International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

# Cladophora Goensis a Novel Source of Biodiesel

[1]Divya A, [1]Monika J, [1]Saurabh P, [1]Ashish P and [1]B.P Saoji

[1]*Bharati Vidyapeeth College of Engineering, Navi Mumbai*

---

**Abstract**

*Microalgae can help to substitute petroleum-based diesel fuels. It can be the renewable energy on which world can rely on. Microalgae are highly photosynthetic efficient and are used as rich source of lipids, Hydrocarbons, and other complex oils for biodiesel. Biodiesel is non-toxic, contains no sulphur, and is biodegradable. It is produced using Transesterification or Esterification. Biodiesel has a higher cetane number and flash point which means better performance. A microalgae offers a $CO_2$ fixation efficiency that is approximately 10-50 times greater than that of oilseeds crops such as soy, etc. The capacity of mitigating $CO_2$ has drawn attention to microalgae. It also offers higher yield compared to terrestrial crops. It has been categorized in two parts one in which pretreatment of algae has been discussed and in second part how biodiesel is extracted that is shown. PFD also displays how effectively it can be carried out. Microalgae does not need freshwater for growth it can be grown in waste water also the temperature in many regions of India is feasible for its growth. There are extensive researches happening on algae as renewable source of energy.*

**Keyword**

Microalgae, Cladophora goensis, Biofuel, Alternate energy.

## I. Introduction

The word "Biofuel" refers to the energy that has been obtained by converting solar energy into autotrophic microorganism and are highly photosynthetic efficient and are used as rich source of lipids,

Hydrocarbons, and other complex oils for biodiesel. Biodiesel is non-toxic, contains no sulphur, and is biodegradable. It is produced using Transesterification or Esterification. Biodiesel has a higher cetane number and flash point which means better performance. It contains oxygen which limits CO2 and soot formation however, NOX emission rise slightly. The oil and gas sector of India are among the eight core industries as well India's economic growth is closely related to energy demand. With the population of 1.4 billion people it is highly required to focus on the energy which will be available for the long run. The consumption of Petrol, Fossil fuels have only led to bad impact on environment due to emission of CO2 and other harmful gases which remains in air for a long period of time and looking at the demand Vs the production of the energy we are standing at the edge.

Algae can be that alternate source of energy and not only it mitigates CO2 but it also does not need freshwater to grow, saltwater can be used for growing algae. Brackish water is slightly salty & turning it into fresh water requires chemical or desalination treatments which are not only expensive but it is also harmful for environment. Fresh water on the other hand is limited hence it should not opt for algae growth. However, the product that will obtain from both the water is same. Microalgae grow in both freshwater and salt water. Salt water can be used for growing algae which otherwise couldn't be utilized to produce any other crop. The salt level should also be maintained if it will be too high than it can rupture cell or result even in death of the specimen Halophytic algae is an algae which is salt tolerant & Scientists have found out that it is an natural & sustainable method to decrease salinity in brackish water and seawater.

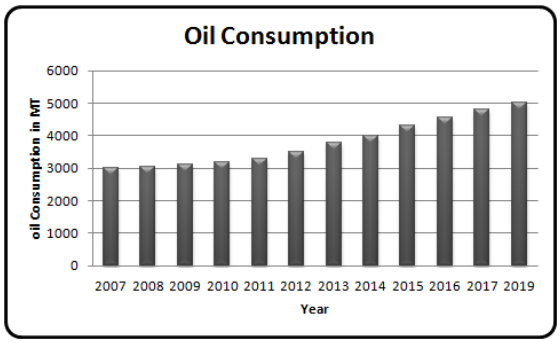


**Fig1. Oil Consumption Chart**

This graph shows the increment of demand throughout the years in fuel supply and with current need of energy this will continue to increase and this is the reason why we need to shift to microalgae as our alternate source of energy. The best way to desalinate water for portable use is to use species of salt tolerant algae which can absorb up to 50 times more salt than the concentration of salt in the water they inhabit. In addition, growing algae also mitigate carbon dioxide. Other sources of biodiesel include soya, jatropha, palm, corn, canola oil which also threaten food security. Algae bloom is excessive growth of algae which is caused due to oversupply of nutrients that is phosphorous and Nitrogen[2-4]. It affects entire ecosystem by blocking

sunlight for other organisms, producing toxins, resulting discoloration in water. However, by proper sewage treatment it can be avoided or by using hydrogen peroxide. The goal of the project is to suggest the feasible method of biofuel production from the algae strain like Cladophora goensis[9].

