Production of Jatropha Methyl ester by Transesterification Process

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Abstract- **Biodiesel, a hopeful replacement as an unconventional fuel has gain major attention due to the predicted shortness of conservative fuels and environmental concern. The usage of biodiesel produced from Jatropha oil by transesterification process represents one of the most hopeful options for the use of conservative fossils. The oil obtained from jatropha is converted into methyl ester (Biodiesel) prepared in the presence of alike acid catalyst. The physical properties such as density, flash point, Kinematic viscosity, Cloud point and Pour point were found out for Jatropha oil and Jatropha methyl ester. A characteristics study was also carried out for the diesel for getting the basic data for analysis. The datas obtained from the Jatropha methyl ester is closely coordinated with the values of conventional diesel and can be used in the existing diesel engine without any modification.**

Key words: Jatropha Oil, Transesterification, Biodiesel

INTRODUCTION:

Biodiesel is an substitute fuel made from nonconventional sceintific resources such as vegetative oils both (edible and non edible oil) and living thing fats. Vegetable oils are esters of glycol with different chain length and degree of saturation. It may be seen that vegetable contains a substantial amount of oxygen(o_2) in their molecules.

virtually the high viscosity of vegetable oils (30- 200 Centistokes) as compared to that to Diesel (5.8- 6.4 Centistokes) leads to adverse pumping, unproductive mixing of fuel with air contributes to incomplete combustion, high flash point result in increased carbon deposits and inferior coking. Due to the above problems, vegetative oil is need to be modified to bring the ignition related properties closer to those of Diesel oil. The fuel change is mainly aimed at reducing the viscosity and increasing the volatility.

All countries depends on petroleum fuels for transports and agricultural automation now a days. The fact that a few nations together produce the bulk of petroleum has led to high price variation and uncertainties in supply for the consuming nations. This in turn has led them to look for alternative fuels that they themselves can produce. Among the alternatives being considered are methanol, ethanol, biogas and vegetable oils. Vegetable oils have certain features that make them eye-catching as replacement for fossils.

Vegetable oil has the characteristics compatible with the CI engine systems. Vegetable oils are also miscible with diesel fuel in any proportion and can be used as extenders. India extremely depends on bring in of petroleum crude and almost two third of its necessity is meet through import. besides the gases emit by petrol, diesel driven vehicle have an unfavorable effect on the atmosphere and human being health.

Source of jatropha Oil: The plant that is usually cultured for the reason of extract jatropha oil is Jatrophacurcas. The seeds are the prime source from which the oil is extract. Owing to the toxicity of jatropha seeds, they are not used by human. The chief aim of jatropha encouragement, therefore, is perform for the sake of extract jatropha oil.
Investigation of jatrophacurcus seed shows the subsequent compound composition.
Moisture: 6.20%
Protein: 18.00%
Fat: 38.00%
Carbohydrates: 17.00%
Fiber: 15.50%
Ash: 5.30%

The oil content is 25-30% in the seed. The oil contains 21% saturated fatty acids and 79% unsaturated fatty acids. These are some of the chemical elements in the seed, cursin, which is toxic and render the oil not suitable for human use.

Oil has very lofty saponification assessment and being expansively used for production soap in some country. Also oil is used as an illuminant in lamp as it burn with no emitting smoke. It is also used as energy in place of, or next to with kerosene stove.

Jatrophacurcus oil cake is wealthy in Nitrogen, Phosphorous and Potassium and can be used as natural manure. By thermodynamic exchange process, pyrolysis, useful foodstuffs can be obtain from the jatropha oil cake. The fluid, solid (char), and gaseous products can be obtained. The liquid can be used as fuel in furnace and boiler. It can be upgrade to senior grade fuel by transesterification process.

It is important to point out that, the non edible vegetable oil of jatrophacurcus has the necessary potential providing a hopeful and commercially feasible unconventional to diesel oil since it has pleasing physical chemical and performance characteristics similar to diesel. Cars might be run with jatrophacurcus without require much change in design.

Jatropha oil excluded from seeds and clean through filter press can put back kerosene or oil light. Jatropha oil can be used as fluid fuel for lighting and cooking. It will also be used in large Diesel engine base power generating sets, pump sets, heavy ranch machinery, where the thickness of oil is not an subject.

The jatropha seeds hold viscous oil which can be used for work of candles, in the beauty industry, cookery and illumination. The afterward use has important inference for meeting the require for rustic power services and also look at practical substitute for fossil fuels to counter green house gas addition in the environment.

