PRODUCTION AND CHARACTERIZATION OF BIODIESEL FROM MICRO ALGAE

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Abstract— **The present work for the production of biodiesel from fresh water green algae Oedogoniumcapillare. The algae oil obtained from Oedogoniumcapillare was 38% from dry biomass algae by using h-hexane as solvent extractor, the algae oil was converted into biodiesel and the percentage yield of the biodiesel obtained from the Oedogoniumcapillare oil was 80% in the course of research. The biodiesel was almost neutral, natural in nature because the pH was 7.1 Oedogoniumcapillare can serve as the high source of energy and considerable amount of biodiesel can be produced. environmental concern has increased significantly in the world over the past decade. A constant demand of motor and power generation fuel rising worldwide together with environmental concern has made us to turn on towards alternative fuels than fossil fuels which can be reduced total CO2 emission. Oedogoniumcapillare can produce biodiesel which is biodegradable in nature and produced less NOx emission. Increasing in the number of populations, standard of living, advantage technology and economics growth across the world has caused energy depletion. Algae have high potential as an alternative source therefore, lipids-secreting micro algae are favorable alternative for the production of biofuel as a renewable energy.**

Keywords—Production, Algae, Oedogonium capillare, Algal Oil, Biodiesel, Energy

I. INTRODUCTION

Most of the energy consumed worldwide, except from nuclear and hydroelectricity, is from coal and petroleum and natural gas. It is well known that these sources are well limited and will exhausted in long term. Microalgae biofuel are renewable and protentional inexhaustible source of energy. The requirement of energy is increasingly continuously because of increase in population, standard of living and industrialization. The major source of greenhouse gas is petroleum diesel. NOX, SOX, CO, particulate matter and volatile organic compounds is also a major source of pollution.

Figure 1: Extraction of Biofuel

Excessive use of fossil fuels has led to global environmental degradation effects and some of them are greenhouse effects, acid rain, ozone depletion, climate change and many more like them made us to turn over in search of natural and pollution free alternative such as biofuels. Internal combustion engine is primary source of power source for almost all modes of power requirement such as farm equipment, construction industry and mobile power plant units and all such because of its outstanding fuel economy and efficiency at the same time with a very low maintenance cost, the diesel engine has become dominant in the transportation field. Dwindling fuel reserves and increasing use of diesel engine emphasis the need for alternative fuels. avoid variety of similar mass feedstock have been identified as suitable option for future source of biofuel production such as corn, cotton, soya bean, soya, sunflower, jatropa and many more. Recently, the microalgae also been considered as important role as a group that might play an important role and environmental protection in future. biodiesel are biodegradable and nontoxic alternative that is obtained from renewable source.

II. LITERATURE SURVEY

The rapid increase in population and growth in industrialization has led to a much-increased global energy demand which has generated a large increase in the use of fossil fuels. According to the United States Energy Information Administration (EIA), the consumption of global energy in the last 20 years has increased from 355 Quadrillon British Thermal Units (QBTU) in 1990 to 510 QBTU in 2010 which is about a 44% increase. The EIA predict that a further 60% increase will take place over the next 20 years (Energy Information Administration, 2005). Most of the energy demand is met from the burning of fossil fuels (petroleum, natural gas and coal) which are easy to use, provide high energy density and are cheap when compared to alternative energy sources. However, the continued use of fossil fuels is inadvisable, because of the acceleration of the accumulation of greenhouse gases (GHG), increases in air pollution and the production of acid rain. Also, the depletion of fossil fuels resources will make their use non-sustainable in the long term (Hook and Tang, 2013). Therefore, a large amount of research has been carried out with the goal of finding new renewable energy sources that are sustainable and environmentally friendly. Among the alternatives, wind energy, solar energy, geothermal energy, hydroelectric energy and biofuels have attracted significant amounts of research and exploitation. First generation biofuels are produced from food crops or other plants that require good quality arable land and plenty of freshwater (Kikuchi et al., 2009). This has resulted in a food versus fuel debate which has limited the ability of first-generation feedstocks to meet the demand for the production of biofuels. In addition, the Net Energy Balance (NEB) for corn bioethanol and soybean biodiesel is very small (i.e. only slightly more energy is yielded from the bioethanol/biodiesel than was used to produce it) (Hill et al., 2006). Second generation biofuels are based on so-3 called energy crops (Miscanthus or Switchgrass), which can grow on marginal land or agricultural wastes left after cropping can be used. The main problem with second generation feedstocks is the difficulty in extracting the lignocellulosic substrates, which make up the bulk of the carbon sources in grasses and agricultural waste like straw (Himmel et al., 2007; Sousa et al., 2009). The possibilities of developing a new generation of biofuels have increased since the first generation of biofuels run into the problems outlined above. Therefore, there is a growing interest in third generation biofuels using microalgae as the feedstock. Microalgae can be grown in saline water or wastewater and do not compete for arable land and precious freshwater (Gilmour and Zimmerman, 2012). As a result of continuous and increasing burning of fossil carbon, the amount of greenhouse gas CO2 in the atmosphere has increased. Algae are very efficient at taking up CO2 from the atmosphere and converting it into organic compounds through the process of photosynthesis. In fact, microalgae can be used to utilise the CO2 directly from flue gases from steelworks or other industries (Zimmerman et al., 2011). Algal biomass can be used in a number of ways to produce biofuels, but the most likely possibility is using microalgae that produce high levels of neutral lipids (triacylglycerol, TAG) as a basis for biodiesel production (Chisti, 2008). Many microalgae, including Dunaliella, Chlorella, Nannochloropsis and Tetraselmis can produce high levels of neutral lipids and can be grown in saline media (Chisti, 2008). The key breakthroughs required to make algal biodiesel a commercial reality are: a) finding a highly productive strain that will produce high levels of neutral lipid during growth and not just in stationary phase, b) finding a good method to harvest small microalga cells efficiently and c) efficient recovery of the lipids from the algal cells (Gilmour and Zimmerman, 2012). One key idea is 4 the formation of an ―algal biorefinery" which will utilise microalga biomass to produce biodiesel, protein for animal feed, health supplements and fertilizer (Chisti, 2008).