## II. Experiment Methodology

### 2.1 Material

Microalgae are highly photosynthetic efficient and are used as rich source of lipids, Hydrocarbons, and other complex oils for biodiesel. Biodiesel produced from crops such as jatropha and soy have lower yields and also threaten food security. Indeed, microalgae have higher oil yields amounting to about 40 times more oil in comparison to terrestrial oilseed crops such as soy and canola. And when it comes to cultivation, microalgae production does not require arable land.

Developments in new materials and advanced designs for cultivation in closed bioreactors, using waste water for biomass production, screening of efficient strains, high-value co product strategy, and cutting-edge metabolic engineering are believed to provide the biggest opportunities to substantially improve the cost effectiveness of production systems. In the light of aforesaid issues, algae are becoming the centre of attention as an optional renewable source of biomass for production of bio ethanol, which is grouped under Third generation bio fuels. Extensive research is being carried out over the last three decades there has been extensive research on algal biofuels production and the use of algae for CO2 bioremediation. Hence Algae have proved itself as one of the most efficient resources when it comes to renewable raw material for biofuels[7]. The extracted carbohydrates from algae can be fermented to make additional biofuels, including ethanol and butanol[8], as well as other products such as plastics and biochemical. Biodiesel derived from microalgae and jet fuels can directly replace petroleum fuels without modification of engines. Algae can be proven to be a biomass resource which is without carbon footprint. This is considered as principle energy process for aquatic biomass even if there are different technologies described in greater detail. Microalgae have engrossed the attention of various researches because of their rich photosynthetic activity and efficacy to generate lipids, a biodiesel feedstock. A microalga offers a $CO_2$ fixation efficiency that is approximately 10-50 times greater than that of oilseeds crops such as soya, etc. The capacity of mitigating $CO_2$ has drawn attention to microalgae. It also offers higher yield compared to terrestrial crops. Microalgae does not need freshwater for growth it can be grown in waste water also the temperature in many regions of India is feasible for its growth. There has been extensive research going on algae as renewable source of energy.

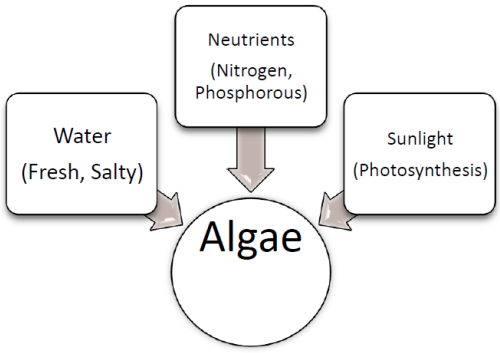


**Fig.2 Microalgae Composition**

### 2.2 Methodology

Methodology here is carried out in two steps and these two steps gets further subdivided. Initially collected algae will be

**Step 1**


**Step 2**


**Fig.3 Oil extraction in steps**

washed, kept under sun for maximum 2 days for drying and will be crushed in fine powder. After this oil extraction process is carried out in which fuel obtained from distillation is not in pure form hence transesterification is done further and after this separation of glycerine is done by Re-Distillation. Fuel and Biomass collected and stored.

### 2.3 Oil Extraction Process

#### 2.3.1 Collection and pre-treatment of algae specie

Algae collected from creek area was washed, one sample was kept under direct sunlight for 2 days and other in

heating oven at a temperature of gradually increasing to 50°C for 24 hours. The sample then crushed in fine powder form and kept in solvent for the next 24 hours.

