IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

# Production of Aegle Marmelos Biodiesel and Its Performance and Emission Study on CI Engine

**Naveen Kumar K J[1], Amaljith P T[2], Sibin Babu[3], Mohammed Shafi[4]**

Asst. Professor, Mechanical Department, SRSIT, Bengaluru, India[1]

UG Scholar, Mechanical Department, SRSIT, Bengaluru, India[2,3,4]

**Abstract**: The present scenario of world fuel consumption is massive and still increasing. Initiating from this point of view various sources were looked at for production of alternate fuels. Biofuels are renewable liquid fuels coming from biological raw materials have been to be good substitute for oil sectors. This project is aimed at production of biodiesel from non-edible seed (Aegle Marmelos) using Potassium Hydroxide (KOH) as homogeneous base catalyst by transesterification process and the study of the fuel properties (Density, Viscosity, Flash point, Calorific value, Pour point, Cloud Point, Ash content and Carbon residue) and comparing it with conventional diesel as per ASTME standards. The basic fuel properties (Viscosity, Flash point and Density) of varying blends of Aegle Marmelos biodiesel with conventional diesel is determined and compared with each other. This project also involves performance study on IC engine like Specific Fuel Consumption, Brake Thermal Efficiency, Exhaust Gas Temperature and Exhaust emissions with varying blends of biodiesel with diesel and comparing it with conventional diesel.

**Keywords**: Aegle Marmelos, Transesterification, Blending, KOH.

## I. INTRODUCTION

The rate of petroleum reserve is declining while energy demand keeps increasing. The current expansion of the Indian economy has escalated petroleum demand, prices have surged, hurting the economies of poor and developing countries. In order to improve the economic status, the renewable, nontoxic bio-fuel comes with many advantages for the environment. Vegetable oils represent a ready, renewable, and clean energy source that has shown promise as a substitute to petroleum diesel for diesel engines. Edible oils like soybean, rapeseed, sunflower, and palm oil are being used for the production of biodiesel and have a very high value and market demand as food product causing food shortages and price increase especially in developing countries. To overcome this situation, researchers are looking for non-edible oil plants. Pongamia pinnata, Jatropha curcas, Aegle Marmelosand other trees native to humid and subtropical environments can be grown on degraded and marginal land.

## II. LITERATURE SURVEY

Liquid fuels from renewable resources are biodegradable and inexhaustible. In this regard vegetable oils having their physical and combustible characteristics close to diesel fuel may stand as immediate candidate substitute for alternative fuel to reduce its dependence on imports. The rural development ministry, government of India hopes to introduce biodiesel for commercialuse especially for automobile very soon. Bio-diesel is already in use in Italy, Brazil, US, Malaysia and japan just that it's made from different natural sources in different places. In India biodiesel will be produced from oil-bearing trees available.

**A.Murugean et al.**conducted experiment on production &analysis of biodiesel from non-edible oils. Bio diesel has become more alternative recently because of its environmental benefits and it is derived from renewable resources, bio degradable and non-toxic in nature. Several bio diesel production methods have been developed among which transesterification using alkali catalyst gives high level of conversation of transesterification is effected by the reaction condition , molar ratio of alcohol to oil ,type of alcohol, type and amount of catalyst, reaction there temperature , purity of reactants free fatty acids and water content of oil's or fats. Alternative fuels for diesel engines have become increasingly important due to decreasing petroleum resource and environmental consequences of exhaust gases from petroleum fuelled engines.

## III. PRIMARY STUDY OF OIL

Vegetable oils are generally composed of triglycerides whose molecular structure are branched and complex. Figure shows the structure of a typical triglyceride molecule. On the other hand, diesel consists of straight chain molecular

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

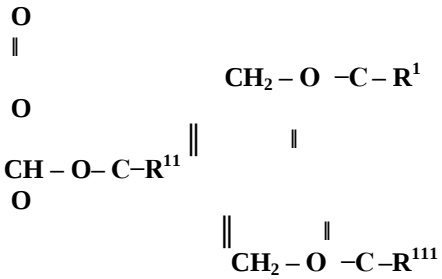
REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

structure. Vegetable oils have comparably energy density, cetane number, heat of vaporization, and stoichiometric air / fuel ratio with mineral diesel fuel. The large molecular sizes of the component triglycerides result in the oils having higher viscosity compared with that of mineral diesel fuel.

