventional diesel in diesel enginesit is concluded that biodiesel may now be considered as a good alternative fuel as it is renewable, but it cannot be considered as a complete solution to replace conventional diesel unless technological improvements are developed to reduce NOx and other emissions.

[3]Sangamesh Talwade1 Navindgi (2016) To find the optimal method for converting Mango seed oil to usable biodiesel and using this biodiesel to run the four stroke diesel engine. The amount of alkaline catalyst and ratio of methanol to fresh oil for the greatest conversion of fatty acid methyl esters are reported. In addition, the optimal reaction was established. Biodiesel blends such as, brake thermal efficiency is lower than diesel, break specific fuel consumption is lower than diesel, and the exhaust gas temperature is higher than diesel.

[4]Baiju, M.K. Naik, L.M. Das, (2009)the combustion product should not be toxic when exhausted to the atmosphere. These requirements can be satisfied using a number of liquid and gaseous fuels. The biodiesel from nonedible sources like Jatropha, Mango, Mahua, Neemetc meets the above engine performance requirement and therefore can offer perfect viable alternative to diesel oil in India. The experiment on the diesel engine are performed and found out that it increase the BSFC using various blends of biodiesel from various resources including diesel. The finding indicates that there is increase in the BSFC when using biodiesel as compared to diesel for the same power output.

[5]Banapurmatha, P.G. Tewaria, (2008),Oil has become increasingly important to the world economy due to its employment to energize the transportation industry. As the world population grows exponentially, so does the demand for oil. Since oil wells have depleted in the United States, it has forced the U.S. to import oil making them dependent on other countries to meet the demand. To solve this problem the U.S. has invested in alternative technologies research like Gasoline Hybrid, Full electric, Hydrogen, Ethanol, and many others. Another study done by the EIA projects the amount of energy consumed worldwide by fuel type.

[6]S. S. Ingle, V. M. Nandedkar(2013) The second biggest source of imports is the Western Hemisphere (19%), with the majority of that crude oil coming from Venezuela. Africa contributed 16% of India's crude oil imports. supply disruptions in several countries, including Iran, Libya, Sudan, and Nigeria, in tandem with India's growing dependence on imported crude oil, have compelled India to diversify its crude

oil import slate. Iran accounted for 5.5% of India's crude imports in 2013, down from 8.3% in 2011-12 as a result of the U.S. and European sanctions imposed on Iranian oil exports. Also, Indian refiners are trying to reduce crude oil import costs by purchasing less expensive crude oil. prices of middle eastern crude oil grades in the past year have been high relative to prices of oil from the Western Hemisphere, prompting Indian companies to import more crude oil from Latin America, primarily from Venezuela, Colombia, and Mexico.

[7]K.Vijayaraja, A. P. Sathiyagnanam (2015) Various blends of methyl ester of mango seed oil with diesel in a single cylinder, four strokes vertical and air cooled Kirloskar diesel engine. The experimental results of this study showed that the MEMSO biodiesel has similar characteristics to that of diesel. The brake thermal efficiency, unburned hydrocarbon and smoke density are observed to be lower in case of MEMSO biodiesel blends than diesel. The CO emission for B25, B50 and B75 are observed to be lower than diesel at full load, whereas for B100 it is higher at all loadthe performance, emission and combustion characteristics of a direct injection, compression ignition engine fuelled with methyl ester of mango seed oil and its blends have been analyzed and compared with diesel fuel. The biodiesel is produced from raw mango seed oil by a method of trans esterification**[8] D.C Rakopoulos, C.G.Rakopouls (2014)** studied the use of four straight vegetable oils like sunflower, cotton seed, olive and corn oils on mini-bus engine and reported that olive oil has very high content of the unsaturated oleic acid (one double carbon bond) and very low content of the unsaturated linoleic acid (two double carbon bonds), in contrast with the other three vegetable linoleic acids. Further, the cotton seed oil has the highest content of politic acid (saturated). These may play some role in the soot formation and oxidation mechanism.

[9] Visnusarathy Dhakshinamurthy (2014) The purpose of this work is to investigate the performance and exhaust emission of various blends of jaunt seed oil methyl ester (JOME) in a small - unmodified single cylinder diesel engine and to compare them with that of a reference diesel fuel (D100)better performance and emission characteristics than diesel. The B30 blend yields 3.5% more brake thermal efficiency than diesel and the specific fuel consumption decreases by 8.8%. In emission characteristics B30 blend shows considerable reduction in CO, CO2, HC, Smoke density particularly NOX emission of B30 decreases by 32% when compared to diesel.

