An Experimental Investigation on Physical Properties of Waste Cooked oil and Honge oil as Biodiesel

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Abstract— Rapid growth in civilization, transportation have led to the problems of global warming, harmful emissions causing damage to the earth because of high consumption of the petroleum based fuels. Usage of fossil fuels leads to the increase in global warming causing environmental pollution, these fossil fuels certainly will get exhaust one or the other day. Biodiesel is an alternative fuel for diesel engine. The esters of vegetable oils and animal fats are collectively known as biodiesel. Biodiesel has an energy content of about 12% less than petroleum-based diesel fuel on a mass basis but it is domestic and renewable. It has higher molecular weight, viscosity, density and flash point than diesel fuel. The physical properties of the biodiesel nearly match that of the fossil fuels as well as biodiesel is eco-friendly, economic with good performance characteristics. In this paper investigation is carried out on Waste Cooked oil & Honge oil as biodiesel in different blend ratios as 40%, 60% & 80% in order to study the properties such as kinematic viscosity, flash point and fire point. The results obtained represent kinematic viscosity, flashpoint and fire point values are within the limits of International standard for biodiesel.

Key words: Biodiesel, Waste Cooked Oil, Honge Oil, Fuel Properties

Nomenclature:
KOME: Karanja Oil Methyl Ester
KOEE: Karanja Oil Ethyl Ester
ASTM: American Society for Testing and Materials

I. INTRODUCTION

In today's growing world we have been observing that there is a huge demand of humankind in their lifestyle. In improving their lifestyle, human beings have forgotten about the environment in which they are surviving. Transport, which plays the major role in a person's life, also plays a important role in degrading the environment. Use of petrol, diesel, LPGs have destroyed the atmosphere. As there are lesser options, we can't fully ignore them, but we can improve the use of such fuels by using Bio-Fuels. Bio Fuels are the fuels derived from different plant oils. These types of fuels do not cause any pollution or harm to the atmosphere. Non edible seeds can be used to produce bio-fuels also they act as lubricating agents. These fuels are used directly or blended with diesel and used in engines [1]. In case if we use these types of fuels than there will be reduced environment pollution and smooth running of vehicles. These fuels are cheaper; it can be easily affordable by a common man. The significant efforts have been made for obtaining biodiesel by transesterification of oil obtained from Jatropha curcas, soybean, sunflower, cotton seed, rapeseed and palm12. The ASTM-445 specification for viscosity at 40℃ of centistokes is generally met by biodiesel and biodiesel blends. The reported viscosity of soy methyl ester is ranging from 3.8 to 4.1 centistokes at 40°C. Addition of Glycerine will increase viscosity of biodiesel but it leads to many other problems. Estimation of surface tension of biodiesel suggests that it is two to three times as great as that of diesel. High viscosity of edible oil, non edible oil and animal fats tend to cause problem when directly used in diesel engines [4, 5]

A. Characteristics of Waste Cooked oil:

The main advantage of Waste Cooked oil is that it is easily available everywhere. When the concentration of Waste Cooked oil is increased in the blends its viscosity decreases and it has a higher BP when compared to other oils. The calorific value is also low, which helps in easy combustion of the fluid. When it comes to point of economic consideration it is cheap.

B. Characteristics of Honge oil:

The oil is yellowish-orange to brown in colour. Actually it is toxic oil which will induce nausea and vomiting if consumed. Honge oil is mainly used in lubrication because of its high viscosity. This oil is mixed with palm oil to decrease at low temperatures too. Viscosity of this oil is greater when there is high concentration of this oil in the blend [2, 3]. Studies conducted by different researchers around the world revealed that biodiesel is proven as a substitute for mineral diesel and at the same time reducing the emission significantly [6-9]

