RESEARCH ARTICLE OPEN ACCESS

The Investigation Of Utilizing Rapeseed Flowers Oil As A Reliable Feedstock To Produce Biofuel And To Be Applied In Iraqi Kurdistan Region

Ribwar K. Abdulrahman*, Hayman K. Mustafa** And Brosk F. Ali***
*(Chemical Engineering department, faculty of engineering, Koya University, Kurdistan region of Iraq)
**(Biology Department, Faculty of Science and Health, Koya University, Kurdistan region of Iraq)
***(Petroleum Engineering Department, Faculty of Engineering, Koya University, Kurdistan region of Iraq)

ABSTRACT
The world demand for energy in recent decade has been dramatic. Indeed, several hydrocarbons reservoirs are depleted around the world. Moreover, the using of fossil fuels for example, natural gas and coal is emitted high quantities of carbon dioxide and other greenhouse gases to the environment that contributed in global worming phenomenon. Hence, many researchers and energy companies are attended and investigated to find out a new and reliable renewable energy source for example, biogas and biodiesel. Indeed, biodiesel can consider a reliable fuel due to many advantages for instance, reduce the global worming phenomenon, reduces carbon dioxide emissions and sustainable energy source. In fact, biodiesel can be produced from several resources for example, vegetable oil and animal fats. Rapeseed oil may consider a quite reliable and cheap source to produce biodiesel. Indeed, it has been observed that during the spring session in Iraqi Kurdistan region, wild rapeseed flowers are growing naturally in many cities of Iraqi Kurdistan for example, Sulaymaniyah, Ranya and Koya. The observed wild rapeseed flowers are produced considerable amounts of rape seed that can be invested to produced rapeseed oil and biodiesel. Therefore, this study is aimed to produce a reliable biodiesel from rapeseed flower oil by adopting transesterification reaction. Furthermore, this study has also applied process production parameters to find out the optimum operating conditions to produce biodiesel form the rapeseed oil for instance, amount of catalyst 1.25 % KOH and amount of methanol on biodiesel production yield about 7:1.Moreover, several laboratory tests for example, density, cloud point, pour point and cetane value have been applied for the produced biodiesel.

Keywords - Biodiesel, renewable energy, Rapeseed oil, process optimization.

I. INTRODUCTION

Rapeseed (Brassica napus) could be considered one of the most important oilseed crops in the world [1, 3]. Moreover, rapeseed is an important oilseed crop in the agricultural systems of many arid and semiarid areas where its yield is often restricted by water shortfalls and high temperatures during the reproductive growth stage [2, 4]. Indeed, it has been observed that during the spring session in Iraqi Kurdistan region, wild rapeseed flowers are growing naturally in many cities and towns of Iraqi Kurdistan for example, Sulaymaniyah, Ranya and Koya. Figure (1) shows a wild rapeseed flower in Kurdistan Region of Iraq. The observed wild rapeseed flowers are produced considerable amounts of rapeseed that can be invested to produced rapeseed oil and biodiesel. Biodiesel is considered as one of the most important sustainable energy sources in the recent decade as well as the future. It could be considered as an alternative fuel for diesel engines. In fact, many oil reservoirs are depleted every day. Moreover, petroleum diesel engines are emitting significant amounts of greenhouse gases every moment that contribute directly in global worming phenomenon [5]. Therefore, many researchers and oil companies tried to discover a new energy sources that can be used as an alternative fuel for various uses [6]. In fact, biodiesel has received huge attention in the world to be used as alternative fuel for diesel engines [7]. Moreover, it possesses several advantages over petroleum diesel for example, reduces the demand of petroleum fuels, nontoxic and reduces the global climate changes and environmental pollution. Biodiesel fuelled engines produce less CO, HC and particulate emissions than petroleum diesel fuelled engines. Indeed, biodiesel could be used directly in some specific diesel engines [8]. However, it should be blended with petroleum diesel, if it required to be used in normal diesel engine. As a result, biodiesel blends can be used in diesel engines without any major modification. Many researchers have indicated that the biodiesel is quite close to diesel fuel. Indeed, biodiesel could be produced from vegetable oils and animal fats as well. Moreover, almost biodiesel is produced from rapeseed oil and waste cooking oil

[10]. Indeed, it is quite important to use low cost feedstock to reduce the production cost of the biodiesel. Moreover, the use of vegetable oil leads to shortage of food while use of animal fat for human consumption is a health hazard [9]. Biodiesel could be produced by transesterification reaction that is a three step reaction which converts the initial triglycerides into a mixture of fatty acid methyl ester and glycerol in the presence of a catalyst usually homogeneous or heterogeneous [6]. Indeed, there are many catalysts can be used for this purpose for example, alcohol such as, ethanol. Theses catalysts can be used in the transesterification reaction [8]. Furthermore, other types could be utilized in this reaction for example, sulphuric acid, hydrochloric acid and sodium hydroxide [7].

Figure 1: Wild rapeseed flower in Kurdistan Region of Iraq.