**Fig.4 Microalgae**

### 2.3.2 Oil Extraction

Algae powder was kept in solvent n-Hexane and Diethyl ether for 24 hours at room temperature for lipid breakage. A layer of oil on the surface was formed, which was separated from the residue and a higher fraction of oil was obtained by using both solvent combination.

### 2.3.3 Distillation

After 24 hours of keeping sample in solvent further process is carried out through distillation in which algae sample is added with methanol and hexane in a ratio of 1:2 and the process carried out till 120°C methanol was removed at this stage but the fuel we obtained was still not in pure form hence we move to next stage i.e. Transesterification. Biomass remains at the end of flask.

### 2.3.4 Transesterification

Conversion from the extracted oil to biodiesel has happened in the transesterification.. The reaction was followed by adding 0.25 gm of NaOH in 24ml Methanol. Here triglyceride reacts with the alcohol to form ester (biodiesel) and the glycerol.

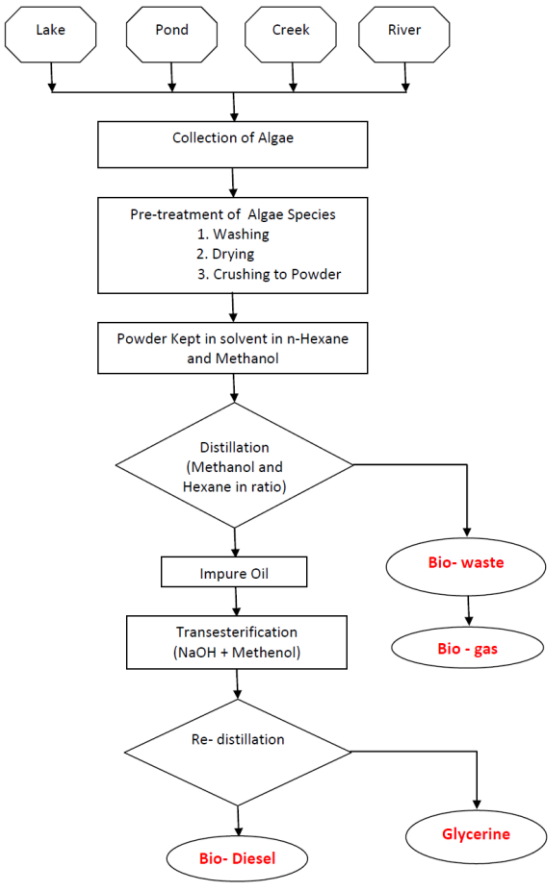


**Fig.5 Oil Extraction Process Flow Chart**

The reaction carried out till it reaches maximum of 70°C but biodiesel is obtained along with glycerine hence re-distillation is done for obtaining pure biodiesel

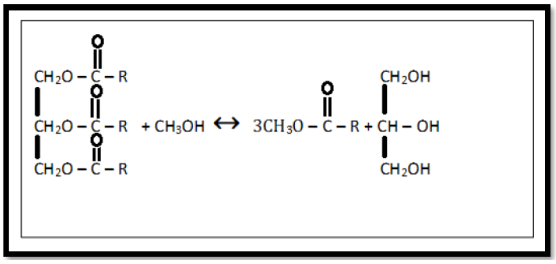


**Fig.6 Oil Extraction Chemical Reaction**

### III. Process Flow Diagram

Virtual Instrumentation is the software used by us for Panel designing. Block Diagram shows the working of process and for ease it's shown in five steps. With VI it is possible to display working in continuation that is it helps in showing how process is actually carried from initial stage to final stage.

**Table1. Components used in LabVIEW Programming**

| Sr. No. | Components | Total Numbers |
|---|---|---|
| 1 | ON/OFF Valves | 7 |
| 2 | Connecting Pipes | 12 |
| 3 | Closed Tank | 2 |
| 4 | Open Tank | 5 |
| 5 | Pump | 1 |
| 6 | Hopper | 1 |
| 7 | Square Led | 2 |

As shown in the front panel window ,we used an closed tank at the top of the process .In that the algae is to be heated as to absorb all the water particle in that and after this process the all material is to be passed in the next closed tank with the help of on/off valve. In the next tank all the algae which is properly dried is to be mixed and grinding process is to be done in this tank.

