LJAST
Libyan Journal of Applied Science and Technology
مجلة ليبيا للعلوم التطبيقية والتقنية

Volume 9 Issue 2
December 2021

Production of biodiesel

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Abstract-- **The need of energy is increasing continuously due to rapid increase in the number of industries, and choice fuels to consider important.in this paper study the physical properties of biodiesel have shown that it is completely with petroleum diesel. Since the combustion of biodiesel emits particulate matter and gases which is lower than petro diesel. The purpose of this study of biodiesel or biodiesel blends in terms of performance and exhaust emissions has been studied in comparison to petroleum diesel**.

Keywords: biodiesel, petroleum diesel, blend, transesterification.

1. Introduction

Biodiesel is a clean-burning fuel currently being produced from grease, vegetable oils, or animal fats. Its chemical structure is that of fatty acid alkyl esters. Biodiesel is produced by transesterification of oils with short-chain alcohols or by the esterification of fatty acids. The transesterification reaction consists of transforming triglycerides into fatty acid alkyl ester, in the presence of an alcohol, such as methanol or ethanol, and a catalyst, such as an alkali or acid, with glycerol as a byproduct [1].Chemical reaction at supercritical conditions without the use of a catalyst has also been proposed. Biodiesel is a liquid mixture of free fatty acids with similar properties to diesel. The name comes from the fact that the "diesel" is produced from renewable oils and not from fossil crude oil. The oil used to make biodiesel consists mainly of triglyceride and some free fatty acids (FFA), figure (1) shows the biodiesel production cycle.The vegetable oils may be blended to reduce the viscosity with diesel in presence of some additives to improve its properties. Heating and blending of vegetable oils may reduce the viscosity and improve volatility of vegetable oils but its molecular structure remains unchanged hence polyunsaturated character remains. Blending of vegetable oils with diesel, however, reduces the viscosity drastically and the fuel handling system of the engine can handle vegetable oil–diesel blends without any problems [2].

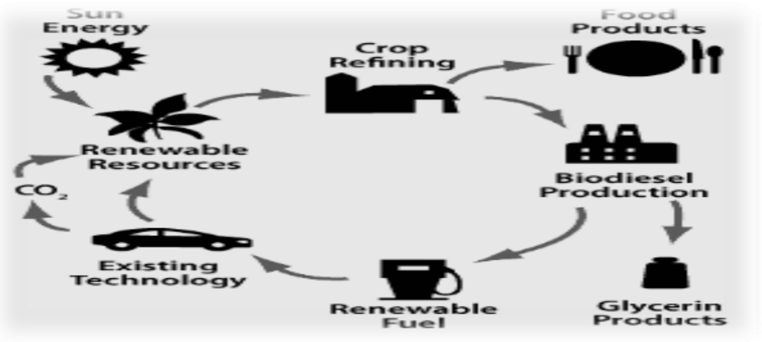

Figure 1: Biodiesel Production Cycle

1.1 Biodiesel production from used cooking oil

The methods used for biodiesel production from used cooking oil are similar to that of conventional transesterification processes. Selection of a particular process depends on the amount of free fatty acid and water content of the used cooking oil. It is reported that the feedstock such as refined vegetable oil, crude vegetable oil, used cooking oil, animal oil and trap greases generally contain 0.05%, 0.3%– 0.7%, 5%–30% and 40%–100% of free fatty acid respectively [3]. Most biodiesel production processes can tolerate up to 1% water in the feedstock, even this small quantity of water will increase soap formation and measurably affect the transesterification process .At present, production of vegetable oil and animal fat worldwide is not sufficient to replace liquid fossil fuel use. There are a few environmental groups who protest the increased amount of farming and the subsequent over-fertilization, increased pesticide use, and land use conversion necessary to produce the additional vegetable oil. Waste vegetable oil has been proposed by many as the best source of oil to produce biodiesel. Here too, the available supply is far less than the quantity needed to replace the amount of petroleum-based fuel that is burned for transportation and home heating in the world.

Figure 2: Sample of waste cooking oil

1.2 Blends Biodiesel with petroleum Diesel

The issues related to the increase in energy demand, fossil fuel depletion, and environmental pollution are considered so urgent that we must find renewable and alternative fuels to replace fossil fuels with the aim of maintaining fresh air and ensuring energy safety[4]. Biodiesel produced by the transesterification reaction of oils or fats that are originated from edible and non-edible vegetable oils and animal fats are considered potential alternative fuels with environmentally friendly, non-sulfur, and non-toxic properties [5][6]. In particular, biodiesel is prone to blending with mineral diesel fuels to form homogeneous blends, which are used in diesel engines without any modifications [7]. However, high viscosity and density lead to poor atomization, time-consuming breakup and mixture formation, increased carbon deposition, and a high energy demand for pumping fuel [8]. Until now, some techniques, such as blending, preheating, and emulsification, have been applied to improve the above-mentioned disadvantages of biodiesel [9][10].

