A REVIEW - PRODUCTION OF METHYL ESTER FROM VEGETABLE OIL

Arun Kumar Rajamanickam
Assistant Professor, Department of Mechanical Engineering,
Sri Krishna College of Engineering and Technology, Coimbatore

UG Scholar, Department of Mechanical Engineering,
Sri Krishna College of Engineering and Technology, Coimbatore

ABSTRACT
In current scenario the present rate of consumption and availability of conventional energy resources leads to create the demand for biofuel and bio lubricant oil. Also the mineral oils make the harmful emission to society. For the alternate of mineral lubricant oils, vegetables oils are used in the process of preparation of biofuel, non-edible vegetables oils such as jatropha curcas, sterculia foetida, pongamia glabra etc., plays the major role in production of bio lubricant oil. The paper investigates the production method of methyl ester from jatropha oil.

Keywords: Vegetable oil, Biodiesel and Transesterification

http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=9

1. INTRODUCTION
Increasing demand for mineral oil lubricant led to the depletion of the availability of oils. As a replacement for mineral oil varies non-edible oils are used for research purpose, to use them as an alternate for mineral oils. As an initiation of these reviews, the jatropha curcas was taken and the method of producing ester from jatropha oil is studied. The need of lubricant oils is to reduce the friction and wear between two mating parts. Also the lubricating oil is used to improve the heat transfer, contaminant suspension and corrosion protection.

The primary intension of using bio lubricant is to reduce the environmental toxicity and pollutions. Vegetable oils are used to prepare the bio lubricant by transesterification process, based on the type of vegetable oil the transesterification process will be modified. Due to organic reactions of oil, ester is transformed through the interchange of the alkoxy moiety this
process is known as transesterification. The properties of vegetable oils are investigated to make them as an alternate for mineral lubricant oils.

Vegetable oils are classified as edible and non-edible oils. Edible oils are used in food preparation e.g. olive oil, palm oil, soybean oil, sunflower oil etc., and non-edible oils are considered as favourable resources for biodiesel production e.g. copaiba, honge oil (pongamia), linseed oil, tung oil, jatropha oil. Non-edible oils are not suitable for food preparation due to the presence of toxic materials.

2. PREPARATION OF BIOFUEL
Transesterification process is widely used to prepare the methyl ester from vegetable oils. During the transesterification process of vegetable oil of animal fats alcohol and triglyceride reacts in the presence of acid which produce mixture of ester and glycerine. Ester will float in the top of the vessel and glycerine will settled in bottom of vessel. Methyl ester will be collected separately by drained offing the glycerine. Then the methyl ester will be blended to the petroleum fuel in the proper proportion to prepare the biofuel. In this paper the preparation of methyl ester and performance evaluation of blended methyl ester were studied.

NIRAJ S. et al presented the development of energy sector is the important factor for the growth of any nation. But with the present rate of consumption, conventional sources of energy like natural gas and petroleum will be exhausted shortly. Due to the above reason the worldwide attention is moving toward the usage of bio degradable oils. Renewable energy resources are used to prepare the biofuels. In this paper, he addresses the issue of preparation of vegetable oil from Jatropha Curcas seeds, using both solvent extraction and mechanical methods. Also he investigates the production of biodiesel from the raw oil obtained transesterification. The investigation result shows that oil produced by solvent extraction has high quality compared to mechanical extraction. It was also found that the following parameters are affects the transesterification process such as oil temperature, reaction temperature, ratio of alcohol to oil and purity of reactants. The use of KOH instead of NaOH as catalyst gave better quality of biodiesel.

Glycerine will be separated from vegetable oil to prepare the mono-alkyl ester and the ester is user to produce bio fuels and lubricants. The ester floats on top and the glycerine descends to the bottom and glycerine can drain off in this work. Reactants purity, temperature of reaction of acid, mixture of liquids, type of catalyst is some of the parameter which improves the esterification process.

K Balamurugan et al investigated the performance of soya bean oil as a lubricant and the wear, corrosion and thermal properties of soya bean oil methyl ester were investigated. To improve the properties of soya bean methyl ester, palm oil methyl ester and castor oil were added. Different proportions of soya bean methyl ester were blended with SAE 40 oil. Test results show that performance of engine and lube temperature was not make any changes compared to manufactures recommendation.

For experimental investigation, single and multi-cylinder diesel engines were lubed with pure soya bean oil, soya bean methyl ester, soya bean methyl ester with bio additives like palm oil methyl ester and castor oil. Manufacture recommended oil were blended with soya bean methyl ester. Soya bean oil preheated to 55°C for 60 minutes to increase reaction of oil with alcohol. Test results of soya bean methyl ester show corrosion resistance of blend has significant improvement.

