Performance Analysis of Bio-Diesel Produced from Blending of Premixed Pongamia Pinnata and Waste Cooking Oil

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Abstract— Energy consumption is increasing all over the world because of increasing in population, lifestyle etc. World is mainly depending on fossil fuels for the energy needs. Due to this continuous energy consumption, the fossils fuels are depleting rapidly and also producing environmental pollution. Liquid fossil fuels are the main and most frequently used energy sources for automobiles. Automobiles are using petroleum derived fuels as main fuel in their existing engines, which results in emission of greenhouse gases and other pollutants. Global warming and environmental pollution are the outcome of these emissions. The petroleum products which we are using rapidly are going to deplete within certain years. Hence there is a need to search an alternative fuel. But, considering the fact that the entire development of automobile industry is based on the use of liquid fossil fuel, it is difficult to expect a change this trend to a mass development and use of new engine constructions that would be suitable for some other type of fuel.

Key words: Gases, Oils, Bio-Diesel and Fossil Fuels

I. INTRODUCTION

There is a various research going on in the entire world to search alternative sources from which automobiles and other machineries can run when the fossil fuel is completely exhausted. It may not be possible to completely replace the fossil fuels at present. But the alternative sources can be used with the fossil fuels to extend the availability of petroleum products for some more time.

The fossil fuel reserves and growing concern for the environment have given rise to increased demand for biodiesel research. More over biodiesel has gained significant attention as it is a renewable, biodegradable, less pollutant emitting, non-toxic and environmentally friendly fuel source as compared with the fossil diesel fuel available at present. It is a renewable and biodegradable fuel that consists of fatty acid methyl esters. It is carbon neutral because the carbon content in the exhaust is equal to the amount initially fixed from the atmosphere. Despite the considerable potential of biodiesel, the production of biodiesel is found to be costlier from edible oils to the growing demand for edible oils and the high cost of the feedstock. According to previous reports, the raw materials for biodiesel production account for almost 75% of the total biodiesel cost. India has great potential for production of biodiesel from non-edible oil seeds. So far, only about 10-15 varieties of oil seeds have been found from 100s of varieties.

Hence future of the biodiesel is going to be limited unless biodiesel can be extracted from other non-edible sources. Therefore, a number of research projects have been carried out using non-edible oils such as Jatropha oil or fats, and other waste oils, to reduce the raw material cost. Large scale plantations of non-edible oil plants were also being thought of. An important constraint of this is its sustainability, as the extension of land required for biodiesel production is considerably larger. Nevertheless, such oils usually contain a high percentage of free fatty acids (FFAs) that severely affect the biodiesel production process. So explorations of alternate options are highly important.

II. RELATED WORK

Pongamia Pinnata is also called Honge and it is mainly found in India. Honge oil is important biofuel. Pongamia Pinnata trees are normally planted along the highways, roads to stop soil erosion. If the seeds fallen along road side are collected and oil is extracted in expeller. Pongamia Pinnata seeds containing 32% oil. It is planted as a shade tree. This specie is commonly called Karanja, Pongam. Pongamia is a medium sized tree that is a height of 9 meters. The distribution of Pongamia is along river and coasts in India.

Pongamia Pinnata belongs to the family specie Papilionaceace. It is one of the nitrogen fixing trees. The oil is extracted from Pongamia Pinnataseeds and it is also used for medical applications. Pongamia Pinnata oil is used as a fuel for lighting lamps and cooking. The oil is also used as a lubricant and in soap making industries.it is also used for the treatment of rheumatism, human and animal skin diseases. Dried leaves are used as an insect prevention in grains. Oil is converted into biodiesel and it is used for run the diesel engine. The crude oil is yellow orange to brown color. Pongamia oil has physical properties similar to diesel. It has reduced toxic smoke and emissions.