[10]Parthasarathy.M,Muhilan (2014)"The performance of the biodiesel was improved. With ethanol addition Mango seed biodiesel showed improvement in performance (Brake thermal efficiency improvement 14% - MOME). MOME was chosen as the fuel and its blends were studied for emission characteristics. NOX emissions and smoke opacity were higher for pure biodiesels when compared to diesel operation but there is a significant reduction in NOX emission (25%) and smoke opacity (35%) for ethanol blended fuelsDiesel blends with ethanol upto 10% (V/V) at room temperature above which separation takes place. But biodiesels blend with ethanol upto B60E40 and their viscosity reduces with addition of ethanol.**[11]SangameshTalwadeDr. M. C. Navindgi (2016)**to find the optimal method for converting Mango seed oil to usable biodiesel and using this biodiesel to run the four stroke diesel engine. The amount of alkaline catalyst and ratio of methanol to fresh oil for the greatest conversion of fatty acid methyl stars are reported. The engine performance characteristics with mangoseed biodiesel blends such as, brake thermalefficiency is lower than diesel, break specific fuelconsumption is lower than diesel, and

the exhaustgas temperature is higher than diesel.

4.0 results and discussions:

references	study	conclusion
S. Savariraj , T. Ganapathy (2013)	toprocess the blended with 2.5 %, 5%, 7%, and 10% of fuel additives blended with bio diesel.	the performance and exhaust emission for different concentration of the fuel additives with biodieselto reduce viscosity up to 0.5% and marginal increased
ManiKunjanJeyaJeevahan,(2017)	biodiesel blends (B10, B20, B30, B40, and B50)produced from mango seed oil and the emissions are analyzed for different load conditions in a four stroke diesel engine	To replace conventional diesel unless technological improvements are developed to reduce NOx and other emissions.
Sangamesh Talwade1 Navindgi (2016)	To method for converting Mango seed oil to usable biodiesel and using this biodiesel to run the four stroke diesel engine	Biodiesel blends such as, brake thermal efficiency is lower than diesel, break specific fuel consumption is lower than diesel
Baiju,M.K. Naik, L.M. Das, (2009)	indicates that there is increase in the BSFC when using biodiesel as compared to diesel for the same power output	the diesel engine are performed and found out that it increase the BSFC using various blends of biodiesel from various resources including diesel.
K.Vijayaraja, A. P. Sathiyagnanam (2015)	Various blends of methyl ester of mango seed oil with diesel in a single cylinder, four strokes vertical and air cooled Kirloskar diesel engine	compression ignition engine fuelled with methyl ester of mango seed oil and its blends have been analyzed and compared with diesel fuel.
SangameshTalwadeDr. M. C. Navindgi (2016)	Mango seed oil to usable biodiesel and using this biodiesel to run the four stroke diesel engine.	thermal efficiency is lower than diesel, break specific fuel consumption is lower than diesel, and the exhaust gas temperature is higher than diesel.

The search for an alternate fuel has led to many findings due toEmissions of oxides of nitrogen (NOx) was higher in biodiesel in all blends than that of conventional diesel. Nitrogen reacts with oxygen only at higher temperatures. As biodiesel produces high flame temperatures at all load conditions than conventional diesel, emissions of NOx of biodiesel is always higher than that of conventional diesel.to explore the feasibility of substitution of diesel with an alternative fuel which can be produced in the country on a massive scale to commercial utilization. Hence it

has become imperative to find alternative fuels to replace the conventional fossil fuels. This report outlines the studies done to find the optimal method for converting Mango seed oil to usable biodiesel and using this biodiesel to run the four stroke diesel engine. The amount of alkaline catalyst and ratio of methanol to fresh oil for the greatest conversion of fatty acid methyl esters are reported. In addition, the optimal reaction was established. Finding the most efficient way to convert Mango seed oil to biodiesel would allow for this biodiesel to be produced as economically as possible.However, there is a limitation in using straight vegetable oils in diesel engines due to their high viscosity and low volatility. In the present work, neat mango seed oil is converted into their respective methyl ester through Trans esterification process.

Conclusions:

Experimental investigations are carried out on a single cylinder diesel engine to examine the suitability of mango seed biodiesel as an alternative fuel. The performance, emission and combustion characteristics of blends are evaluated and compared with diesel and optimum blend is determined. In this work, emissions characteristics were investigated for various biodiesel blends derived from vegetable oils to test whether biodiesel blends are really a better alternative fuel to environment compared to conventional diesel. Biodiesel was first produced from vegetable oil and the biodiesel blends of B10, B20, B30, B40, and B50 were prepared. Emission tests were conducted for conventional diesel and biodiesel blends, in a four stroke diesel engine.

- CO emission of all blends is higher than that of diesel, except the blend B20 and B40 has a lower CO emission that of diesel. CO emission of B20 and B40 blends at maximum load is 0.02% volume against 0.03% volume of diesel
- The CO2 emission of mango seed biodiesel is less in comparison with diesel. Blends B40 emit very low emission compared to all other blends. And B40, B60 and B80 blends have less NOx emission compared to diesel and B20 and B80 are high NOx emission compare to diesel.
- The engine performance characteristics with mango seed biodiesel blends such as, brake thermal efficiency is lower than diesel, break specific fuel consumption is lower than diesel, and the exhaust gas temperature is higher than diesel.

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