Biodiesel: A Step Towards Green Technology

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Abstract— The development of any nation mostly depends on the kind of technology and amount of energy available. Fossil fuels always a favorite source of energy for the world. But due to rise in the cost and the depletion of fossil fuels made the world to think about the other sources. Biodiesel is one such area where many studies have been done recently. It is generally manufacture through the process of transisterification (alcholysis) process of oil in the presence of methanol and catalyst. This paper examines the suitability of biodiesel formed from different sources of oil to be used as a conventional fuel in the compression ignition engine. It also compares the performance and emission of biodiesel with that of plain diesel and found that biodiesel can be a good source of energy in upcoming years. Comparison has been made on performance parameters like brake thermal efficiency (BTE), Brake specific fuel consumption (BSFC) and the emissions like CO, HC and NOx.

Key words: Transisterification, Brake thermal efficiency (BTE), Brake specific fuel consumption (BSFC), CO-Carbon mono-oxide, HC-Hydro-carbons, NOx-Nitrogen-Oxides

I. INTRODUCTION

Most of the developed and developing country depends on fossil fuel for their energy requirement. Power production and transportation are the major sectors where energy requirement goes on increasing day by day. Also with the same pace sources are getting depleted. According to a study, fossil fuel will be last for next three to four decades. The ever excessive use and dependency causing environmental problems like global warming and air pollution. Now the time comes when the world seriously needs to think about the alternate solution. But there are certain binding factors for this alternate source which are as follows:

- It should be abundantly available
- Cost should be comparable.
- Less environmental hazardous.
- To be used conventionally without much modifications in the current on-going system.

Recent studies suggest many alternatives which include non-conventional and renewable sources of energy. Where biodiesel is one such area where lot many researchers concentrated their study. Biodiesel is long chain of (methyl, propyl or ethyl esters. It is manufactured with trasisterification process of oil obtained from various sources such as Neem, Jatropha etc. Almost three hundreds crops have been identified as a conventional source of oil for biodiesel preparations. This fuel is then subjected to performance and emission testing on compression ignition engine. Various performance parameters such as BTE, BSFC and Brake power are evaluated. At the same time it is tested for the amount and the kind of emission is gives at different load conditions. At the end it is compared with that of diesel performance.

Current papers examine various such studies carried out by the different researchers by taking different sources of oil for biodiesel preparation. Comparison is drawn based on the performance and emission of different biodiesel and their blends in different proportion with the diesel.

II. METHOD OF PREPARATION OF BIODIESEL

The production of biodiesel consists of the following steps:

A. Pretreatment

Oil from which biodiesel is prepared is first gone through vacuum drying process followed by esterification in case of high FFA in the oil. Traces would be removed formed during the esterification process.

B. Transistrification Process

In this process, the feed stock and the intermediate products flow through the mixer units, where it is supplied with methanol and catalyst in the parallel flow. The reactor is multi-stage and multi chamber reactor which help to achieve maximum conversion efficiency into methyl ester. The composite process configuration is supported by define temperature along the mixer arrangement. This ester rich mixture consist of methanol, glycerin, small amount of catalyst, soaps and high boiling components which is to be removed. The ester phase is washed in order to remove water soluble substance. Some water still exists which is removed with the vacuum dried process in a dryer circuit to adjust the tolerable amount of water.

The phase mixer is pumped into the settler where the glycerin is allowed to settle down. This sedimentation process is time consuming still an effective process. After settling down, the upper portion contains methyl ester which is pumped out into another tank.

III. COMPREHENSIVE REVIEW

Transisterification is the process of converting the oil form the different sources into fatty methyl esters. It was found in the study that the catalyst, amount of methanol and reaction time is the important factors which affect the production. Also excess presence of catalyst reduces the yield. The methanol and the oil ration should be optimal otherwise the production process remains incomplete. Also the temperature should be optimal. Sufficient time of reaction is necessary for the complete conversion. Over time leads to reverse transisterification process. [1]

Mahua biodiesel is tested for its thermal physical properties and found that the cetane number is greater than the diesel. But the other properties like kinematic viscosity, flash point and fire point is greater than the diesel which is undesirable. Also the calorific value is slightly smaller than the diesel which ultimately affects the brake thermal efficiency. Also it is observed that BSFC decreases gradually with the increase of brake power. The heat release for the pure diesel is found is better than the biodiesel. The smoke density is also a worrying factor as its increase with the increase in the blending proportion. But the NOx

emissions found to be lower than the pure diesel which is good indication. [2]

