Effect of Reaction Temperature on the Biodiesel Yield from Waste cooking Oil and chicken fat

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Abstract *The global demand for energy sources have been significantly increased recently. Indeed, several hydrocarbon reservoirs have been depleted in the world. Moreover, the using of fossil fuels such as natural gas and crude oil are contributed in global worming phenomenon that emitted several gases such as, carbon dioxide and sulphur dioxide to the atmosphere. As a result, the researchers are investigating in producing an alternative friendly fuel that meet the global environmental legislation for example, bio fuel, solar and wind energy. Indeed, biodiesel may consider one of the most obvious alternative sustainable fuels that may be produced from vegetable oil and fats. Therefore, this study is attempted to study the effect of reaction temperature on the biodiesel Yield from waste cooking oil and chicken fat that has been produced in a previous study[1]. The study has adopted several transesterification reaction temperature for instance, 40°C, 55°C and 60°C. The study has found that the reaction temperature is a quite important factor in increasing the biodiesel yield and 60°C may be considered the optimal temperature for the transesterification reaction.*

Keywords— *Biodiesel, reaction temperature, sustainable fuels.*

I. INTRODUCTION

Due to the recent global environmental legislations and the global demand for energy sources, a search for an alternative fuels have been significantly increased . Indeed, the researchers have investigated in several alternative fuels for example, hydrogen, solar and wind. In fact, biodiesel is one of the most well-known alternative fuels and it may be considered as an environmentally clean energy. Biodiesel can be produced from several renewable sources for example, animal fats and vegetable oils [2]. Furthermore, it also posses other advantages for instance, higher lubricating quality and lower sulphur content [8]. Biodiesel can be produced by adopting the transesterfication process which also called alcoholysis . It simply displacement of alcohol from an ester by another alcohol in process similar to hydrolysis except that an alcohol is used instead of water. In fact, this process has been widely used to reduce the viscosity of triglycerides. The transesterfication reaction is represented by below equations:

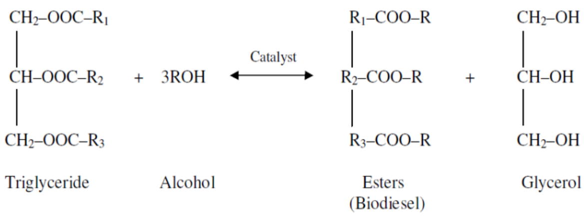

Figure1: Transesterification of triglycerides with alcohol [2].

In fact, several variables may be affected the transesterfication reaction for example, reaction time, temperature and alcohol to oil ratio. Indeed, the reaction temperature has huge effects on the reaction yield. The reaction temperature could be achieved near the methanol (alcohol) boiling point at the atmospheric pressure [3]. Moreover, the temperature is an important parameter as is allows the faster reaction kinetics and mass transfer rates in the trenesterfication reaction. Moreover, a relatively high reaction temperature is required for heterogeneous system in order to increase the mass transfer rate between reactant molecules and catalyst. This is due to existence of initial three phase mixture. oil- methanol- solid catalyst. Higher temperature may decrees the time required to reach the maximum conversion [4]. The producer of the reaction are the biodiesel itself with glycerol. The produced fuel and glycerol should separated from each other and that can be achieved by using a separator funnel. The heavier co-product, glycerol, settles out and may be sold as is or purified for use in other industries, for instance in pharmaceutical and detergents. After the transesterification reaction and the separation of the crude heavy glycerine phase, the producer is left with a crude light biodiesel phase [5]. This crude biodiesel requires some purification prior to use. Indeed, biodiesel poses a viscosity that similar to petroleum diesel. Biodiesel can be used in pure form (B100) or it could be blended with petroleum diesel [5].