N Foidl et al investigated the preparation of methyl ester and ethyl ester from jatropha curcas seed. Transesterification is the most used technique for producing methyl and ethyl ester from vegetable oils. Methanolic is prepared at 300C and stirred for 30 minutes. Transesterification processes were take place by using KOH as a reactant. Transesterification
process done at 750°C and stirred for 90 minutes. Fuel properties of both methyl and ethyl ester blends were tested and compared with the diesel fuel. Test results indicate that blended methyl and ethyl ester can be used as an alternate for diesel in conventional engines without making any modification on existing ones.

Ejilah I.R et al, the increase in price and continuous pollution of crude oils are major challenges in conventional fuels to overcome the drawback worldwide attention is focusing on production of bio fuel from vegetable oils and animal fats. In this study methyl ester was prepared from jatropha curcas and performance of jatropha methyl ester has been investigated in CI engines. Methyl ester was blended with conventional diesel in volume fraction of 5%, 10%, 15% and 20%. Both the diesel fuel and jatropha methyl ester blended fuel was tested in CI engines. The test result shows that fuel consumptions in CI engines compare to jatropha methyl ester blended is higher than diesel fuel.

As per the ASTM standard test procedures the physical properties of jatropha methyl ester and diesel fuel was carried out. The results of engine performance analysis shows that specific fuel consumption of jatropha methyl ester blended diesel fuel is lower than diesel fuel and brake thermal efficiency of 5% and 20% jatropha methyl ester blended diesel fuel is higher than diesel sample. From this study it shows that jatropha methyl ester blended diesel fuel is an alternate for diesel fuel in CI engine.

G. Antol et al, in this work the transesterification process of sunflower oil was studied. The variables (proportion of reactants, method of purification and temperature conditions) are optimised by Taguchi’s methodology to obtain the better result of yield from sunflower oil. After that, the sunflower methyl esters were characterised to investigate the properties of ester as fuel, such as fire and flash point, viscosity and acid value were conducted as per the standard. Decrease in acid rain and in the greenhouse effect caused by combustion due to these factors and to its biodegradability, the production of biodiesel is considered an advantage to that of fossil fuels. In addition to this, it also shows a decrease in the emission of CO2, SOx and unburned hydrocarbons during the combustion process. Economic aspect is the barrier for biodiesel production.

Transesterification of sunflower oil to obtain biodiesel consists in replacing the glycerol of triglycerides. Methyl esters have a positive energy balance, that is, the total consumed energy in the production process is lower than the energy that they can provide as fuels. The calorific value of biodiesel is 12% lower than that of fossil diesel fuels. However, this is partially compensated by higher density, leaving the total loss of energy at less than 6% CO, hydrocarbon, NOx and CO2 emissions are very similar to or less than those of diesel fuel. Smoke opacity emitted by the engine is reduced by using biodiesel. The biodiesel obtained by means of this process is of good quality and it is suitable for using in automotive engines.

P. Nakpong et al presented, alkali-catalysed methanolysis method is used to prepare the biodiesel from crude jatropha curcas. Reaction of jatropha curcas take place in the presence NaOH used as catalyst and the investigation carried out to find the optimum condition. 4:1-10:1 molar ratio is considered for methanol-to-oil, 0.25-2.0% w/w of oil as condition of catalyst, 32-60°C as reaction temperature and 5-40 minutes as reaction time. Gas chromatography (GC) technique is used to analysis the jatropha methyl ester. From the investigation it conclude that the optimum yield in 6:1 molar ratio, 1.0% of catalyst concentration, 60 °C as reaction temperature and 40 minutes a reaction time.

Jatropha methyl ester production under this optimum condition was 98.6% and the properties of jatropha methyl ester blended fuel met the standard properties of biodiesel with exception of oxidation stability. Viscosity of vegetable oils is higher than diesel fuel which affects the flow properties of the fuel.
S. Hawash et al presented the Transesterification of Jatropha curcas oil (JCO) to biodiesel using CaO as a solid base catalyst is studied. Effect of molar ratio of methanol to oil, water content, reaction time and mass ratio of catalyst to oil are investigated on bench scale. Experimental results revealed that a 12:1 molar ratio of methanol to oil, addition of 1.5% (w/v) CaO catalyst 70°C reaction temperature, 2% water content in the oil produced more than 95% biodiesel yield after 3 hours reaction time. Calcium oxide activated with ammonium carbonate was an efficient super base catalyst for a high yield transesterification reaction and the base strength of CaO was more than 26.5 after dipping in ammonium carbonate solution followed by calcinations. Fatty acid methyl esters (FAME) which are produced by transesterification of vegetable oil with methanol can be used as biodiesel which represents a suitable renewable substitute for petroleum based diesel.

FAME is commonly produced by performing a transesterification reaction with homogeneous base catalysts such as KOH or NaOH dissolved in methanol under mild conditions. Biodiesel was produced on bench scale by transesterification of JCO at reflux of methanol employing CaO as heterogeneous base catalyst. Results obtained through the actual study suggest that calcium oxide being canned with ammonium carbonate at high temperature show a high catalytic activity in transesterification.