II. EXPERIMENTAL METHODOLOGY

Fig. 2.1: Redwood Viscometer

The above figure 2.1 is an experimental setup of red wood viscometer. The viscometer oil cup and jet is cleaned with diesel. Viscometer is levelled by adjusting screws and spirit level. Then the water jacket is filled with water to the mark & the brass valve is placed in position to close the jet. The oil is poured in to the oil cup for examination so that the level of oil comes up to the pointer tip , the thermometer is then clamped in position using balance weight box of empty 50 ml measuring flask is noted. The heater is switched on and temperature of oil and the cup is monitored. To improve the heat transfer and maintain the water temperature uniform the water is kept stirred. When the oil reaches the temperature at which viscosity is to be determined then the heating is stopped and the 50ml measuring flask is placed below jet. The ball valve is lifted and simultaneously the stop watch was stopped the ball valve closed when the oil in the flask crossed the 50 ml mark. Then weight of the flask with 50ml of oil is noted. The experiment is repeated for different temperatures. Here each bio fuel is blended with diesel and the blend is used as a fuel in the experiment. The oils used are waste Cooked oil and Honge oil. The blends used for testing are 40%, 60%, 80% of bio fuels.

Fig. 2.2: Cleveland's open cup apparatus

The Cleveland open-cup method is one of three main methods in chemistry for determining the flash point of a petroleum product using a Cleveland open-cup apparatus, also known as a Cleveland open-cup tester. First, the test cup of the apparatus (usually brass) is filled to a certain level with a portion of the product. Then, the temperature of this chemical is increased rapidly and then at a slow, constant rate as it approaches the theoretical flash point. The increase in temperature will cause the chemical to begin to produce flammable vapor in increasing quantities and density. The lowest temperature at which a small test flame passing over the surface of the liquid causes the vapor to ignite is considered the chemical's flash point. This apparatus may also be used to determine the chemical's fire point which is considered to have been reached when the application of the test flame produces at least five continuous seconds of ignition.

III. RESULTS & DISCUSSIONS

Viscosity is the most important property of biodiesel since it affects the operation of fuel injection equipment, particularly at low temperatures, when the increase in viscosity affects the fluidity of the fuel. Viscosity is a measure of the internal fluid friction or resistance of biodiesel to flow, which tends to oppose any dynamic change in the fluid motion. As the temperature of oil is increased its viscosity decreases and it is, therefore, able to flow more readily. It is also important for flow of biodiesel through pipelines, injector nozzles, and orifices. The lower the viscosity of the biodiesel, the easier it is to pump and atomize and achieve finer droplets. High viscosity leads to poorer atomization of the fuel spray and less accurate operation of the fuel injectors. The kinematic viscosity values of biodiesels are between 3.6 and 4.6 mm2/s. The kinematic viscosity of diesel fuel is 2.7 mm2/s at 311 K. Biodiesel is a little bit heavier than fossil diesel (860–895 kg/m3 for biodiesel, towards 820–860 kg/m3 for petroleum-based diesel at 288 K), but this fact does not prevent its mixing with the petroleum diesel for blended application.