III. MATERIAL & METHODOLOGY

A. PROCESSING STAGE

The processing stage consists of a reactor tank, which is used for both esterification and transesterification reactions based on Free Fatty Acid (FFA) content. The reactor is tall and narrow with a conical bottom to ensure gravity separation. The reactor consists of Inlet, Outlet, Connections to condenser and a stirring mechanism.

Sequence of Operation:

- Used Algae oil is pumped into the reactor.
- Mixed methoxide is added to reactor from tank A. Methoxide is automatically pumped based on the quantity of oil loaded to reactor. The reactor is operated for 90 mins at 60^{0}C. After the completion of 90 mins reactor power supply is cut of automatically so that separating of glycerol starts. After 20 mins of separating an alarm is given by the equipment, so that the operator can separate the triglycerides and glycerol, the separated Triglycerides is fed back to the reactor for methanol recovery.

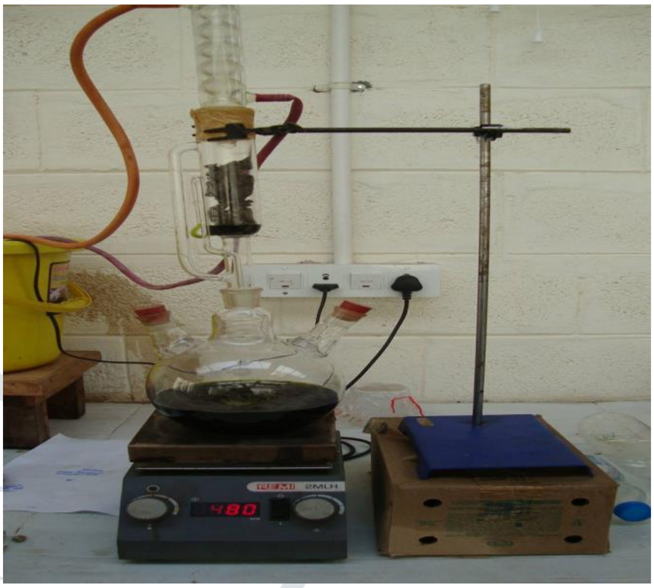

Figure 2: Soxhlet Extraction

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Figure 3: Algae harvesting

B. METHANOL RECAPTURE

Given the relatively low boiling point of methanol, it is possible to recapture the methanol via a simple still. The mix of methanol and triglycerides, still liquid following the reaction stage, can be heated to vaporize the methanol. These vapours can then be condensed and recycled, maximizing use, reducing waste, and lowering overall processing cost.

Figure 4: Distillation process

C. WASHING STAGE

The most commonly recommended method of washing biodiesel is aeration, whereby air is bubbled through layers of water and biodiesel. The bubbles rising into the biodiesel carry with them a thin film of water. The biodiesel contaminants dissolve in the water. When the bubble bursts, this water falls out of the biodiesel layer and returns to the water layer, bringing the contaminants with it. This method yields a very high water-biodiesel surface area and minimizes the risk of emulsification.

Figure 5: Washing process

IV. RESULTS AND DISCUSSIONS:

The Oil yield was 38% and biodiesel conversion 80%. Table 1 shows that the fatty acid profile of Algae oil. The summary of the fatty acids in the oil were as follows; total saturated fatty acids was 22.56%, while the total unsaturated fatty acid was 71.73%, 3.46% were the percentage of fatty acid undetected. This might be as a result of impurities present in the crude oil. Ideally the vegetable oil should have low saturated and high unsaturated fatty acids to obtain good yield and a better-quality bio diesel. It is observed that a high ratio of monounsaturated fatty acid to polyunsaturated fatty acid is desirable for biodiesel production and low concentrations of polyunsaturated fatty acid could contribute to satisfactory low temperature operability and oxidative stability.

Figure 6: Biodiesel

Sl.No	PARAMETER	RESULT	SATURATED/UN SATURATED
1	Myristic acid	3.9%	Unsaturated
2	Palmitic acid	20.76%	Saturated
3	Oleic acid	16.02%	Mono Unsaturated
4	Linoleic acid	27.81%	Poly Unsaturated
5	Lenolenic acid	24%	Poly Unsaturated
6	Palmitoleic acid	1.8%	Saturated

Table 1: GC Test Report

V.CONCLUSION

Algae has oil content of 38% and the biodiesel yield was 80%. Algae oil biodiesel contains 71.73% unsaturated fatty acids. The fatty acid value was very high and it required pretreatment with sulphuric acid before alkaline transesterification. Most of the properties of the biodiesel are within the limits for biodiesel and can hence be used as alternative fuel for diesel engines.

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