II. Research methodology

The rapeseed oil obtained at a local market at Koya city in Iraqi Kurdistan region. Hence, it is quite important to determine the free fatty acid (FFA) of the oil in order to use the accurate catalyst amount at the transesterification reaction. Furthermore, the free fatty acid (FFA) has been determined and found to be less than 2%. Hence, alkali was used for the transesterification of rapeseed oil. Moreover, the experiment has accomplished in a laboratory that utilized a 250ml flasks. The flasks were kept in a water bath maintained at 60°C. This temperature keeps the methanol below its boiling point temperature. Alkali transesterification reaction has been adopted to produce the biodiesel from the oil. The calculated amount of KOH has been dissolved with the needed amount of methanol. This liquid has been poured into the oil in a specific flask. The reaction has been done at 60°C and for 30 min at 700 rpm and figure (2) shows the hotplate magnetic stirrer that been used in the production process. After the reaction was completed for oil, the reaction mixture was allowed to be separated into two layers by using a separator funnel and figure (3) shows the separator funnel that been used in the experimental work. After a wile of time, two materials have been separated from each other. At the bottom of separator, a red color that content the impurities and glycerol. The esters obtained at the upper layer of the separator funnel.

Figure 2: Hotplate Stirrer used in the optimization process.

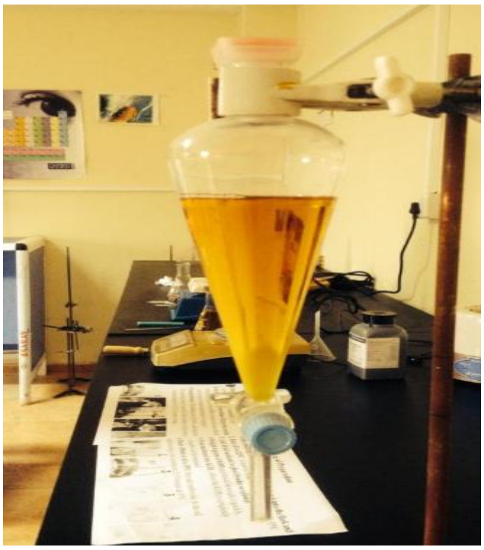

Figure 3: Separator funnel.

Table 1: Rapeseed oil Properties [8].

Property	Value	Unit
Boiling point	584	K
Flash point	546	K
Molecular weight	926	Kg/KMole
Vapor pressure at (373K)	$3.72\ 10^{-9}$	pa
Kinematic viscosity (373K)	9.35	mm^2/s

Thermal conductivity at (373K)	0.15	W/m.K^2
Density (373K)	778	Kg/m^3
H:C Ratio	1.81	-

III. Results and discussion

As it has been stated earlier, biodiesel has been successfully produced by adopting transesterification reaction. The produced biodiesel has been subjected to several laboratory tests for example, density, viscosity and flash point. Table 2 shows some of produced biodiesel properties.

Table 2: The produced biodiesel properties.

Property	Produced biodiesel	Biodiesel specification EN 14214
Density (kg/L)	0.881	0.86-0.9
Viscosity cSt	4	3.5-5
Flash point °C	143	>110
Cetan number	52	>51

The production process optimization is applied for several process parameters for example, reaction temperature and catalyst amount. Firstly, the study is investigated in the effects of catalyst concentration and reaction time. Indeed, the catalyst type and catalyst concentration have significant effect on the transesterification reaction [10].Moreover, this study has considered the relationship between the biodiesel yield % and the reaction time at several KOH catalyst concentrations for example, 0.5, 1.25 and 2 %. Moreover, all the reaction at versus catalyst concentration has been ruined at 7:1 methanol: oil ratio, 60 ºC reaction temperature and 700 rpm agitation speed. Figure (4) shows the relationship between biodiesel yield % and the transfication reaction time at versus KOH concentrations. It seems that the utilizing KOH about 1.25% will produce the optimum biodiesel yield about 96%. Furthermore, the other KOH concentrations are also produce considerable amounts of biodiesel at several transfication reaction times. However, it has been observed that the adopting of high KOH concentration for example, 2% or more would contribute in increasing the reaction viscosity and may lead to decrease the biodiesel yield.

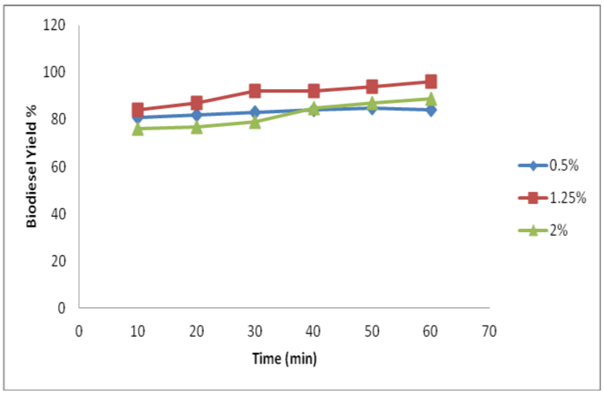

Figure 4: shows the relationship between the biodiesel yield % and the reaction time at several KOH catalyst concentrations.