Rapeseed oil monoester of ethylene glycol monomethyl ether was taken as a biodiesel and tested in a CI engine. It is found that the biodiesel contains more amount of oxygen in it and hence improves the brake thermal efficiency. Also when blended with diesel in 50% of the volume, the emissions from the engine such as CO, smoke reduces significantly where as NOx doesn't show any big change in general. It is found that the cetane number of this biodiesel is higher than the diesel and shorter ignition delay when compare to diesel. Also the heat release is slightly higher than the diesel. [3]

There are some seeds which goes wasted after certain agriculture process. Cotton seed is one of them which are of having no major use after fabric is drawn. Oil can be extracted from it and convert it into useful biodiesel. Research is done to check the performance and emission of biodiesel made from the cotton seed oil. It was observed that 15% and 20 % blend with the diesel is favorable in terms of performance and emission.100% biodiesel causing poor performance and emission parameters. [4]

Some research is done on biodiesel–ethanol-water micro- emulsion as a fuel. The physiochemical property shows that micro-emulsion is more stable than emulsion fuel and so as better to be used in the diesel engine. In comparison with pure biodiesel and diesel, the emissions are much decreased. BEW (Biodiesel-Ethanol-Water) micro-emulsion was found be capable of replacing the current conventional fuel. [5]

In a study, Undi, Palm and Simarouba is taken as oil source and biodiesel is prepared from it. It is later subjected to performance and emission testing on CI engine and compared with diesel. Properties of the biodiesel from all the three sources were found. Simarouba methyl ester has less density than the other two. But the calorific value of Simarouba fuel is found less than that of Undi and Palm biodiesel. Also it is concluded that the cloud point of all the three biodiesel is high and hence unsuitable to be used in the cold climatic conditions. [6]

Non edible oil is also an attracting source of oil from where the biodiesel can be manufactured. Thumba, Neem is one of the source on which the study was carried out. First oil is gone through transistrification process and blends were prepared. It is tested for its performance and emissions and compared with plain diesel. It was found that performance increases for the 20% blend of biodiesel. Also the CO and NOx is reduced by 2% and 6% respectively. The smoke density was reduced by 3% when compared with diesel. When straight Neem oil is used, the emissions was increased. [7]

The amount of biodiesel in volume present in the diesel affects the performance parameters significantly. In a study it is found that with the increase of blending proportion, the brake thermal efficiency decreases. The reduction is around 12.8 %, which is quite significant. Also the power and torque reduces with the increasing proportion. In most of the study it is found that the cylinder pressure is higher for the certain oil based biodiesel. The ignition delay is also decrease with the increase in the biodiesel proportion the plain diesel. [8]

Exhaust gas temperature is the important parameter while studying the performance of any new fuel. In a study it is found that the exhaust temperature is generally increases with the increase in the load. It is also observed that the exhaust gas temperature for the biodiesel and its blend is higher than the diesel when compared on the same load. Also the rate of pressure rise is higher for the diesel but the duration of the combustion is higher for the biodiesel and its blends on the same load. Heat release is more for 20% blend when compared to 80% blend but smaller than the diesel. Talking about the emission then the CO and HC reduces significantly but the NOx increases to a little extent. [9]

Biodiesel is blended in different proportions with the diesel in different study. Blend of 20%, 40% and up to 80 % is of common approach. At these different blends, it is evaluated for the perfect one which depends on the performances and emission characteristics for the different load conditions. It is observed that the exhaust gas temperature increase with the increase in the blend of biodiesel proportion in the diesel. Maximum heat release is observed for the 80% biodiesel blend when compared to 20 %, 40% and 60% the emission like CO decree with the increase the in biodiesel proportion but for the 80% blend, the NOx is smallest one in comparison with all other fuel blends and diesel.[10]

It is very important to estimate the amount of blending of biodiesel in the plain diesel in order to get the optimum performance and emission. Some of the studies focused on the estimation of blending ratio. Blend ratio estimation is based on the injected fuel per engine cycle and produced power is analyzed. In this the speed, filtered engine speed and fuel injection per engine cycle are the main variable in deciding the blending proportion. After getting result, it is compared experimentally to validate the result. It was found that the result was so much closer to what an analysis found. [11]

IV. CONCLUSION

From the wide variety of studies that has been carried out, following conclusions are drawn:

- Biodiesel is very good source of biodiesel which has the ability to replace the conventional fuel in upcoming future.
- It has certain issues like kinematic viscosity, cetane no for certain oil source, and calorific value which needs to be deal with and can be a topic of further research.
- Till now, the optimal blending proportion suggested is around 20% of the volume.
- The cost of oil is the main reason for the expensive biodiesel which needs to be deal in order to see it as alternate fuel

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