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Optimizing the Various Parameters for Biodiesel Production by Transesterification

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Abstract **- Steep hikes of petroleum prices and rising demand of petroleum products compile the scientific society to think for the renewable alternative fuels like biodiesel. Biodiesel production is generally carried out through the process of trans-esterification reaction. The reaction is facilitated with a suitable catalyst either homogeneous or heterogeneous. The selection of appropriate catalyst depends on the amount of free fatty acids in the oil. As per the current scenario of rapid increase in the usage of automobiles, the demand for the fuel also increases drastically. In the present study the raw neem oil is converted into biodiesel by using transesterification process and to optimize the various parameters of biodiesel production.**

Key words: NeemOil, Transesterification.

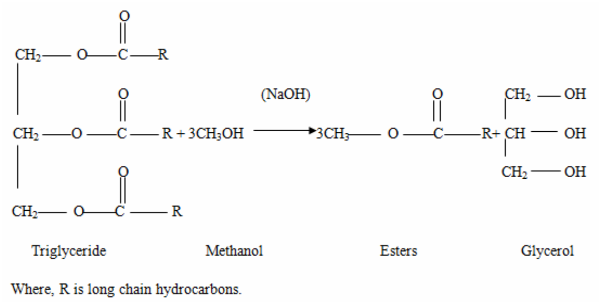
I. INTRODUCTION

Bio-diesel, which can be used as an alternative diesel fuel, is made from renewable biological sources such as vegetable oil and animal fats. It is biodegradable, non-toxic and possesses low emission profiles. Also, the uses of bio-fuels are environmentally beneficial. Chemically, bio-diesel is referred to as the mono-alkyl-esters of long-chain-fatty-acids derived from renewable lipid sources. Bio-diesel is the name for a variety of ester based oxygenated fuel from renewable biological sources. Currently, most of the biodiesel is produced from the edible/refined type oil using methanol and alkaline catalyst. However, large amount of non-edible type oils and fats are available in our country [1]. Biodiesel is a domestic fuel alternative and can contribute to a more stable supply of energy. The biodiesel fuel production process has evolved considerably to minimize the original problems with viscosity. Today, biodiesel is an increasingly attractive, non-toxic, biodegradable fossil fuel alternative that can be produced from a variety of renewable sources [2]. The Asian governments must ensure there is a system in place ensuring that the bio fuel crops are grown only in approved places and conditions. A system of continuous monitoring of production sites is also imperative to prevent serious damage to the environment. Unfortunately, in most of the countries under consideration here, such monitoring is prohibitively expensive [3]. Methanol was replaced by dimethyl carbonate for biodiesel production. In the process, fatty acid methyl ester (FAME) was produced through transesterification of soybean oil with dimethyl carbonate (DMC) using potassium methoxide as a catalyst. This method produced a more attractive by-product, glycerol carbonate (GC) [4]. The Palm fatty acid distillate biodiesel could be easily used as an alternative fuel to diesel engine. Esterification and transesterification using H_2SO_4 as acid catalyst and NaOH as base catalyst can reduce FFA about 60% to less than 0.5%. Also the reaction time of 60 min and temperature about 65°C make a simplified production system. The purification process gives a high quality palm ethyl ester biodiesel with properties close to ASTM standards [5,6]. Microwave irradiation was proved to be efficient for biodiesel production catalyzed by claimed sodium silicate. Biodiesel yields of 95.8% from rapeseed oil and 92.8% from Jatropha oil were achieved [7].

In the view points of environmental friendliness and saving cost, the advantages of the prepared Bronsted–Lewis acidic IL made it predominant to the conventional homogeneous alkaline and acidic catalysts [8]. $HClSO_3$–ZrO_2demonstrates high catalytic activity and long durability in esterification of oleic acid, in which the fatty acid methyl ester yield reaches 100% consecutively for at least 5 cycles under mild conditions[9]. Non-edible is an excellent potential to be used as an alternate feedstock for biodiesel production[10,11]. This is the time to know and prepare the bio diesel through trans esterification.

II. TRANSESTERIFICATION PROCESS

Transesterification is otherwise known as alcoholysis. It is the reaction of fat or oil with an alcohol to form esters and glycerin. A catalyst is used to improve the reaction rate and yield. Among the alcohols, methanol and ethanol are used commercially because of their low cost and their physical and chemical advantages. They quickly react with tri-glycerides and NaOH and are easily dissolved in them.



General Equation or Transesterification

III. OPTIMIZATION PARAMETERS

Optimizing parameters are classified into five parts. They are (a)Reaction time(min), (b)Temperature(^{o}c), (c)Agititation rate(rpm), (d)Alcohol quantity(ml) and (e)Amount of catalyst(% wt).