This research is also studies the impact of alcohol: oil molar ratio and reaction time. Moreover, the relationship between the biodiesel yield and the reaction time has been studied at several methanol: Oil ratio for instance, 4:1, 5:1 and 7:1. The reaction has been maintained at 700 rpm agitation rate and 60 °C reaction temperature. Additionally, 1.25 % KOH has been adopted. Figure (5) shows the relationship between biodiesel yield % and reaction time for several methanol: oil ratios. It seems that the methanol: oil ratio has quite strong effects of the biodiesel yield. Indeed, the optimum biodiesel yield has been achieved in this optimization process is (96%) of biodiesel at methanol: oil molar ratio about 7: 1 and reaction time about one hour. Furthermore, the other methanol: oil rations such as, 4:1 and 5:1 have produced considerable amounts of biodiesel for example, (83 and 88) % biodiesel yield at one hour reaction time.

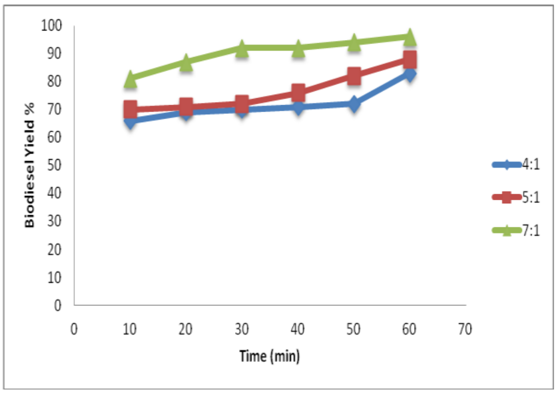

Figure 5: shows the relationship between biodiesel yield% and reaction time for several methanol: oil ration.

The study is also examined the impact of reaction temperature and reaction time. Undeniably, the alkali-catalyzed transesterification reaction temperature may possess huge rules in achieving the optimal biodiesel yield. Therefore, this research has studied the relationship between the biodiesel yield

% and the tresnsfication time at several solution temperatures for instance, 45, 55 and 60 °C. Moreover, the all treansfication reactions have been adopted at methanol: oil ration about 7:1, 700 rpm agitation and 1.25% KOH concentration. Figure (6) shows the relationship between the biodiesel yield % and the reaction time at several treansfication reaction temperatures. It seems that the optimal biodiesel yield can be achieved at 60C about 96%. . Furthermore, the lower reaction temperature such as 45C is also produce considerable amounts of biodiesel. However, it produce less amount of biodiesel that at 60C.

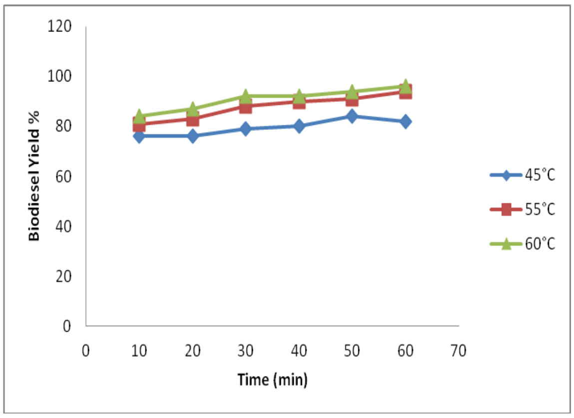

Figure 6: Shows the relationship between the biodiesel yield % and the reaction time at several treansfication reaction temperatures.

IV. CONCLUSION

In conclusion, this study is attempted to investigate and produce biodiesel from rapeseed oil. It could be argued that it is quite possible to produce biodiesel from rapeseed oil by using transesterification reaction method. It is also could be stated that the Kurdistan region of Iraq is producing enormous quantities of wild rapeseed flower at spring session in every year. Moreover, the wild rapeseed flower is growing in almost all Kurdistan region wild fields for example, Zagros Mountains, Koya and Raniyah. Furthermore, the Kurdish rapeseed flower is producing high amount of seed which contain considerable amounts of rapeseed oil. However, it is quite recommended that to achieve more studies on the Kurdish wild rapeseed flower to find out if it possible to grow it in green houses or pre-prepared environment. Therefore, it is quite recommended that utilizing the wild rapeseed flower in order to produce rapeseed oil and biodiesel. Moreover, the process optimization is also achieved for several process parameters for example, catalyst concentration & the alcohol: oil ratio. It could be argued that adopting methanol/ oil ratio about 7:1 could achieved good biodiesel yield about 96%. Moreover, it could be also argued that using 1.25 % KOH catalyst could produce considerable amount of biodiesel from rapeseed oil. It seems that the optimal biodiesel yield can be achieved at 60ºC about 96%. . Additionally, the lower reaction temperature such as 45ºC is also produce considerable amounts of biodiesel. However, it produce less amount of biodiesel that at 60ºC. However, it is also quite recommended that to achieve more studies and process optimization before installing biodiesel plant for commercial production.

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