Experimental Investigation on the Production of Biodiesel from Various Oils and Determine Various Properties

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ABSTRACT

Inflation in fuel prices and unprecedented shortage of its supply has promoted the interest in development of the alternative sources for petroleum fuels. India is looking at renewable alternative fuel sources to reduce its dependence on foreign imports of oils. As India imports 70\% of the oil, the country has been hit hard by increasing cost and uncertainty. Biofuels have the potential to become alternative fuel for fossil fuels. In the present work, an experiment was carried out for the production of biodiesel from various raw oils with the help of transesterification reaction. Once oils can be converted into biodiesels next step for the experiment is to determine various properties of biodiesels and compared with diesel fuel.

Keywords— Diesel, Coconut, Groundnut, Sunflower, Soyabean, Transesterification, Properties.

I. INTRODUCTION

Energy consumption is inevitable for the existence of human beings. Fuels derived from petroleum products have been the most important source of world’s energy and mostly the transportation sector. It is estimated that towards the end of this century, crude oil and petroleum products will become very scarce and costly. Even though the fuel economy of modern engines are improving day by day, the enormous increase in the number of automobiles have started dictating the demand for fuel. It is believed that gasoline and diesel, which are the most widely used fuels these days, will be facing extinction towards the end of this century. So, it is the need of the hour to find other sources of eco-friendly, renewable fuels which can be used as an alternative to the conventional fossil fuels. With increased use and depletion of fossil fuels, alternative fuel technology will become much more common in the years to come. Biodiesels, produced from vegetable oils, has been under research as an alternative fuel for the past few years. Biodiesel can either be used as a sole fuel, known as neat biodiesel or can be blended with petroleum diesel in various proportions for use in dieselengines. Recent researches in this field show that biodiesels can be blended with diesel up to 30\% by volume without any modifications to the engine. Further increasing the biodiesel content in the fuel blend requires minor modifications like varying the injection pressure, injection timing, compression ratio etc. In a few foreign countries, B20 (20\% biodiesel + 80\% diesel) fuel blend has been used widely in compression ignition engines as a partial alternative to petroleum diesel. Biodiesel could be produced from a wide variety of vegetable oils such as Groundnut oil, Coconut oil, Soyabean oil, Sunflower oil, etc. but most of the above are edible oils. As far as a developing country like India is concerned, the use of an edible oil for biodiesel production leads to an imbalance between the food and the fuel sector. So the main criterion to be followed in this case is that the alternative fuel (biodiesel) should be produced from a nonedible vegetable oil. Some of the main non-edible vegetable oils are Jatropha, Pongamia, Mahua, Nerium, Eucalyptus, Castor oil etc. The vegetable oil source from which the biodiesel is derived is selected depending upon their availability in that region of the country. It is estimated that if the farm lands available in the country are properly utilized, India could be a leading producer of biodiesel in the world. Therefore, the use of biodiesel as an alternative fuel would contribute to the overall development of agriculture, economy and environmental sector of the nation.
II. METHODOLOGY

2.1. Transesterification Reaction

The step by step procedure to carry out transesterification is as follows:
- Prepare standard solution of 1000ml of distilled water + 4 gms of NaOH.
- In burette take this standard solution.
- In another conical flask take 50 ml of Isopropyl alcohol.
- Neutralize it by using 3 to 4 drops of burette solution.
- Now add 10 gms of raw oil to the conical flask.
- Heat up to 60˚C in heating oven.
- Cool the flask.
- Add 3 to 4 drops of Phenolphthene indicator.
- Titrate against burette solution until pink colour appears.

Weight of oil

Where, 28.2 = Molecular weight of oleic acid.
- Amount of NaOH required is calculated as
  Amount of NaOH required = FFA + 3.5 = X gms
- One liter of oil is collected in 3 mouth flask and it is stirred by magnetic stirrer at about 900 to 1000 rpm at about 60°C up to 2 to 3 hrs.

In 3 mouth flask now add 300 ml methanol + X amount of NaOH and stir it well up to 2 to 3 hours at 1000 rpm and at 60°C.
- The mixture is poured into the separating flask.
- Settling is done for 4 to 5 hrs and glycerin is collected at the bottom and biodiesel is collected at the top.

Glycerin is removed.
- Biodiesel is washed by using hot water.
Then washed biodiesel is oven dried and pure biodiesel is obtained.

2.2. Fuel Samples
III. RESULTS AND DISCUSSION

3.1. FFA Content

Fig-16 shows FFA content for various oils. It was found that, FFA content of Coconut oil was 1.32%, Groundnut oil was 1.692%, Sunflower oil was 2.256% and Soyabean oil was 2.82%.

3.2. Amount of NaOH Required

Fig-17 shows amount of NaOH required for various oils. It was found that, amount of NaOH required for Coconut oil was 4.82 gms, Groundnut oil was 5.192 gms, Sunflower oil was 5.756 gms and Soyabean oil was 6.32 gms.

3.3. Kinematic Viscosity

Fig-18 shows kinematic viscosity of various fuels. It was found that, kinematic viscosity of diesel is 3.57 cSt, Coconut biodiesel was 4.68 cSt, Groundnut biodiesel was 5.16 cSt, Sunflower biodiesel was 5.39 cSt and Soyabean biodiesel was 5.64 cSt.

3.4. Flash Point

Fig-19 shows flash point of various fuels. It was found that, flash point of diesel was 54°C, Coconut biodiesel was 165°C, Groundnut biodiesel was 176°C, Sunflower biodiesel was 157°C and Soyabean biodiesel was 174°C.

3.5. Fire Point

Fig-20 shows fire point of various fuels. It was found that, fire point of diesel was 54°C, Coconut biodiesel was 165°C, Groundnut biodiesel was 176°C, Sunflower biodiesel was 157°C and Soyabean biodiesel was 174°C.
Fig-20 shows fire point of various fuels. It was found that, fire point of diesel was 64°C, Coconut biodiesel was 174°C, Groundnut biodiesel was 192°C, Sunflower biodiesel was 183°C and Soyabean biodiesel was 186°C.

3.6. Density

Fig-21: Density of various fuels

Fig-21 shows density of various fuels. It was found that, density of diesel was 827 kg/m$^3$, Coconut biodiesel was 865 kg/m$^3$, Groundnut biodiesel was 868 kg/m$^3$, Sunflower biodiesel was 871 kg/m$^3$ and Soyabean biodiesel was 891 kg/m$^3$.

IV. CONCLUSION

Among various fuels used for the experiment the minimum and maximum FFA content was found for coconut oil and soyabean oil respectively. Amount of NaOH required was found minimum and maximum for coconut oil and soyabean oil respectively. Minimum and maximum kinematic viscosity was found for coconut oil and soyabean oil respectively. Minimum and maximum flash point temperature was found for sunflower and groundnut biodiesel respectively. Minimum and maximum fire point temperature was found for coconut and groundnut biodiesel respectively. Minimum and maximum density was found for coconut and soyabean biodiesel respectively.

REFERENCES