The problem of viscosity has an adverse effect on the combustion of vegetable the fuel, such as spray atomization,consequent vaporization, and air/ fuel mixing. But vegetable oils have oxygen molecules present in them.



Structure of a typical triglycerides molecules

Fig. 1 Aegle Marmelos Seeds

Fig. 2 Aegle Marmelos Oil

Aegle Marmelos biodiesel can be used as an alternative energy sources in which the emission characteristics are less. The use of homogeneous catalyst has led to less yield of biodiesel and the cost of the process was found to be more. heterogeneous catalyst have been successful in obtaining higher yield of biodiesels, but, the catalyst concentration and the time taken to produce it was found to be higher.Researchers have looked at the optimization of parameters such as reaction temperature, reaction time, stirring speed & methanol molar ratio to obtain more yield of biodiesel.

## IV.EXPERIMENTAL INVESTIGATION

Transesterification is the chemical reaction between triglycerides and short-chain alcohol in the presence of catalyst to produce mono-ester. The long-and branched-chain triglyceride molecules are methanol, ethanol, propanol and butanol. Methanol is used commercially because of its low price. Among these various conversion methodologies, the transesterification process has become commercial success.

The transesterification is the method of biodiesel production from oils and fats and can be carried out by two ways:-

(a) Catalytic transesterification
(b) Supercritical methanol transesterification

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

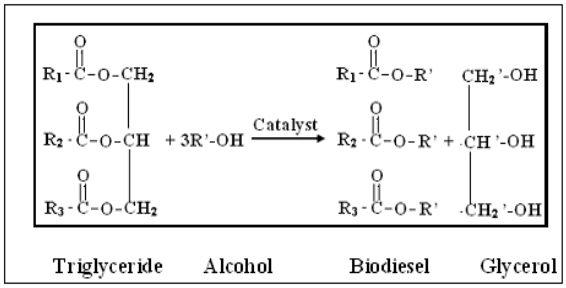



Fig. 3 Transesterification Reaction

Where R1,R2,R3 are the Palmitic acid, oleic acid, stearic acid, linoleic acid, arachidic acid, linolenic acid the cotton seed oil in the flask was heated on a heating mantle with a mechanical stirrer arrangement. The oil is heated until the temperature is $60^0$ c. Then, the catalyst KOH was mixed with methyl alcohol to dissolve and added to the heated cotton seed oil in the reactor. After the mixture was stirred for 1 hour at a fixed temperature of about $60^0$ c, it was transferred to another container and the separation of the glycerol, was allowed. Once the glycerol layer was settled down, the methyl ester layer, formed at the upper part of the container, was transferred to another vessel after that, a washing process to remove some unreacted remainder of methanol and catalyst was carried out, using distilled water and blown air. Then, a distillation process at about 110 c was applied for removing the water contained in the esterified Aegle Marmelos oil. Finally, the produced cottonseed oil methyl ester was left to cool down and dried.

Fig. 4 Separation of Bio Diesel

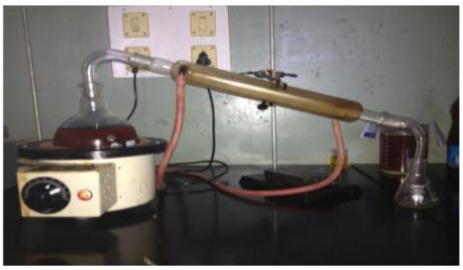


Fig. 5 Methanol Recovery

## V. PERFORMANCE EVALUATION

A diesel engine is an internal combustion engine which operates using the diesel cycle (named after Dr.Rudolph Diesel). Diesel engines have the highest thermal efficiency of any internal or external combustion engine, because of their compression ratio.

The defining feature of the diesel engine is the use of the heat of compression to initiate ignition to burn the fuel, which is injected into the combustion chamber during the final stage of compression. This is in contrast to a petrol (gasoline) engine or gas engine, which uses the Otto cycle, in which a fuel/air mixture is ignited by a spark plug.The exhaust of automobiles is one of the major contributors to the world's air pollution problem. Recent research and development has made major reductions in engine emissions, but a growing population and a greater number of automobiles mean that the problem will exist for many years to come. During the first half of the 1900s, automobile emissions were not recognized as a problem, mainly due to the lower number of vehicles. As the number of automobiles grew along with more power plants, home furnaces, and population in general.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

REPSE-17

Sri Venkateshwara College of Engineering, Bengaluru

Vol. 4, Special Issue 7, May 2017

## VI. RESULTS AND DISCUSSION

The preliminary studies to determine the optimum quantity of methanol, catalyst, reaction temperature and reaction time required for esterification of cotton seed oil and rice bran oil have been conducted by varying the concentration content of above parameters.