II. Research methodology

The work methodology has been obtained form a pervious study [1] as the following, the waste cocking oils and chicken fats have been obtained and collected from a local butcher shops and fast food restaurants in Koya city in Iraqi Kurdistan region. The chicken fats have been washed and cleaned with deionised water. Moreover, the solid fat has been melted at (65 -70) °C [6,7]. The melted fat has been filtrated to remove any suspended particles and impurities. The waste cocking oil is also filtrated in order to remove its impurities. Then the melted fats and waste oil have been mixed and produced a new fat and oil blend. Furthermore, the experiment has done in a laboratory that used of 250 ml flasks. The flasks is kept in an water bath maintained at 60°C. This temperature keeps the methanol below its boiling point temperature. Alkali transesterification reaction has been used to produce the biodiesel from the oil and fat blend. The KOH has been dissolved with the needed amount of methanol. This liquid has been poured into the melted chicken fat in a specific flask. Then the methanol and catalyst mixture have been added to the liquid oil and fat mixture in a specific flask. The reaction has been done at 60°C and for 30 min with 700 rpm hotplate magnetic stirrer. Furthermore, figure (2) shows the hotplate magnetic stirrer. Moreover, the reaction then finished and the reaction products have been transferred to a separator funnel which separated the products into two layers. Figure (3) shows the separator funnel. Finally, two materials separated from each other. In the bottom of separator, content the impurities and glycerol and in the top of separator the biodiesel appears.

Figure 2: Hotplate magnetic stirrer.


Figure 3: Separator funnel.

III. Results and Discussions

The results for the transesterification reaction has been obtained from a previous study [1] which adopted a sample of blended WCO and Chicken fat with 1.8 mg KOH/g for blended oil and fat. Moreover, this process is achieved yield about 83% with 7:1 methanol to oil ration at 60 °C. Table 1 shows some physical properties of produced biodiesel.

Table 1: Physical properties of produced biodiesel [1].

Properties	Produced biodiesel	ASTM Sanders for Biodiesel
Density 15°C kg/m3	882	860- 900
Viscosity 40°Cmm2/s	5.924	1.9 – 6
Cetane Number	71	40 min
Flash point °C	108	54 min

The transesterification reaction temperature may has a significant effects on the biodiesel yield from chicken fat and waste cooking oil. Thus, the study has adopted several reaction temperatures for example, 40°C and 60°C. Figure 1 shows the relationship between the of transesterification reaction temperature and the biodiesel yield%.

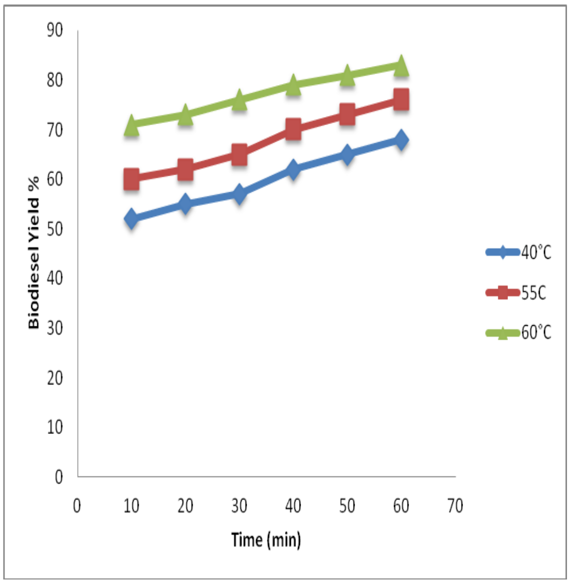

Figure 4: The relationship between the of transesterification reaction temperature and the biodiesel yield%.

From figure 4. It can be argued that the biodiesel yield percentages is increased by increasing the transesterification reaction temperature with reaction time. However, the maximum conversation to ester could be achieved at methanol: oil ratio about 7:1 at 60 °C with 83% yield.

IV. Conclusion

In conclusion, this study is investigated the effects of transesterification reaction temperature on the biodiesel yield from chicken fat and waste cooking oil by adopting several reaction temperatures for example, 40°C and 60°C. Moreover, it could be argued that the transesterification reaction temperature has high effects of the biodiesel yield. Moreover, the adopting of 60°C reaction temperature may consider the optimal reaction temperature that produce high amount of biodiesel at methanol to oil ratio about 7:1. However, it is also recommended that to study the effects of the catalyst amount and reaction time at the mentioned reaction temperature and methanol to oil ratio.

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