Experimental Parametric Study of Biodiesel to Develop Economic Zero Effluent Discharge (ZED) for Diesel System

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Abstract— *In this globalization realm, there in constant growth in the rate of expenditure of fossil fuels, consequent on ever increasing population and urbanization. This gives charge to depletion of finite resources in the near future. Fossil fuel emission causes global-warming also green-house gases are intangible factor which collectively degrading the planet. As such, the situation demands for an alternate source of energy that can be used to overcome the conjectured energy crisis. In contrast to this, if the energy source is clean and renewable, it will reduce the environmental trouble as well. In the quest an alternate and renewable energy resources, scientists have plead with a variety of options among which biodiesel-diesel blends as alternative fuels has become a popular option and is getting the attention of many researchers. This is because scientists have enlist the properties of biodiesel prepared from vegetable oils are very close to commercial diesel and thus it has a promising future as an alternative fuel for diesel engine. Biodiesel being renewable, biodegradable and green fuel can reduce our dependence on conventional/non-renewable fossil fuels and it also helps to keep pure quality of air by reducing obnoxious automotive/vehicular emissions. Possible solution of this problem is to replace or find renewable and economically feasible fuel as an alternative source. Already a lot of work for source which fulfill the criteria of sustainability and economical carried out. But the effluent is critical issues. So characterization and formation of biodiesel with zero effluent is prime objective.*

Keywords— Biodiesel, Emission, Zero effluent discharge.

I. INTRODUCTION

The world is currently facing the worst energy crisis in history. Many countries worldwide are still heavily dependent on petroleum as their main source of electricity and transportation of fuel, and its price has been setting records in recent day. Thus the only possible solution to this crisis is to find sustainable (Renewable) and economically feasible source of alternative energy. There are many alternative sources fulfill the first criterion (sustainability). However, few of this can fulfill the second criterion (economic feasibility).The best option, fulfilling both criteria, the biofuel particularly that need from radially available biomass feedback.

Biodiesel is a non-toxic, sulphur-free, biodegradable, oxygenated and environment friendly alternate diesel fuel. Biodiesel (fatty acid alkyl esters) is an alternative diesel fuel derived from the reaction of vegetable oils or lipids and alcohol with or without the presence of a catalyst.

One of the importance aspects of biodiesel is its bio-degradability and being more environmental friendly than of the fossil fuels, resulting in less environmental impact upon accidental release to the environment.

Biodiesel fuel is made through a process called transesterification. This process involves removing the glycerin from the vegetable oil or fat. During the process byproducts are left behind, including methyl esters and glycerin. So to reduce and form zero effluent in process is objective.

II. LITERATURE REVIEW

In the recent years, serious efforts have been made by several researchers to use different sources

Ma F, Hanna MA

Showed the use of straight vegetable oils is restricted by some unfavorable physical properties, particularly their viscosity. Due to higher viscosity, the straight vegetable oil causes poor fuel atomization, incomplete combustion and carbon deposition on the injector and valve seats resulting in serious engine fouling. One possible method to overcome the problem of higher viscosity is blending of vegetable oil with diesel in proper proportion, and the other method is transesterification of oils to produce biodiesel.[2]

Peterson CL et.al

It was reported that the transesterification process has been proven worldwide as an effective means of biodiesel production and viscosity reduction of vegetable oil. Temperatures, catalyst type, concentration ratio of alcohol to fuel and stirring speed rate have been observed to influence the transesterification process to a greater extent.[3]

Masjuki HH et.al

A brief study was conducted on the use of biodiesel from coconut oil (50/50 blend), ''B50" in motor coaches. This study revealed that it is a viable and a practical alternative fuel for older in-service engines. Particulate matter was almost negligible with the use of this fuel. Operators reported that the test vehicles had no noticeable drivability downsides. On the other hand, it was observed that the vehicles had some improved power performance while operating under city traffic conditions.[4]

Ramadhas AS et.al.

It found that no significant engine problems were reported in tests with urban bus fleets running on B20. Fuel economy was comparable with diesel fuel and the fuel consumption of biodiesel blend being only 2–5% higher than that of conventional diesel. Ester blends have been reported to be stable, and did not separate at room temperature over a period of three months. One limitation to the use of biodiesel is its tendency to crystallize at low temperatures below 0^0C.[5]

Wagner et al.

Conducted 200 h engine tests with soybean oil ester fuel on John Deere (4239T Model) engine. It was reported that the engine performance with methyl, ethyl and butyl esters was nearly the same as that with diesel fuel. Emissions of oxides of nitrogen were significantly higher for the esters. It concluded that the esters could be used on a short-term basis, and that further testing to be done for determining long-term ester fuel effects. [6]

Ryan and Bagby

Found that the vegetable oils (peanut, sunflower, cottonseed and soybean oils) exhibit characteristics opposite to those expected in most other fossil fuels. For this purpose, an alternative liquid fuel that will blend readily with diesel fuel is required Many researchers have studied performance and emission characteristics of undi oil blended with diesel. [8]

C. Srinidhi et al.

Performed an experiment analysis of performance parameter (such as brake power, break specific fuel consumption, brake thermal efficiency and Exhaust Gas temperature) and emission characteristics (NOx, HC, CO. etc.) is obtained for various bio diesel and diesel blends and compared with ordinary diesel at various loads on a modified variable compression ratio CI engine. The results of the investigation shows that the performance and emission characteristics of the engine fuelled with Honne oil methyl ester – diesel blends is comparable to diesel.[9]

Bawane et al.