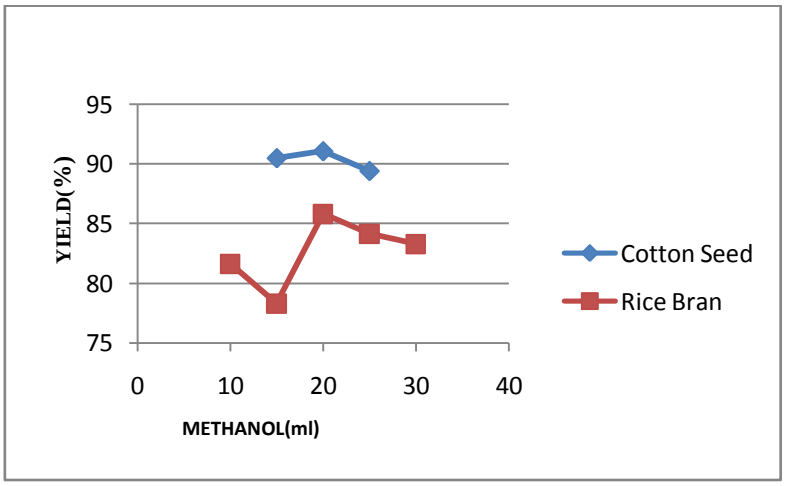



Fig. 6 Methanol vs. Bio – Diesel Yield

## VII. CONCLUSION

1. The alkaline catalyst Tran esterification process converts the FFA of refined oil to its mono- esters and glycerol. The effects of alcohol to oil molar ration, catalysts amount, and reaction temperature and reaction duration are analysed in each step. It has been also found that the conversion efficiency is strongly affected by molar ratio of alcohol to oil.
2. The maximum ester conversion is achieved at the reaction temperature of $50\pm5^0$C. The viscosity of biodiesel is nearer to that diesel. The flash point of biodiesel ($>130^0$C) is greater than that of diesel and the calorific value is slightly lower than that of diesel. This Trans esterification method reduces the overall production cost of the bio- diesel, as it uses low cost unrefined non- edible oils.
3. The present analysis of Aegle Marmelos oil have been trans esterified using methanol in presence of alkali and reveals that biodiesel from unrefined Aegle Marmelos oil is quite suitable as an alternative to diesel. However, further research and development on additional fuel property measures, long term run and wear analysis of biodiesel fuel property measures, long term run and wear analysis of biodiesel-fuelled engine is also necessary.
4. Engine performance test show that Aegle Marmelos oil as a fuel does not differ greatly from that of diesel. A slight power loss, combined with an increase in fuel consumption, has been experienced with cotton seed oil and rice bran oil. This may be due to lower heating value of mono alkyl ester

## REFERENCES

[1] Kapilan N. Nadar and Rana Pratap Reddy. Combustion And Emission Characteristics Of a Dual Fuel Engine Operated With Mahua Oil And Liquefied Petroleum Gas. Thermal science: Vol. 12 (2008), No. 1, pp. 115-123
[2] Kapilan N. Nadar,RanaPratap Reddy and Eswara Rao Anjuri, comparison of performance of biodiesels of mahua oil and gingili oil in dual fuel engine. Thermal science: Vol. 12 (2008), No. 1, pp. 151-156
[3] Geyer SM, Jacobus MJ, Lestz. Comparison of diesel engine performance and emission from Neal and transesterfied vegetable oils ASAE 1984;27(2):375-84
[4] Clark, S.J.; Wagner, L.; Schrock, M.D. and Piennar, P.G. 1984. Methyl and ethyl soybean esters and renewable fuels for diesel engines. JAOCS, 61 (10): 1632-1638.
[5] Gupta, P.K. 1994. Investigations on methyl ester of plant oils as alternate renewable fuel for compression ignition engines. Thesis, Ph.D. Punjab Agricultural University, Ludhiana, India.

## BIOGRAPHY

**Naveen Kumar K J**, Graduated in BE (Mechanical Engineering) from SIT, Tumkur and M.Tech from VTU PG Studies,Mysore.I have 1 year of teaching experience and also worked in various sectors.