Biodiesel from Waste Vegetable Oil- A Study on Production and Performance

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Abstract - Biodiesel production is an initiative that uses waste vegetable oil (WVO) from the college food services to produce a clean-burning. The primary aim of this project is to avoid the reuse of vegetable oil which is a carcinogen and to produce biodiesel which will power the vehicles. Creating biodiesel from waste oil makes use of existing waste oil and also reducing the consumption of non-renewable petroleum diesel. Biodiesel use improves air quality by producing a drastically lower amount of soot, diesel particulate matter, carbon monoxide and other elements that are produced by petroleum diesel. During this process, WVO is mixed with a methanol and KOH solution. The lye used is and it acts as a catalyst for the reaction. The biodiesel reactor is charged with these ingredients and the reaction parameters are set, i.e., 650C and 200 rpm agitation speed. The biodiesel produced is checked for its quality and sent for running generator or vehicles.

Keywords: Biodiesel, WVO, carcinogenic, non-renewable

I. INTRODUCTION

Bio-diesel is one of the most promising alternate fuel. It is produced from vegetable oil using fairly simple chemistry. Pure vegetable oil works well as a fuel for Diesel engines itself. However, vegetable oil is inherently viscous and cannot be burned efficiently at ambient temperatures in modern over-the-road vehicles. Conversion to Biodiesel has many advantages as it readily mixes with petroleum diesel fuel in any ratio , can be used in modern diesel engines with little or no modification , also restores lubricity of low-sulfur diesel fuel by mixing as little as 1% biodiesel . Bio diesel reduces the emissions of Sulfur dioxide by 100%, Soot emissions by 40-60%, Carbon monoxide by 10-50%, Hydrocarbons by 10-50%, Nitrous oxide by 5-10%, depending on engine tuning and the age of the engine. Therefore it is advisable to produce biodiesel from low cost materials like waste vegetable oil.

The primary aim of this project is to avoid the over use of vegetable oil which is a carcinogen and to produce biodiesel which will power the vehicles. Creating biodiesel from waste oil makes use of existing waste oil and also reducing the consumption of non-renewable petroleum diesel. Biodiesel use improves air quality by producing a drastically lower amount of soot, diesel particulate matter, carbon monoxide and other elements that are produced by petroleum diesel. During production process, WVO is mixed with a methanol and KOH solution. The lye used is and it acts as a catalyst for the reaction. The biodiesel reactor is charged with these ingredients and the reaction parameters are set, i.e., 65^0C and 200 rpm agitation speed. All the reaction conditions and concentrations are being optimized.

II. METHODOLOGY

A. *Optimization of process parameters*

1. *Determination of reaction time*

Filled the reactor vessel with 1.5L of oil. Heated the oil in the vessel to appropriate temperature. Poured 330 ml of methoxide mixture (330ml methanol+3.75g NaOH) into the reactor vessel. Collected samples from the reactor at regular intervals of time. Amount of the biodiesel produced is noted till it becomes constant. Time to get the constant weight is noted.

2. *Optimization of reaction temperature*
   By fixing the amount of catalyst and reaction time from the previous experiments, found the optimum temperature for the reaction
3. *Optimization of agitation speed*
   Agitation is an important parameter in the biodiesel production. It ensures the proper mixing the reactants. Moreover, optimizing the agitation rate helps to reduce the power consumption. In this study, the parameters-catalyst concentration, reaction time and temperature are kept constant.
4. *Optimization of catalyst requirement*
   The amount of catalyst required plays a vital role in the biodiesel production, inadequate catalyst makes the reaction very slow and too much of it causes the oil to saponify. Therefore, an optimum amount of catalyst has to be taken to carry out a biodiesel reaction.In this study, graded amount of NaOH (by weight) were taken to determine the optimum amount.

B. *Process flow chart*

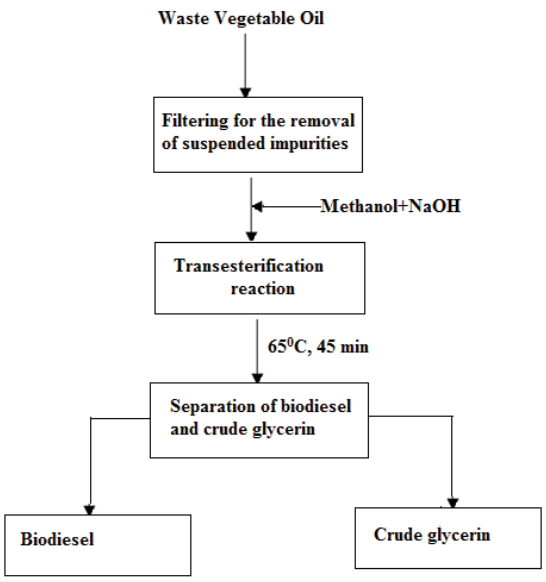

Figure 2.1. Process flow for Biodiesel process

C. *Analysis of the biodiesel sample*

The biodiesel thus produced is tested for its quality. The parameters affecting the quality of biodiesel analysed are Colour, pH, Density, Viscosity, Flash and Fire point . Also the performance of biodiesel blends (2:3, 2:6 and 2:8) were compared with that of petroleum diesel. Load test on low speed single cylinder diesel engine is being carried out.

