2014 3rd International Conference on Informatics, Environment, Energy and Applications
IPCBEE vol.66 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2014. V66. 21

Study of Process Parameters of Biodisel Production from Cottonseed Oil

Ajaygiri K. Goswami[1], G. A. Usmani

University Institute Chemical Technology, North Maharashtra University, Jalgaon (M.S.), INDIA

Abstract. Cottonseed oil is one of the sources for production of Biodiesel manufacture. The present study is completely focused on the yield of biodiesel from cottonseed oil on the basis of parameters like oil alcohol ratio, concentration of catalyst and process temperature. The process is base catalyzed transesterification reaction. Here two parameters are kept constant and one parameter is increased and the degree of esterification variation is studied. In this work, oil to alcohol ratio and temperature is kept constant and catalyst concentration has been increased which results to different degree of esterification for different catalyst concentration. Similarly the process temperature & catalyst concentration kept constant and oil to alcohol ratio is increased, here too yield of biodiesel varies. The process temperature changed and remaining two parameters oil to alcohol ratio & concentration of catalyst are kept constant which gives a different yield. From the experimental studies , the optimum process conditions for transesterification of cottonseed oil has been examined which results in good yield of Biodiesel which is the best alternative fuel for petrodiesel.

Keywords - Biodiesel, Cottonseed oil, Optimization, Transesterification.

Introduction

In recent years high demands of petro-diesel because of tremendously raise in automobiles [1]. Higher price of diesel and environmental issues, the biodiesel as an alternative fuel is highly concern subject [2] The biodiesel is the requirement of country like India as an alternative fuel because the cost of Diesel is increasing day by day due to increasing the price of crude oil. The economy of the country also depends on diesel cost variation. The use of vegetable oils for frying purpose produces mainly the problem of their disposal.[3]The proper utilization of these oils is an advantageous for biodiesel production.[4].The Cottonseed oil methyl ester could be one of the good source for production of biodiesel which is an alternative fuel of diesel. In India especially in the region of Maharashtra, high yield of cottonseeds takes place. The cottonseed possesses the structure like sunflower seed having oil bearing kernel covered by tough outer hull. The oil has been extracted from kernel used to prepare cottonseed methyl ester by transesterification process [**5**]

Recently biodiesel derived from vegetable oils or animal fats is the most alternative fuel for petro-diesel, mainly due to renewable, domestic resources, better emission characteristics and biodegradable nature. The transesterification process is very common for production of biodiesel which is comparatively low cost process where methanol used in presence of alkali catalyst.

The transesterification process is also favorable presence of acid catalyst but the rate of reaction is slower therefore less attention is given to acid catalyst [**6**]. The cost of biodiesel production as compared to petrodiesel is around one and half times more which is an obstacle for commercialization which paramountly depends on the feedstock oils [**7**].

[1] Corresponding Author
Email:goswamiakg1@gmail.com, Tel. No.: +91-922694614

Methodology

The transesterification reaction is very popular one and use of vegetable oils is the best way for carrying out the reaction for the production of biodiesel [**8**]. In the laboratory, the transesterification of cottonseed oil was carried out in three neck bottom flask of capacity 500 ml. The flask contains a magnetic needle and solution mixture. This was then placed on the magnetic stirrer. The flask has three openings from which central opening for reflux condenser. The alcohol (Methanol) is volatile which is vaporized during the reaction, so reflux condenser is used to taper such that vapors return back into the flask. The second opening for thermometer is used to monitor the temperature continuously during the reaction and third for filling the reactants into the flask. Cottonseed oil in a three neck round bottom flask was taken, heated the oil at 110˚C temp. so that moisture content in it were removed, then it was cooled & filtered. In a beaker NaOH catalyst and methanol was added, shaking was done so that NaOH pellet gets mixed with the methanol and sodium methoxide is formed. Round bottom flask was kept on magnetic stirrer with needle inside it. The cottonseed oil was poured into the flask. Heating and stirring of oil was started at same time, heated up to 40˚C & sodium methoxide added into the round bottom flask by opening , stirring and heating & continuous mixing was continued for 2-3 hours at temp 60˚C. The mixture allowed settling for 24 hours at which two separate layers were obtained. Optimum conditions of the transesterification reaction results into two phases that are separated in few minutes. The top layer will be methyl ester of cottonseed oil and the bottom one of glycerol [**9**]. Using a conical separating funnel the glycerol is separated at the bottom. In a good completion reaction glycerol begins to separate immediately when stirring and heating is stopped with two layer ester and glycerol being separated by means of separating funnel. In the ester, the traces of glycerol, unreacted methanol. Soap present in these traces could be removed by adding hot distilled water [**5**]. The separation of ester requires 2-3 hrs. The methanol & soap is separated and glycerol separated as byproduct. The recovery of ester obtained is nothing but the biodiesel [**10**]