Jatrophacurcus as an energy source: Oil commencing jatrophacurcus: There are number of variety of jatropha. Best amongst these are jatrophacurcus. Jatropha oil is an significant product from the plant for meeting the cookery and illumination needs of the rustic population, boiler fuel for industrialized purpose or as a feasible replacement for Diesel. About one- third of the energy in the fruit of jatropha can be extract as oil that has a comparable energy value to Diesel fuel. Jatropha oil can be used directly in Diesel engines added to Diesel fuel as an extender or transesterified to a bio-diesel fuel. There are some technological troubles to using jatropha oil straight in Diesel engines that have yet to be entirely overcome. Moreover, the cost of produce jatropha oil as a Diesel replacement is now superior to the cost of Diesel itself.

Other products of Jatrophacurcus: The jatropha oil can be used for soap manufacture and makeup production in rural areas. The oil is a strong laxative, widely used as an antibacterial for cough, skin diseases and as a pain relief from rheumatism. Jatropha oil has been used commercially as a raw material for soap manufacture for decades, both by large and small industrial producers.

When jatropha seeds are squeezed, the resulting jatropha oil can be process to produce a high- strandard biodiesel that can be used in a usual diesel car, while the deposit (press cake) can also be processed and used as biomass feedstock to power electricity plants or used as fertilizer (it contains nitrogen, phosphorous and potassium).

Use as jet fuel: aircraft fuels may be more generally substituted with biofuels like jatropha oil than fuels for other forms of transport. On December 30, 2008, Air New Zealand flew the first successful test flight with a Boeing 747 running one of its four Rolls-Royce engines on a 50:50 blend of jatropha oil and jet A-1 fuel. as a result, Air New Zealand and Houston based Continental Airlines have run tests in Jan. 2009, further indicating the viability of jatropha oil as a jet fuel.

Variations in the Yield of Jatropha Oil: It is often considered that a more effective extraction technique would yield greater quantities of oil. This is partly inaccurate, since an effective extraction method would only yield the best quantity and not more than that. The optimum oil content in jatropha plants varies between species and genetic variants.

Climatic and soil conditions generally affect the yield of the oil as well. However, improper processing techniques such as lengthened exposure of the harvested seeds to direct sunlight can harm the oil yield considerably. The maximum oil content that has been reported in jatropha seeds has been close to 47%. However, the accepted average is 40%, and the fraction that can be extracted is taken to be around 91%.

Methods and Devices for Jatropha Oil Extraction

Some of the methods that are usually employed for the extraction of jatropha oil are as follows

Oil extraction: Oil presses have been used for the purpose of oil extraction as simple mechanical devices – neither powered or manually driven. different oil presses can be used for jatropha oil extraction, the most commonly used presses include the Bielenberg ram press.

The Bielenberg ram press involves the traditional press method to extract oil and prepares oil cakes and soaps. It is a simple device that yields around 3 liters of oil per 12 kg of seed input. Since the recognition of jatropha as an alternative energy sources (biofuel), jatropha oil extraction methods have also gained due importance in the market. Since jatropha oil is the primary component required for the production of biofuels, the development of oil extraction methods and the optimization of existing methods of extracting the oil have become important.

Oil pressing: Different kinds of oil pressing are used for the purpose of jatropha oil extraction. The most commonly used ones are the Sayari oil expeller (also called as Sundhara oil expeller & the Komet Expeller). The Sayari

expeller is a diesel-operated oil extraction device that was first developed in Nepal. It is now being developed for use in Tanzania and Zimbabwe for the purpose of jatropha oil extraction and oil cake production. The prototype included heavy parts made of cast iron. The lighter version of the cast iron replaced with iron sheets. A model driven by electricity is also available. The Komet expeller is a single-screw oil expeller that is often used for extracting jatropha oil from the seeds and also for the preparation of oil cakes.

Traditional Methods: Traditional methods by which oil is trapped from the seeds by using simple implements are still practiced in countryside and less developed areas.

Modern Concepts: Methods similar to ultrasonification have been discovered to be effective in increasing the percentage of jatropha oil that can be extracted.

Using chemical methods like aqueous enzymatic treatment. The optimum yield for such methods has been revealed to be approximately 74%. Jatropha oil extraction ways are still being researched. The goal of such research is to discover methods to extract a greater percentage of jatropha oil from the seeds than the current procedures permit

Oil Extraction:

Oil Extraction can be made Mechanically
(by pressing thekernels) Chemically;and
Enzymatically

Manufacture method

Transesterification: It is the process of reacting a fat or oil with an alcohol in a presence of a catalyst.The commonly used alcohols is methanol or ethanol. Catalyst is usually sodium hydroxide or potassium hydroxide. The main product of transesterification is biodiesel and the co-product is glycerin

Separation: After transesterification, the biodiesel stage is separated from the glycerin stage; both undergo purification .The chemical properties of jatropha oil are given below.