2. Experimental methods

2.1The procedure

Biodiesel was produced in a laboratory using an Erlenmeyer flask as a reaction vessel. The reactants used were methanol and wasting vegetable oil. With sodium hydroxide (NaOH) as a catalyst. The vessel was kept at reaction temperature (60˚C) in a water bath with good magnetic stirring during the entire reaction time (1hr or 2hr) First the catalyst was pulverized, thereafter the weight was measured and the catalyst was mixed with the methanol in the reaction vessel. The catalyst was left to dissolve in the methanol with good stirring in the water bath at the reaction temperature, and after that poured in to another vessel containing 500 mL of and wasting vegetable oil. The substances where left to react. After the reaction time the content was poured into a separating funnel and left for glycerol and biodiesel to separate. The lower darker phase containing glycerol was then poured out and the remaining biodiesel was once washed with 5 % w/w water solution of phosphoric acid to remove the alkaline from the biodiesel. The water phase was poured out and the volume, viscosity, weight, cold flow properties in terms of (Cloud Point , Pour Point and flash point were examined for biodiesel and its blend) were measured.

A- Kinematic Viscosity

Viscosity is the degree of a material's resistance to flow, high viscous materials flow with great difficulty, and while less viscous ones flow with ease [11] .The determination of kinematic viscosity of biodiesel samples was carried out with an Ubbelohde viscometer (Figure 3). The procedure for measuring the kinematic viscosity of biodiesel samples can be described as follows:

1-Fill the viscometer through a tube (3) with a sufficient quantity of the sample liquid that is appropriate for the viscometer being used or by following the manufacturer's instructions 15 mL.

2- Placed the viscometer in oil silicone bath stabilized at the temperature specified.

3- Maintain the viscometer in a vertical position for a time period (more than 20 minutes) to allow the sample temperature to reach equilibrium.

4- Close tube (2), and raise the level of the liquid in tube (1) to a level about 8 mm above mark M1.

5- Keep the liquid at this level by closing tube (1) and opening tube (2).

6- Open tube (1), and measure the time required for the level of the liquid to drop from mark M1 to M2, using an appropriate accurate timing device.

7- Calculate the kinematic viscosity of the sample using formula in following equation

$$V = Ct$$

Where:

V is the kinematic viscosity, in (mm^2/s), for the reference Standard liquid, C is constant of viscometer; t is the flow time, in seconds.

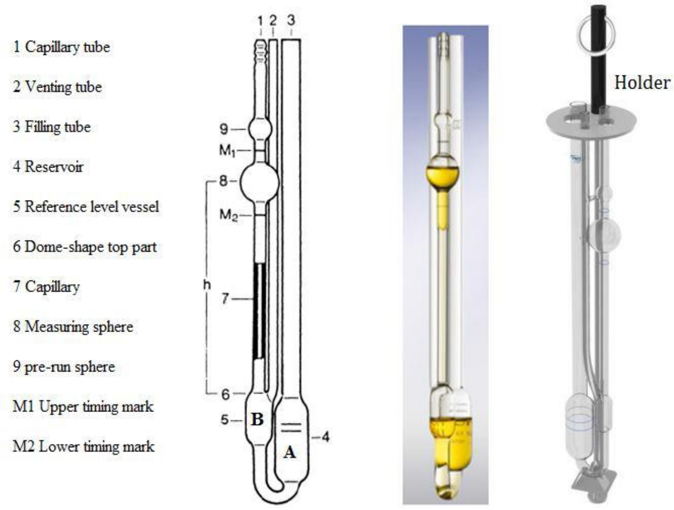

Figure 3: Illustrated diagram of Unbeholden viscometer

B- Density Measurements

The density of the biodiesel was measured using a Pycnometer with a bulb capacity of 25ml. The weighing was done by using a high precision electronic balance with a precision of ± 0.1mg. The density values of the samples were measured for temperatures between 20℃ to 90℃.

1-Before use, clean the glassware with water and then rinse with a small amount of acetone.

2- The Pycnometer is completely filled with biodiesel, and the mass of the biodiesel in the Pycnometer measured using an electronic balance.

3- Then placed in silicon bath until it reaches the selecting temperature.

4-Weigh the full Pycnometer on an electronic balance.

5- Determine the density of biodiesel at selecting temperature.

C- Flash point

It is the lowest temperature recorded by a thermometer when the sample is heated under standard conditions such that a cloud of saturated vapor forms above the surface of the liquid that can flash when a flame is near. In this method we used the Pensky Martens closed device (ASTM 93-95) , This method is used to determine the flashing degree of fuel oil, diesel oil, lubricating oils and liquids that have the ability to form an oil tape on the sample surface under test conditions. Santi Stoke at a temperature of 40℃ .