Vijittra Chalatlon et al carried this work, as an alternate for petroleum diesel fuel the biofuel was prepared from jatropha curcas and the properties of jatropha methyl ester, jatropha methyl ester blend were tested. Investigation was done on diesel engine with diesel fuel, pure jatropha methyl ester and jatropha methyl ester blended diesel in varies concentration. For the test 5%, 10%, 20%, 50% and 80% of jatropha blend were considered. Emission level carbon monoxide and carbon dioxide, fuel consumption of engine and brake thermal efficiency were measured. There is no major changes were found in brake thermal efficiency and fuel consumption up to the extension of 20% blend of jatropha with petroleum diesel fuels. Based on load condition during lower load operation emission of blende fuel was lower than that of petroleum fuel and high load condition emission become higher with higher percentage of ester blends. Higher percentage of jatropha methyl ester blend with petroleum fuel has higher emission of carbon monoxide. The chemical and physical properties of Jatropha oil and diesel were tested according to ASTM Standard. From this work it concludes that jatropha methyl ester blend is a promising alternate for compression ignition engines.

Devendra Vashist et al presented the problem arise in compression ignition engine when the non-edible oil is used as a energy source. The problems of these fuels are viscosity and volatility. Jatropha and castor oil are selected as a source of this work. Biodiesel was prepared from the jatropha methyl ester and the castor ester. Investigations were done up to 20% of blended diesel under different load condition. The optimised operating condition of diesel engine based on lower brake specific fuel consumption and higher brake thermal efficiency were identified and compared with diesel and blended diesel fuels. Vegetable oils have higher viscosity makes them incompetent to use as a fuel in diesel engine.

K. Pramanik et al present investigation of preparation of biodiesel from jatropha curcas as an alternate fuel for CI engines. Different composition of jatropha methyl ester blended with diesel and the performance of diesel engine was compared with blended jatropha methyl ester and pure jatropha ester. The significance changes are obtained in the CI engine with vegetable oil alone. By using biofuel the fuel consumption and temperature of exhaust gas were reduced. Blends containing up to 50% of methyl ester has acceptable thermal efficiency. Form the performance test and properties of jatropha methyl ester shows that 40 to 50% of blended fuels can be alternate for diesel without making any modification on engine.

Xin Deng et al, biodiesel produced from renewable sources in different proportion with diesel fuel can be used in existing engine without any major modification. Production of
biodiesel fuel is expensive process due to the high cost of vegetable oils, technological issues in transesterification and need of catalyst.

In developing countries production of biodiesel from edible oil is limited and is banned. In non-edible oil presence of some toxic materials these oils are not used for cooking purposes. Production of biodiesel from high acid value oil by using homogeneous catalyst is ineffective process. Solid based catalyst biodiesel production from jatropha curcas oil by transesterification process has a low conversion rate. To improve the methyl ester yield from jatropha curcas oil it is necessary to remove the FFA content.

Kazi Mostafijur Rahman et al presented the study, day by day modernization of world the uses of vehicles are increasing but the availability of energy sources for these engines are gradually decreasing. This leads to the production of alternate fuel for engines. Biodiesel is a one of the suitable alternate for diesel engines, biodiesel is produced from vegetable oils and animal fats. This paper investigates the possibilities of producing biodiesel from jatropha curcas. Jatropha curcas is a wildly growing non-edible plant in arid and semi-arid regions. Jatropha seeds contain nearly 50 to 60% of oil. In this study the conversion of jatropha oil into biodiesel by transesterification process and performance of jatropha methyl ester were evaluated. Alternate fuels are need of word to decrease the net emission of carbon dioxide and oxides of nitrogen. Physical properties of jatropha methyl ester was analysed and compared with the diesel fuel.

Bang-Quan He et al investigated the performance of diesel engine for diesel fuel and ester blended diesel fuel. Additives are used to improve the properties of methyl ester blended diesel fuel. Emission characteristics of methyl ester blends were investigated at varies proportion with diesel fuel at different load conditions. Test results shows that carbon monoxide and carbon dioxide reduced at significant level. Due to wide usage of diesel engine it create the pollution to overcome the drawback methyl ester blended diesel fuel are used.

3. CONCLUSIONS
The above study reveals the following conclusions, due to the modernization of world the usage of vehicles are increased but the energy sources are decreasing gradually to overcome this problem production of alternate fuel is important. For producing alternate fuels vegetable oils and animal fats are plays the major role.

1. Transesterification is the most common process to prepare the methyl ester from vegetable oils.
2. Jatropha methyl ester blend up to 50% with the diesel can be a alternate for conventional fuel.
3. Fuel consumption of blended methyl ester with diesel is less compared to that of diesel fuel.
4. Significance improvements were observed in performance and the brake thermal efficiency of diesel engines.

REFERENCES


A Review - Production of Methyl Ester from Vegetable Oil


