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Biodiesel Production from Waste Cooking Oil Using Co-solvent Technique

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Abstract: Biodiesel is a mixture of mono-alkyl esters of long chain fatty acids derived from a renewable lipid feedstock. It can be used as an alternative fuel as the fossil fuels are getting depleted tremendously. In current scenario, in spite of fulfilling energy demand, use of biodiesel leads to the substantial reduction in the pollution caused by PM, HC and CO. Current study mainly focused on production of biodiesel from waste cooking oil using alkaline catalysts NAOH and KOH and co-solvent acetone in the presence of methanol. Waste cooking oil is used because of its high oil content and abundant availability. We have employed co-solvent method to produce biodiesel.
Keywords: waste cooking oil, acetone, biodiesel, catalyst, optimization

I. INTRODUCTION

Biodiesel is an alternative fuel derived from vegetable oil or animal fat. It is obtained from renewable raw materials. It has various advantages. The emission profile of biodiesel is satisfactory and it is biodegradable. It is an ecological fuel and is not dangerous merchandise [4]. The feedstock we use is the waste cooking oil because of its abundant availability and high oil content. Acetone is used as the co-solvent. It is a colorless, mobile, flammable liquid. The feedstock is comprised of recycled oil and grease from restaurants and food processing plants [1]. NAOH and KOH are used as catalysts in the presence of methanol. The method we use to produce biodiesel is co-solvent method. The relevance of using a co -solvent for the production of biodiesel is studied and its effect in the reaction time, reaction temperature and yield of biodiesel [2]. The produced biodiesel from waste cooking oil are checked with the ASTM Standards to clarify the quality of biodiesel obtained in the experiment.

II. MATERIALS AND METHODS

A. The materials used for the production of biodiesel:

1) Waste cooking oil
2) KOH and NAOH
3) Methanol
4) Acetone

B. The method used for production is co-solvent method:

1) Experimental methodology

*a) Test A:*Take 100 ml of oil in preprocessed stage. Add 10 ml of methanol and 1gm of NAOH and maintain the mixture in magnetic stirrer under a temperature of 65°C for 60 min. Separate the product using separating funnel.

*b) Test B:*Take 100 ml of preprocessed oil. Add 10 ml of methanol and 1gm of NAOH and 1 ml of acetone keep the mixture in magnetic stirrer under a temperature 75 °C for 120 min. Separate the product using separating funnel.

*c) Test C:*Take 100 ml of preprocessed oil. Add 10 ml of methanol and 1gm of KOH and keep the mixture in magnetic stirrer under a temperature of 65 °C for 60 min. Separate the product using separating funnel.

*d) Test D:*To 100 ml of preprocessed oil taken, add 10 ml of methanol and 1gm of KOH and 1 ml of acetone keep the mixture in magnetic stirrer under a temperature 75 °C for 120 min. separate the product using separating funnel. Biodiesel is obtained from all the tests and filter it from glycerol using a separating funnel and wash it to obtain the pure biodiesel [3].The biodiesel obtained is undergone through a several processes to test its quality like cloud point, flash point, fire point etc.

The results were analyzed with the ASTM Standards as follows:

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S.No	Property	units	Petro-diesel	Waste cooking oil methyl ester	ASTM(Biodiesel)
1	Density	Kg/m^3	832	890	890-970
2	Fire Point	℃	72	162	138 min
3	Flash Point	°C	66	158	130 min

Table 1: ASTM Standards and properties [1]

III. RESULTS& DISCUSSIONS

S.No	Catalyst used	Catalyst Concentration(Wt. %)	Reaction Time(min.)	Reaction Temperature (°C)	Co-solvent to oil molar ratio	Biodiesel yield (Vol%)
1	NAOH	5	60	65	-	83
2	NAOH	10	120	75	1	91
3	KOH	5	60	65	-	81
4	KOH	10	120	75	1	94

Table 2: Factorial design for optimization of biodiesel

From the results obtained, it was observed that using acetone as the co –solvent, reduction in the reaction time and temperature to yield almost the same volume percentage of biodiesel obtained from normal conditions (Table 2). The properties of biodiesel obtained are checked with the ASTM Standards (Table 1) and was in par with the standard values.