III. RESULTS AND DISCUSSION

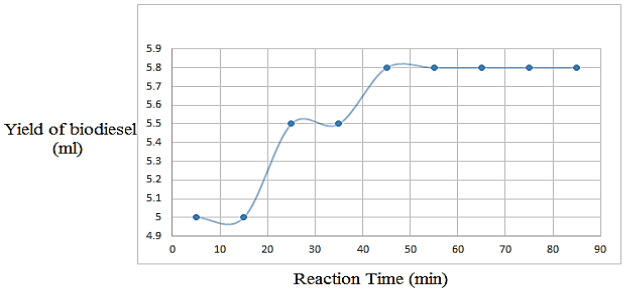

Fig 3.1. Graph showing Yield of biodiesel vs. Weight of NaOH

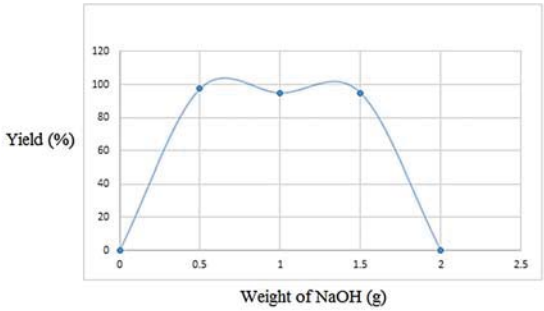

Fig. 3.2. Graph showing yield of biodiesel vs. time

The NaOH at different concentration were tested for yield. From the fig3.1 it is evident that maximum yield occurred at 0.5g/1000ml and after 1.5g/1000ml the reaction drastically reduces, hence the optimum catalyst concentration is 0.5g/1000ml of oil. The Fig 3.2 shows the yield at different time intervals. Yield is found to be constant after 45 minutes.

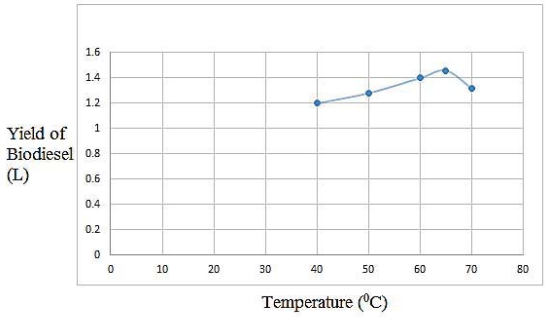

fig3.3. Optimization of reaction temperature

Yield study conducted for different temperatures and is shown in fig 3.3. The optimum temperature for the biodiesel production is found to be 65^{0}C. Agitator speed is important regarding the economy. Biomass yield with different speeds are studied , fig3.4 shows optimum speed as 200rpm.

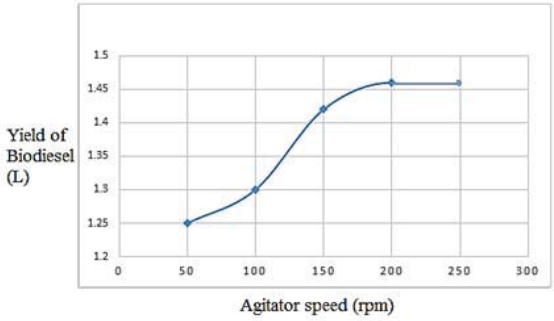

Fig.3.4. Graph showing yield of biodiesel vs. agitator speed

Table. 3.5. Optimum process parameters

PARAMETER	VALUE
Reaction time	45 min
Reaction Temp	65^0C
Agitator speed	200 rpm
Catalyst conc.	0.5g/1000ml

The properties of Biodiesel obtained are listed in Table 3.1 below.

Table.3.1 Properties of biodiesel

PROPERTY	OBSERVATION
Colour	Golden yellow
pH	7
Density	0.8713g/cc
Viscosity	7.023 cp
Flash point	140^0C
Fire Point	150^0C

In the performance study, biodiesel blends (2:3, 2:6 and 2:8) efficiency were compared with that of petroleum diesel. Load Test on Slow Speed Single Cylinder Diesel Engine were conducted in Kirloskar make 4 stroke, single cylinder, and vertical, water cooled, hand cranking type governor controlled diesel engine. The loading device is cast iron drum with spring balance and belt drive.

Performance of biodiesel blends in IC engines is shown in fig. 3.5.

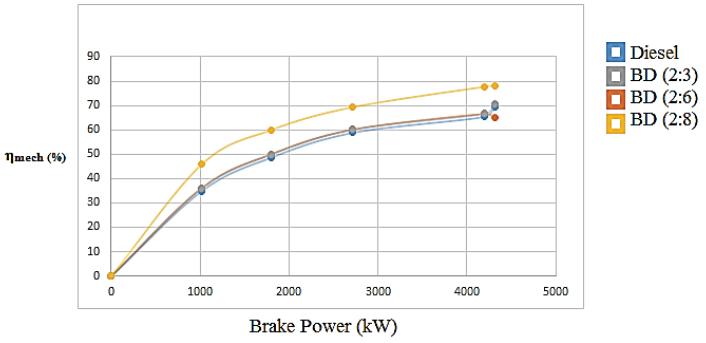

Fig.3.5. Mechanical efficiency vs. Brake power

Itis clear that the biodiesel blend 2:8 has the maximum efficiency. The blend 2:6 shows almost the same performance as that of petroleum diesel. The performance of blend 2:3 was almost comparable to that of petroleum diesel but it reduced at maximum load conditions. Therefore, 2:8 is the most suitable biodiesel blend which can be used in a diesel engine without any modification.

IV.CONCLUSION

Biodiesel can be used as an alternate fuel in diesel engines either blended with petroleum diesel or in pure form. The high flash and fire point (140^0C and 150^0C respectively) results in poor combustion of fuel in the engines. The shortcomings of biodiesel can be overcome by blending biodiesel with petroleum diesel. The blended biodiesel has greater efficiency compared to diesel. The biodiesel blend 2:8 has a mechanical efficiency of 78% while the petroleum diesel has only 69% efficiency. Thus, blend in the ratio 2:8 drastically increases the engine performance.

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