1-The degree to which the first crystallization in the liquid is recorded when the temperature is lowered. Cleans the machine and dries well.

2- Heating of high viscosity samples.

3-Fill the cup to the mark shown inside.

4-Place the cup in the device, cover well, and place the thermometer through its hole.

5-The heating process starts with a temperature rise of 5-6 °C per minute with the mixing of the sample.

6-When the temperature reaches 16 °C before flashing, the flash test starts by rounding the test flame as the temperature increases by 1 °C.

7-The temperature at which a clear flash occurs inside the vessel is recorded when the test flame is rounded.

D- Cloud Point

The degree to which the first crystallization in the liquid is recorded when the temperature is lowered.

1- After filtering, the sample shall be placed in the test container up to the mark indicated.

2- Close the bowl with a proper seal with a special thermometer opening.

3- Place the thermometer so that it reaches the bottom of the test vessel slightly and then place the vessel in a suitable temperature cooler.

4- The temperature drop is monitored every degree Celsius until a clear cloud is formed and this temperature is recorded which is the degree of Cloud point.

E-Pour Point

The temperature at which the product starts to accumulate crystals from small crystals at this temperature is able to move its surface when the cup is tilted. In other words, the lowest temperature remains the product retains the liquidity property before turning completely to the solid state because of low temperature.

1- The test vessel is a cylindrical glass tube with a flat base and has a marker to determine the sample height in the tube.

2- Fill the container with the sample and then close the container with a cork stopper and install the thermometer so that the thermometer submerges the surface of the liquid.

3- Aspirate the tube into the cooling device, a multi-stage cooling device where the sample cools regularly.

4-We remove the sample from the device every three degrees Celsius and note that the sample spills each time.

5- The degree of spillage is the temperature at which the sample does not spill plus.

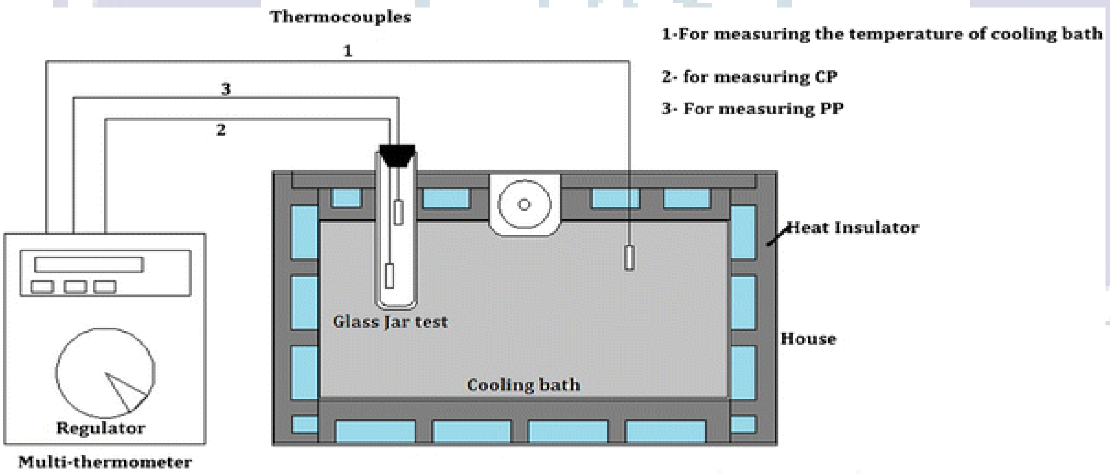

Figure 17: The schematic of the cloud point and pour point measurement apparatus

4. Results

Table (1) the result properties for biodiesel

Property	Unit	Result
Kinematic viscosity	mm^2/s	4.6239752
Density at 24.6 ℃	Kg/m^3	879
Flash Point	℃	147
Cloud Point	℃	17.8
Pour point	℃	11.3

Table (2) the result properties for biodiesel blend with Petro-diesel

Property	Unit	Result
Kinematic viscosity	mm^2/s	3.42
Density at 24.6 ℃	Kg/m^3	833.87
Flash Point	℃	170
Cloud Point	℃	3
Pour point	℃	-2

6. Consultation

Biodiesel can be used directly in any diesel engine without any necessary modifications, and it is a renewable alternative fuel that can be used pure or in blends with petroleum diesel to improve performance and reduce toxic emissions .Because the pollution is important problem in world and choose fuel for reduce it , biodiesel used for solve this problem when it work as fuel in engine , and has a contribution in reducing particulate matter emission, reduced emission of greenhouse gases, and decrease in air pollution.

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