Fig. 1: Pongamia Pinnata seeds

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III. EXPERIMENTAL RESULTS

Fig. 2: Decorticator

A decorticator is a machine used for stripping the skin of seeds in preparation for further processing. It works on the principle of impact. Initially seeds are fed in the hopper. Inside the machine it is having specially designed rotating blades. Rotation of blades results in high centrifugal force. Due to this force seeds gets break and detached from the cover.

Fig. 2: Mechanical expeller

Expeller has a capacity to crush 25-30 kg/h seed and it works on the principle of screw press mechanism. It is a mechanical method for extracting oil from different seeds. The seeds are squeezed under high pressure. Seeds enter one side of the press and waste materials exit the other side. Due to friction and continuous pressure from the screw drives to move and comperes the seed material. The oil flows through small openings that do not allow solids to pass through. The waste product is removed from the machine. The expeller machine creates the heat in the range of 55-90°C.

A. Determination of Free Fatty Acid

Determining amount of free fatty acid (FFA) is must to convert oil into biodiesel. If FFA is less than four, we can directly go to transesterification process. If FFA is more than four, then there is two-step process, esterification and transesterification. In esterification process, we are minimizing the FFA into less than four. For checking FFA in oil, we have to do titration test. In beaker, we have to take 1ml of oil, small amount of Iso propyl alcohol (IPA) and indicator. Mix the solutions properly. Conduct titration test using the NaOH solution from the pipette. If color of the solution turns into pink color, then stop the experiment. Calculation of the FFA is done by the formula,

$$\text{Amount of FFA} = \frac{28.2 * \text{Amount of NaOH solution}}{\text{Weight of oil}} \ldots (1)$$

1) Waste Cooking Oil

$$\text{FFA} = \frac{28.2 * 0.1 * 1.9}{2.5} = 2.14\%$$

2) Esterified Pongamia Pinnata Oil

$$\text{FFA} = \frac{28.2 * 0.1 * 2}{1.8} = 3.13\%$$

3) Mixture of Esterified Pongamia Pinnata and Waste Cooking Oil

$$\text{FFA} = \frac{28.2 * 0.1 * 1.9}{1.9} = 2.82\%$$

Fig. 3: Titration Test

IV. CONCLUSION

The conclusions of present experimental investigations to evaluate combustion and emission characteristics of four stroke diesel engine fueled with Pongamia Pinnata, waste cooking vegetable biodiesel and premixed Pongamia Pinnata biodiesel and its blends with diesel are summarized as follows.

1) Brake specific fuel consumption of premixed Pongamia Pinnata and waste cooking oil biodiesel is slightly larger than blends of Pongamia Pinnata and waste cooking oil biodiesel. But brake specific fuel consumption of all biodiesel is lesser than diesel.
2) The value of brake thermal efficiency of premixed Pongamia Pinnata and waste cooking oil biodiesel is in between the Pongamia Pinnata and waste cooking oil

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biodiesel. But brake thermal efficiency of all biodiesel is greater than diesel.

3) Carbon monoxide and Hydrocarbon emission is decreased significantly for premixed Pongamia Pinnata and waste cooking oil biodiesel when compared with diesel and it is same characteristics for blends of Pongamia Pinnata and waste cooking oil biodiesel.
4) Carbon dioxide emission is decreased significantly for premixed Pongamia Pinnata and waste cooking oil biodiesel when compared with diesel and it is same characteristics for blends of Pongamia Pinnata and waste cooking oil biodiesel. But when increasing load carbon dioxide emission is increasing for all blends and diesel.
5) Comparatively a slighter increment in NO_x emission is found in B20 blends of Pongamia Pinnata and waste cooking oil biodiesel. But NO_x emission is decreased significantly for premixed Pongamia Pinnata and waste cooking oil biodiesel.
6) Smoke opacity is decreased significantly for premixed Pongamia Pinnata and waste cooking oil biodiesel when compared with diesel and for blends of Pongamia Pinnata and waste cooking oil biodiesel.

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