Content	Value
Acid Value	37.2
Saponification value	194.6
Iodine Value	101.1
Viscosity (at 31ºC), Centistokes	42.4
Density (g/cm³)	1.11

Fatty acid composition

Palmitic acid (%)	4.5
Stearic acid (%)	6.5
Oleic acid (%)	47.1
Linoleic acid (%)	33.1
Other acids (%)	1.8

Experimental process

Neutralization: The vegetable oil contains about 13- 18.5 % free fatty acids in nature, it must be freed before taken into actual conversion process, 14% of free fatty acid makes Jatropha oil improper for industrial biodiesel production.

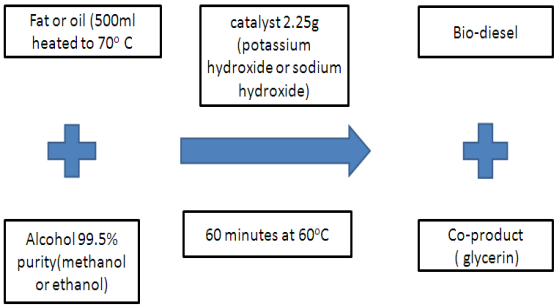
The dried out oil is disturbed with 4 % HCl solution for 30 minutes and 0.85 gram of NaOH was added per 100 ml of oil to neutralize the free fatty acids and to coagulate with the following result

$RCOOH + NaOHRCOONa + H_2O$

Jatrophacurcas plant

The gelatinous liberated fatty acid (soap) is detached by filtration. This procedure brings the free fatty acid satisfied to below 2 % and is ideal source for biodiesel production.

Biodiesel production: In this study, the base catalyzed transesterification is selected as the process to make biodiesel from Jatropha oil. Transesterification-ion reaction is passed out in a batchreactor.



After achievement of transesterification process, the mix is allowed to settle below gravity for 24 hours in a separating funnel. The products formed during transesterification were Jatropha oil methyl ester and Glycerin. The base layer consists of Glycerin, surplus alcohol, catalyst, impurities and traces of unreacted oil. The high layer consists of biodiesel, alcohol and a little soap. The disappearance of water and alcohol gives 80-88 % pure glycerin, which can be sold as crude glycerin is distilling by simple distillation.

Jatropha methyl ester (biodiesel) is mixed, wash with hot distill water to remove the unreacted alcohol; oil and catalyst and allowable to settle under gravity for 25 hours. The divided biodiesel is taken for description.

Biodiesel Characterization

The exact gravity reduce after transesterification, viscosity from 57 to 4.73 centistokes, which is satisfactory as per ASTM norm for Biodiesel.

Flash point and fire point are significant temperature specific for safety during transport, storage and handling. The flash point and fire point of biodiesel

was found to be 128°C and 136°C in that order. Flash point of Jatropha oil decrease after transesterification, which shows that its unstable characteristics had improved and it is also safe to handle.

Higher density means further mass of fuel per unit volume for vegetable compare to diesel oil. The higher mass of fuel would give higher energy obtainable for work output per unit volume.

Higher viscosity is a major problem in using vegetable oil as fuel for diesel engines. Cloud and pour point are principle used for low temperature performance of fuel. The cloud point for Diesel is 4ºC which is very low and the fuel performs satisfactorily even in cold climatic conditions. The higher cloud point can affect the engine performance and emission adversely under cold climatic conditions. The pour point for Diesel is -4ºC. In general higher pour point often limits their use as fuels for Diesel engines in cold climatic conditions. When the ambient temperature is below the pour point of the oil, wax precipitates in the vegetable oils and they loose their flow characteristics, wax can block the filters and fuel supply line. Under these conditions fuel cannot be pumped through the injector. In India, ambient temperatures can go down to 0ºC in winters.

Fuels with flash point above 66ºC are considered as safe fuel.

CONCLUSION

In the current investigation, it has confirmed that Jatropha oil may be used as resource to obtain biodiesel. The experimental result shows that alkaline catalyzed transesterification is a promising area of research for the production of biodiesel in largescale.

Effects of different parameters such as temperature, time, reactant ratio and catalyst concentration on the biodiesel yield were analyzed. The best combination of the parameters was found as 6:1 molar ratio ofMethanol to oil, 0.92% NaOH catalyst, 60ºC reaction temperature and 60 minutes of reaction time The viscosity of Jatropha oil reduces substantially after transesterification and is comparable to diesel. Biodiesel characteristics like density, viscosity, flash point, cloud point and pour point are comparable to diesel.

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