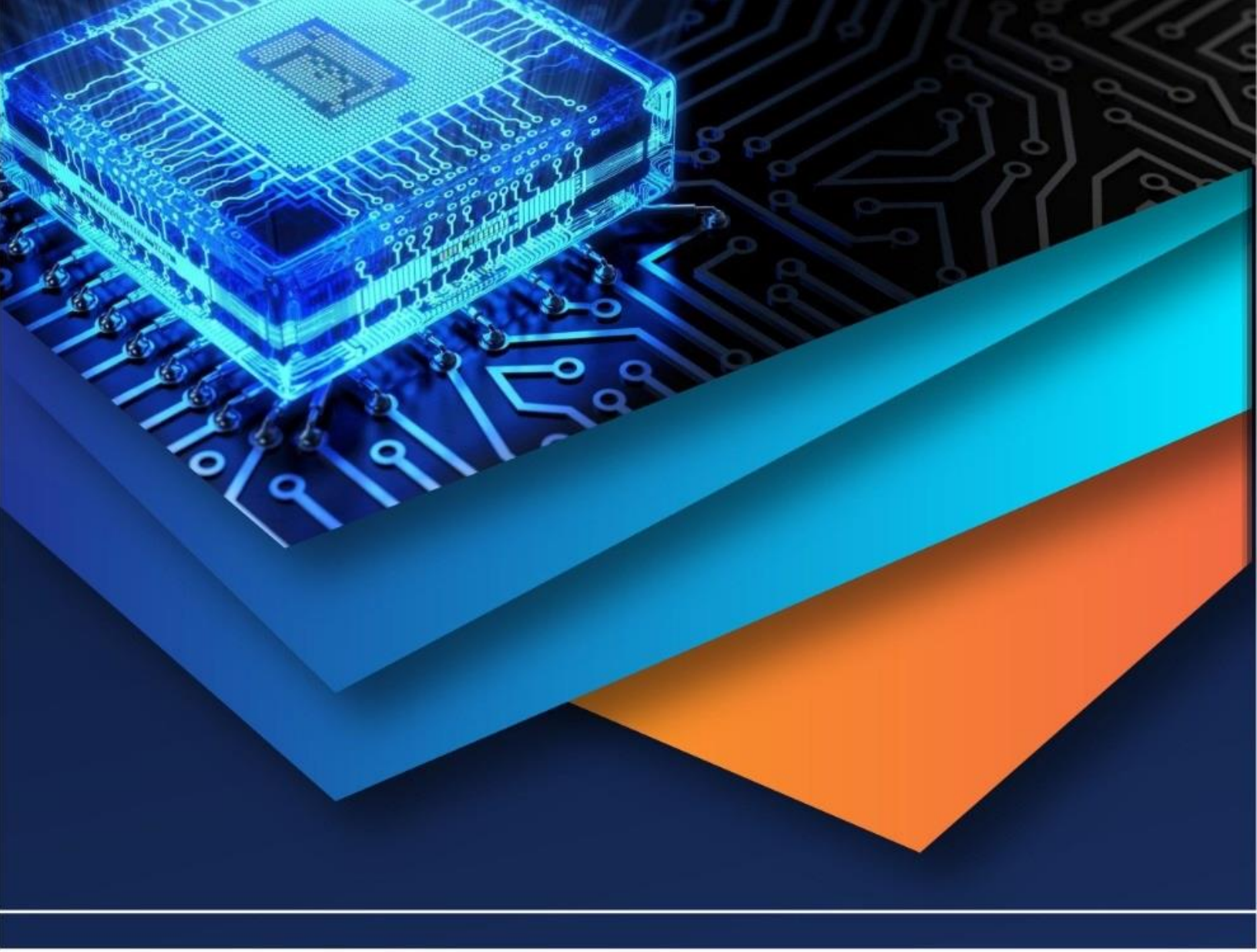
IV. CONCLUSION

The presence of co-solvent makes the system homogeneous. Eventually the co-solvent consumed for high yield is very less and the reaction temperature is subsequently reduced. Hence, this method is a can be used for the production of high yield biodiesel. The biodiesel obtained from this method is of good quality. It can be used in its pure form or can be blended with petroleum for commercial uses. The most important factor is the method considered to be very cost-effective method.

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