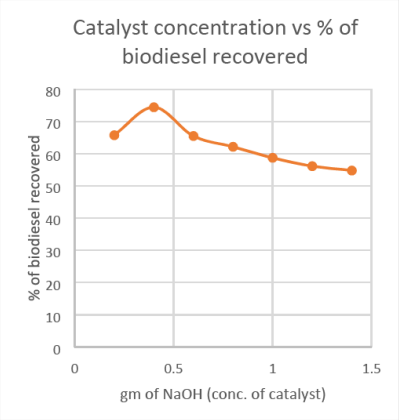
There are three basic parameters of transesterification process, temperature, catalyst concentration and oil alcohol ratio. Here two parameters kept constant and third one changed and variation in biodiesel yield was studied. So three observation tables where Oil: Methanol ratio & Temp. constant and Concentration changes, Oil: Methanol Ratio & Concentration are constant and temp changes, concentration & temp. are constant and Oil: Methanol ratio changes which results into variations in the biodiesel yield was studied in seven batches. The percentage recovery of biodiesel was studied using the amount of biodiesel obtained in grams. Present study is completely focused on the degree of transesterification of cottonseed oil by changing experimental process parameters. The main aim of this study is to maximize the yield of methyl ester with optimum process parameter.

Result and Discussion

1. Oil: Methanol ratio & temperature are constant and catalyst concentration changes-

Fresh cottonseed oil was used to prepare biodiesel by transesterification process. 300 gram of total mixture of oil and methanol was taken in seven batches in which Oil: Methanol Ratio was taken 1:6 & Temperature 65 ℃, both were constant and concentration of catalyst NaOH increases from 0.2 gm to 1.4 gm and recovery of biodiesel was obtained for all seven batches was as follows:

Batch	gm of NaOH(Conc. Of Catalyst)	gm of Biodiesel obtained	%recovery of Biodiesel
1	0.2	169.2	65.80
2	0.4	191.5	74.47
3	0.6	168.5	65.52
4	0.8	159.9	62.18
5	1.0	151.1	58.76
6	1.2	144.5	56.19
7	1.4	141.0	54.83

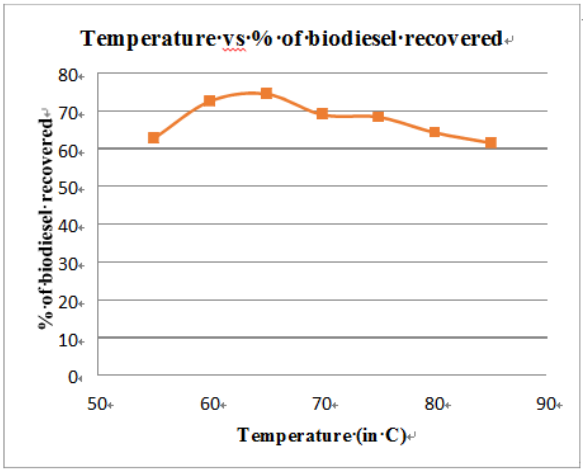


The better result obtained at catalyst concentration 0.4 gm where % Recovery of Biodiesel was found much higher

2. Oil: Methanol Ratio & concentration are constant and Temp changes:

For the value of the catalyst concentration 0.4 gm, the optimum yield was found. 300 gram of total mixture of oil and methanol was taken in seven batches. Oil: Methanol ratio was taken 1:6 & catalyst concentration was taken as 0.4gm and the temperature was varied from 55℃ to 85℃ and the biodiesel recovery was studied. The optimum result was obtained at process temperature of 65℃ where highest % Recovery of Biodiesel was obtained.