Parameters	Levels				
	1	2	3	4	5
Reaction time (min)	40	45	50	55	60
Temperature (^{o}C)	45	50	55	60	65
Agitation Rate (rpm)	300	350	400	450	500
Alcohol Quantity (ml)	19	20	21	22	23
Amount of catalyst (wt%)	0.5	0.55	0.6	0.65	0.7

Table 1

EXPERIMENTAL SETUP AND PROCEDURE

The aim of the present work was to convert neem oil into biodiesel. Hence, 100ml of neem oil is taken into the beaker and preheated upto 50^{o}C using magnetic stirrer with hot plate apparatus. The optimization parameters are shown in the table 1. Hence, base methanol 20ml was taken into the beaker and 0.55wt% of NAOH (catalyst) was added to it. And stirrer until catalyst was dissolved into the methanol. After that this mixture was added to the preheated oil slowly with continuous stirring.

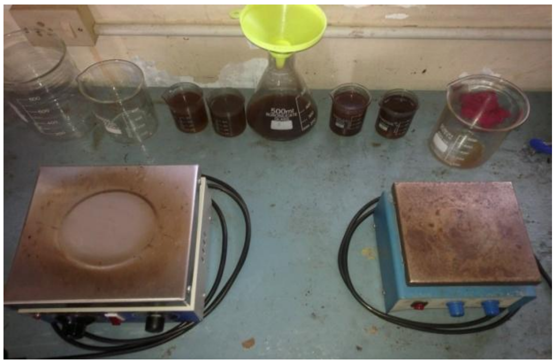


Figure 1 Magnetic stirrer

Temperature was maintained at 50°C and agitation rate was up to 350rpm. The reaction was carried out for 45min. Then process was stopped and poured into the separating flask. Kept it for 24 hours to settle down. We obtain two layers lower layer was soap (Glycerol) and upper stack was biodiesel and it was separated. The yield was measured using measuring jar. This process was carried out for other four levels with their suitable optimization parameters.

Fig 2 Biodiesel process in measuring jar

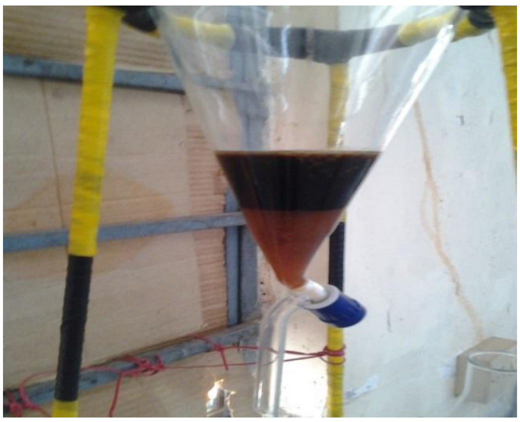


Fig 3 Biodiesel Process In Separator Flask

IV. RESULTS AND DISCUSSION

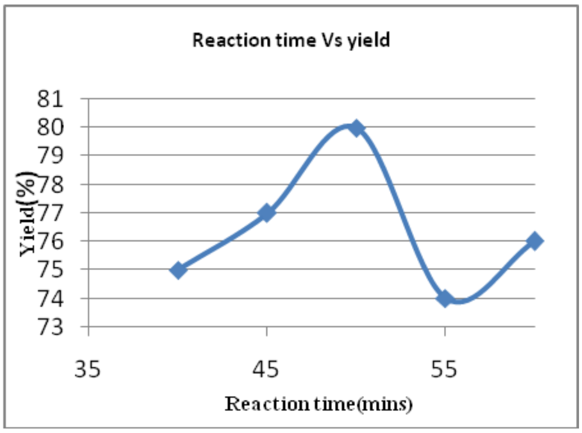


Fig 4 reaction time Vs yield

From the above graph the optimum yieldof neem oil is reach maximum at reaction time of 50mins. At this time we add 21 ml alcohol and 0.6% wt of catalyst.

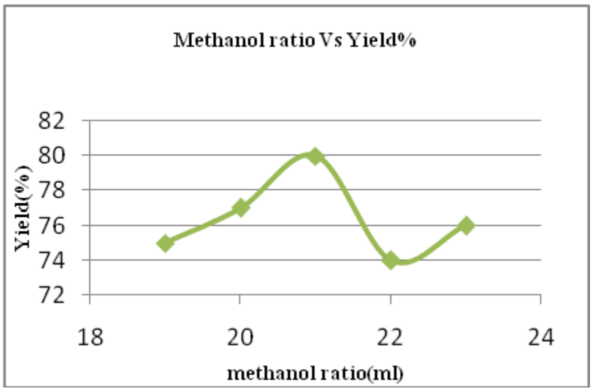


Fig 5 Methanol ratio Vs yield

From the above graph the optimum yield for neem oil is reach maximum when we add 21ml of methanol and 0.6% of catalyst

CONCLUSION

The high FFA (6%) content neem oil has been investigated for the biodiesel production The trans esterification of neem oil has been investigated for bio diesel production. The effect of molar ratio, catalyst,reaction temperature and reaction time are analyzed in each step process. The maximum yield was reached after 50 mins of reaction wit 0.6% catalyst (NAOH). This is optimum time for reached maximum yield.

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