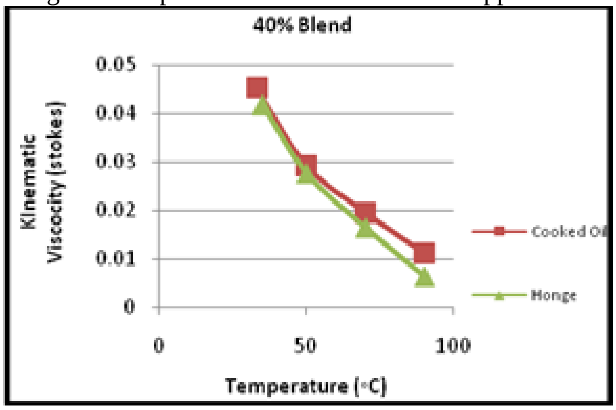

Fig. 3.1: Kinematic viscosity v/s Temperature for 40% blend

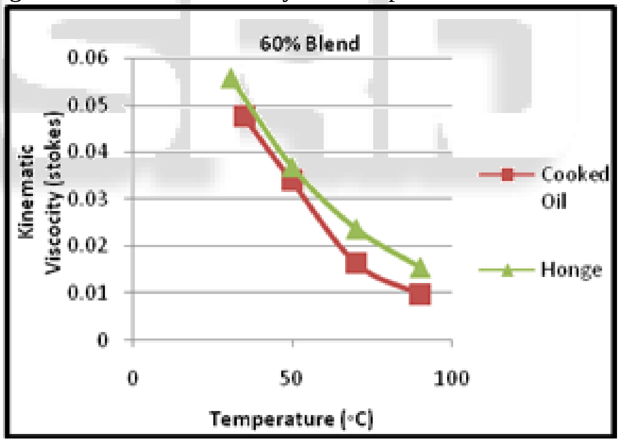

Fig. 3.2: Kinematic viscosity v/s Temperature for 60% blend

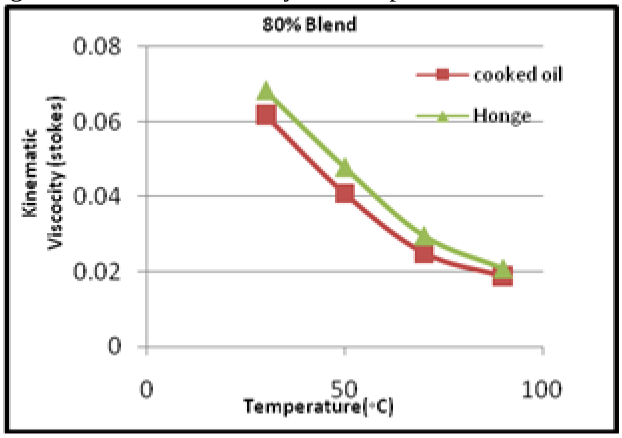

Fig. 3.3: Kinematic viscosity v/s Temperature for 60% blend

From the fig.3.1, it is observed that kinematic viscosity of Waste Cooked oil for 40% blend is higher than the Honge oil. With increase in temperature there is decrease in the viscosity of Honge compared to Waste Cooked oil. This is due to less density of Waste Cooked oil resulting in comparison with Honge oil. For blends 60% & 80% shown in fig.3.2 and fig.3.3 of Waste Cooked oil represents that Honge oil viscosity is more than Waste Cooked oil since it may be due to lesser miscibility for Waste Cooked oil.

Types Of Oils	Honge Oil			Waste Cooked Oil		
Blends (%)	40	60	80	40	60	80
Flash Point(°C)	75	80	101	70	75	95
Fire Point (°C)	83	95	113	80	90	110

Table 3.1: Flash and Fire point of Honge & Waste Cooked Oil

Table 3.1 represents the flash & fire points for both Honge & Waste Cooked oil for 40%, 60% & 80% blends. It is observed that the flash point and fire point for Waste Cooked oil is lesser than that of Honge oil which may be due to vaporization temperatures.

IV. CONCLUSIONS

In this experiment conducted the graphs shows the viscosity variation of all the two oils with different blends at different temperatures. The flash and fire point of Waste Cooked oil is lower than the other the oil, so combustion of Waste Cooked oil is earlier than Honge.

- At 40% blend the Waste Cooked oil has the maximum viscosity whereas Honge has minimum viscosity at all temperatures.
- At 60% blend the Honge has the maximum viscosity and Waste Cooked oil has the minimum viscosity at lower temperatures.
- At 80% blend the Honge has the maximum viscosity and Waste Cooked oil has the minimum viscosity at all temperatures.

The one with higher viscosity will also be used as lubricant which reduces the need of another lubricant and one with lower viscosity will be used as fuel for running the engines by blending it with diesel. Viscosity of the biodiesel is found to be about one-tenth of the value of crude oil and was very close to that of diesel. This property supports very strongly in favor of biodiesel being used in a diesel engine without any engine modification. To ensure long-term application of biodiesel in engines, it is very important to note the specific difference between KOME and KOEE so that the engine operating condition can be monitored with respect to the particular fuel. Our studies show the following significant differences. The cold flow properties of ethyl esters are better than methyl esters. Viscosity of ethyl esters is slightly higher than that of methyl esters. The cloud point of biodiesel is higher than that of diesel. However, cloud point of ethyl esters is lower than that of methyl esters. The flash point of biodiesel is higher than diesel. Furthermore, flash point of ethyl ester is higher that of methyl ester. So biodiesel developed through both the routes is safer to transport. Distillation characteristics are different from that of diesel. Biodiesel does not contain any highly volatile components; the fuel evaporates only at higher temperatures.

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