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BIO-DIESEL PRODUCTION FROM MACRO ALGAE AS A BIOFUEL FOR DIESEL ENGINE

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Abstract: because of its eco-friendly nature, non-toxic characteristics, biodegradability and lower net carbon cycle compared to standard diesel fuels. In this paper, Biodiesel was produced from oil extracted from potential algal species Enteromorpha, collected from Vadodara, India. The effect of factors such as solvents, reaction conditions and reaction time on biodiesel production were also studied. The produced biodiesel was also characterized.

Keywords: *Algal oil, Biodiesel, Renewable energy, Biodiesel, Triglycerides, Trans-esterification*

I INTRODUCTION

Fossil fuel reserve is declining and they are harmful for environment. Thus, it becomes essential to find alternative sources of energy. Currently, biodiesel has gained much attention as one of the best alternative source of energy due to its non- toxic nature compare to normal diesel. A number of studies have shown that we can obtain the biodiesel from waste cooking, palm, animal fat, canola, jatropha and algae. Among given species, macro algae is a good feedstock for biodiesel production of their eco-friendly nature..

II MATERIALS AND METHODS

2.1 Material:

Macro algae (collected from a lake behind Parul University, Limda, Vadodara, Gujarat, India), Methanol, n-Hexane and Diethyl ether (laboratory grade), Sulfuric acid and Potassium hydroxide were purchased from different venders.

2.2 Oil extraction from algae sample

Fresh macroalgae water collected and washed twice with water. The algal biomass was dried in sunlight for 48 hours and in hot air oven for 3 days at 800C. The dried algae sample was then grinded in to fine powder by using mortar pastel for effective solvent extraction.

Figure 1.Powdered Algae

In round bottom flask, Macro algae powder was mixed with different solvents at different temperatures for 24h to extract oil from the algae powder. Experimental details are given in Table-1 below:

Experiment	Macro algae (g)	n-Hexane (ml)	Diethyl ether (ml)	Time	Oil extraction (ml)
A	50	100	0	24h	23
B	50	0	100	24h	27
C	50	50	50	24h	30

Table 1.Oil extracted from Algae powder

After completion of the reaction, the residue was filtered through simple filtration. The solvent is then removed through simple distillation to collect algae oil from the filtrate.

2.3 Trans-esterification

In a beaker, 1gm of KOH was mixed with 40ml of methanol and stirred properly for 20 min to produce methoxide ion. The methoxide was then poured into the algae oil in a conical flask under stirring. The reaction mixture is then heated to 40 C. Experimental details are given in Table-2 below:

Sample	Algae oil (ml)	Methanol(ml)	KOH (gm.)	Temp (˚C)	Time (min)	Biodiesel (ml)
A	23	40	1	30-40	20	13
B	**27**	**40**	**1**	**30-40**	**20**	**15**
C	**30**	**40**	**1**	**30-40**	**20**	**19**

Table 2. Biodiesel production

After completion of the reaction, the solution was kept for 16h for clear separation of bio-diesel. The layers were then separated and biodiesel layer was washed with hot distilled water repeatedly to remove the unreacted components. The pure biodiesel was dried by heating gently in order to remove the smaller particle of water.

III RESULTS AND DISCUSSION

3.1 Extraction of oil from algal biomass

3.1.1 Effect of solvent to algae ratio

The effect of solvent to algae ratio on percent yield of extracted oil is shown in Figure. 2. It was observed that the percent yield of oil increases with increase in the amount of solvent. The excess solvent can extract more oil from the algal bio mass.

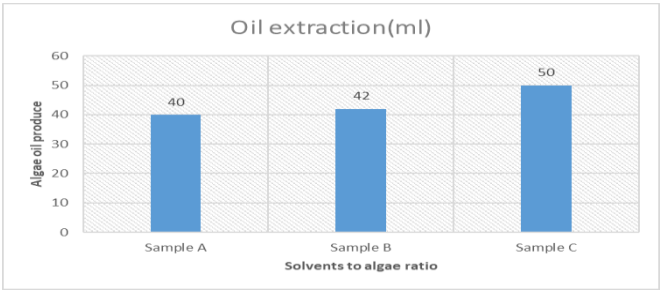

Figure 2.Effect of solvent to algae ratio on the extracted oil yield

3.1.1 Effect of the algal biomass size

With decrease in the size of algae biomass, the amount of oil extracted increases. The smaller particles of algae biomass provides larger surface area for interaction between the algae species and solvent and ultimately, increase the yield of oil extracted.

3.1.2 Effect of contact time

With increase in the contact time between solvent and biomass, the amount of oil extracted increases. The contact time facilitates the interaction between solvent and biomass for longer period. Therefore, oil is extracted from all portions of the algae specie.

3.2 Trans-esterification reaction

3.2.1 Effect of molar ratio of oil to methanol

The yield of biodiesel increases with increasing the ratio of oil and methanol because the reaction proceeds in forward direction due to excess reactants.

3.2.2 Effect of temperature

At higher temperature, reaction proceeds in forward direction and increases the production of biodiesel. In this study, maximum biodiesel produced at 45°C.

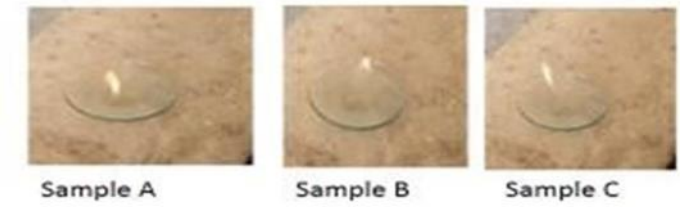

Figure 3. Effect of temperature on the amount of biodiesel produced

3.3 Test of biodiesel produce

Pictures of the flames produced by different fuel samples are presented in figure 4. Flames generated after ignition of fuel sample on watch plate.

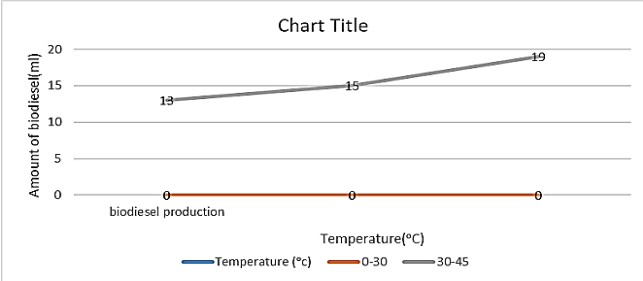

Figure 4 .Ignition Test

IV CONCLUSION

The marine macro algae was selected and used as a raw material for biodiesel production. The production of biodiesel from the selected macro algae species was done in two steps. In the first step, algal oil was extracted with optimization study of the different solvents. The algal oil was treated by the acid esterification process to reduce the acid value and make it suitable for the second step (trans-esterification process). During the second step, the pre- treated algal oil was converted into biodiesel by the trans-esterification reaction using base catalyst. The produced biodiesel was confirmed, tested and analyzed according to international standard specifications of diesel. Both two-step methods were determined as efficient method to convert high FFA content feedstock into biodiesel. From this investigation, it has been proven that macro algae could be used as a potential source to produce biodiesel.

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