Performed experimental work to obtain the operating and emission characteristics of Undi Oil Biodiesel on Variable Compression Ratio (VCR) engine run on various blends of biodiesel, compression ratios and load conditions. From the comparison of results, it is inferred that the engine performance is improved with significant reduction in emissions for the chosen oils without any engine modification. [10]

Bawane et al.

Experimental Investigation of Performance Characteristics of Calophyllum Inophyllum Biodiesel in CI Engine by Varying Compression Ratio. An experiment was conducted to obtain the operating characteristics of the variable compression ratio (VCR) engine run on biodiesl made from calophyllum inophyllum oil, at various compression ratio, and the results are compared with diesel. From the comparison of results, it is inferred that the engine performance is improved with significant reduction in emissions for the chosen biodiesel without any engine modification. [11]

Anil .K. Rajvanshi et al.

Evaluated the prospect of biofuel in India for energy purposes, using agricultural material. A strategy is developed so that from a given piece of land maximum bio-energy and remuneration to the farmer's results. Thus the values of the product of bio-energy and net returns (BENR) were estimated for the different cropping systems evaluated. It is shown that with this strategy not only the country can become self-sufficient in edible oil but will also have the potential of taking care indigenously of a substantial proportion of its energy need. [12]

S.Sundarapandian and G.Devaradjane et al.

Evaluated the performance characteristics, combustion parameters and emissions of vegetable oil esters like Jatropha, Mahua and Neem Oil esters. From the results, it is found that the heat release and work done are reduced by about 4% for Jatropha, 5% for Mahua and 8% for Neem oil esters when compared to diesel.. From the investigation, it is concluded that the performance of vegetable oil esters are good. Thus the developed model is highly compatible for simulation work with bio diesel as alternative fuel [13]

Chavan S B et al.

Conducted an experiment, concluded that there is a best source as a raw material that is Undi Oil for biodiesel production. Seed characterization - Fresh seeds contains moisture 12%, the available oil percentage in Undi seeds is 55-75%. As per practical trial, recorded 52% of oil. Physico- chemical Properties - The fresh extracted crude oil is greenish yellow and it get darkened during the storage. [14]

G Basavaraj et al.

In this work the policy framework to promote the biofuel sector in India is very encouraging, experience has show that the government's initiatives have not translated into results on the production and commercialization fronts to meet the country's energy demand. [15]

LITERATURE OUTCOMES

This review paper provides good techniques that can be applied the work. Reading the literature reviews helped to clarify understanding of transestrification . Literature review gives the best idea to formulate new methodology and techniques for proposed work and which will be best suitable for further research in current field. This scrutiny gives stimulation for research work to generate new methodology to find out biodiesel with zero effluent discharge

III. PROPOSED WORK

Apart from the problem of diesel scarcity and higher fuel costs ,there is the growing menace of vehicular pollution. To compensate for the shortages of diesel fuel, the adaptation of a selected alternative fuel to suit the diesel engine is considered more economically attractive in the short-term than engine modification to suit the fuel. For this purpose, an alternative liquid fuel that will blend readily with diesel fuel is required .

1)The main objective of this work is to achieve high conversion of main product that is biodiesel and least of glycerin which is by product, using transesterification reaction.

2) The practical trials of biodiesel production will be carried out to get maximum biodiesel conversion from respected feedstock.

3)The factors those are responsible for high yield (catalyst percentage, alcohol to oil molar ratio, time of reaction, temperature of reaction, stirring speed of reaction etc) will be studied separately.

4) The synthesized biodiesel will be characterized to emission analysis like nitrous oxide (NOx), carbon dioxide (CO2), hydro carbon (HC), carbon monoxide (CO) and Sulphur oxide (Sox) etc. which will help in both the direction of reducing emission problems and search of alternative fuel for Diesel Engines.

IV. EXPERIMENTATION

The transesterification is the reaction between oil and fat, with a short chain alcohol (methanol, ethanol, and propanol) in the presence of suitable catalysts in the transesterification reaction, as they give high production yield .Few researchers have worked feedstock having higher FFA levels using alternative processes. But there are certain exceptional cases wherein direct trans-esterification cannot be performed. Such cases appear in raw vegetables oils (non edible oils) like karanja., Jatropha, mahua, castor, simaroubae, neem, cotton seed, and Thumba i.e. Citrulluscolocynthisschard. Because these non edible oils possesses high free fatty acids (FFA). For determining whether the raw vegetable oils can be transesterified directly, the acid value is the most important property that must be known. Oils of high free fatty acids content can be converted into biodiesel via dual step transesterification process. In the first step, the oil is treated by an acid dissolved in methanol to reduce FFA content, whereas in the second step the preheated oil is transesterified with methanol in the presence of base catalyst calcium oxide(formed from calcinations) to form biodiesel with zero effluent.

V. CONCLUSIONS & FUTURE SCOPE

From the experimentation, it has been concluded that research has been carried out for different biodiesels and its blends in order to study the effect of process parameters on responses along with the various optimization techniques but very few work has been notified with the combined use transesterification along with zero effluent discharge system. Therefore, it is needed to extend present research , here is the new methodology by which biodiesels are prepared with zero effluent discharge.

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