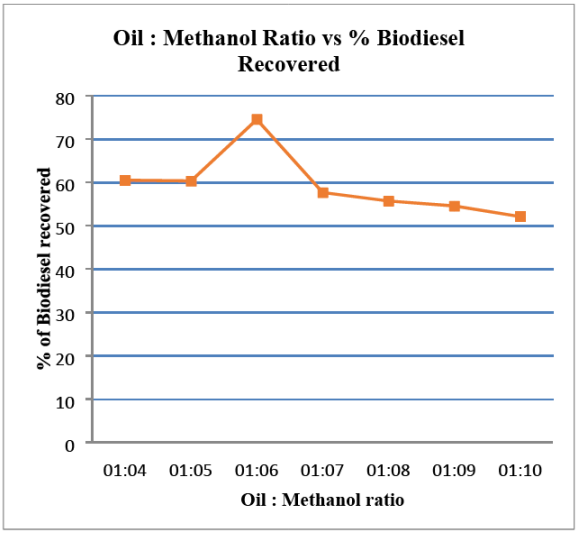
Batch	Temp. (in ℃)	gm of Biodiesel	% recovery of Biodiesel
1	55	161.2	62.68
2	60	186.5	72.52
3	65	191.5	74.47
4	70	177.5	69.02
5	75	175.8	68.36
6	80	165.3	64.28
7	85	158.2	61.52



3. Concentration & Temp are constant and Oil: Methanol ratio changes:

Biodiesel obtained from fresh cottonseed oil using transesterification process. 300 gram of total mixture of oil and methanol was taken in seven batches in which Oil: Methanol ratio was varied where optimum values of the process temperature and concentration of catalyst was taken as 65℃ and 0.4 gm respectively for analysis. But the third parameter (i.e.) Oil: Methanol Ratio was increased from 1:4 to 1:10. The results were obtained as follows:

Batch	Oil : Methanol Ratio	gm of Biodiesel obtained	% recovery of Biodiesel
1	1:4	145	60.41
2	1:5	150.6	60.24
3	1:6	191.5	74.47
4	1:7	151.2	57.6
5	1:8	148.4	55.65
6	1:9	147.1	54.48
7	1:10	142	52.06



The better result obtained at Oil: Methanol Ratio 1:6, where % Recovery of Biodiesel was found much higher.

Conclusion

The study was carried out for the preparation of cottonseed oil Biodiesel by base transesterification process in which totally focused on the increase in ester content by changing the basic process parameters. Two parameters were constant and third one varied and Biodiesel yield was analyzed. From the present study of production of methyl ester of cottonseed oil it was found that the optimum process parameters like temperature, catalyst concentration and oil alcohol ratio were 65^0C, 0.4gm & 1:6 respectively for better yield of biodiesel.

References:

[1] K.Anbumani and Ajitpal singh (2010), "performance of mustered and neem oil blends with diesel fuel in IC engine", *ARPN Journal of Engineering and applied sciences*, vol.5, 40, pp. 1819-6608.

[2] S.S.Ragit et. al (2011), "optimization of neem methyl ester from transesterification process and fuel characterization as diesel substitute", *Biomass and bioenergy*, vol 35, pp. 1138-1144.

[3] M.Thirumarimurugan, V.M.Sivakumar, A.Merly Xavier,D.Prabhakaran and T.Kannadasan, "Preparation of biodiesel from sunflower oil by transesterification'', International journal of bioscience, Biochemistry and Bioinformatics, vol 2,no.6,nov.2012,pp441-444.

[4] K.Kalisanni,K.Khalizani,M.S.Rohini, "Analysis of Waste Cooking Oil Raw Material for Biofuel Production" (2008)pp. 82-83.

[5] T.Sathya and A.Manivannan, (May-June 2013), "Biodiesel production from neem oil using two step transesterification", *vol3, issue3*, pp. 488-492.

[6] Y.Zhang, M.A.Dube, D.D.McLean and M.Kates (2003), "Biodiesel production from waste cooking Oil its Economic assessment and sensitivity analysis", *Bioresource Technology* 90, pp. 229-240.

[7] Prokop.T (2002), "Personal communication, Imperical western products", *14970, Chandler St.Coachella, CA91720*

[8] F.Ma and M.A.Hanna (1999), "Biodiesel production: a review", *Biosource Technology*, 70, pp. 1-15.

[9] Traik M. Labib, S.I. Hawash, K.M. El-Khatib, Abbas M. Sharaky, G.I. El-Diwani and E. Abdel Kader (2013), "Kinetic Study and techno-economic indicators for base catalyzed transeserification of Jatropha Oil", *Egyptian Journal of Petroleum*, pp. 9 - 16.

[10] Wanodya Asri Kawentar and Arief Budiman (2013), "Synthesis of Biodiesel from second_used cooking oil",
International Conference on Sustainable Energy Engineering and Application, pp. 190 – 199.