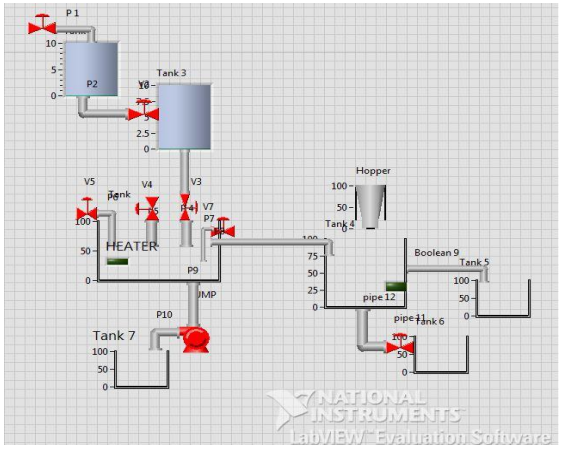


**Fig.7 Front Panel Diagram of Chemical Process**

After that there is an main tank , which is also a reactor tank in which a main process is to be carried out .The mixed powdered form of algae is to be added in this tank and all the other chemicals one by one i.e. Hexane, Methyl ether, Methane. Then the heater will start & the process will starts heating, After the heating we get a bio-product waste, for that there is pump is placed and all the bio-product waste will be sucked by the pump and get collected in the bellow tanks Then the main part in the tank is to be get in distillation process, after the distillation process we get the separate of glycerine & biodiesel, but is not in proper form. For that we need to do a process at the particular temperature.

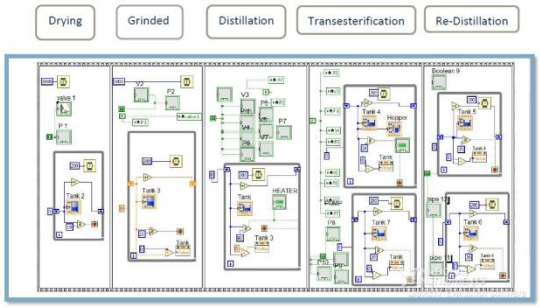


**Fig.8 Process Block Diagram Window**

After this process there is hopper element is placed above the tank, the particular quantity of NaOH powder is to be put in the solution and then for the separation of glycerine and bio-diesel oil need to do a distillation process again. After the final distillation process we get the two separate products in the two different tanks. At the top tank we get the glycerine as a by product form and at the bottom tank we get our final product as a biodiesel.

## IV. Experimental Observation

### 4.1 Effect of Temperature

It is observed that production of biodiesel depend on reaction temperature. Higher temperature increases biodiesel production[10-11].

### 4.2 Effect of Catalyst

The role of catalyst in transesterification reaction is very crucial. Transesterification reaction hydroxide was used as a catalyst, with amount ranging from 0.3 to 0.5 % of weight of oil. There is an increase in the rate of reaction and also in the yield due to catalyst.

### 4.3 Viscosity

The viscosity measurement has been carried out by using a viscometer. The interest for determining the quality of biodiesel is viscosity which has the range of 28 to 70 °C .We found that viscometer offers a resolution of a viscosity measurement of ±0.039 mPa with a relative error of 1.3973%. Demonstrated that the biodiesel produced has good quality was done when the measurement process was compared with a commercial viscometer.

### 4.4 Cetane Number

The cetane number is a 72 qualitative measure of the influence the diesel fuel has in determining the ignition delay. Higher the cetane rating of the diesel fuel lesser is the property for diesel knock.

All experimental observation are tabulated as follows

**Table2. Experimental Observation**

| Properties | Biodiesel | Diesel Fuel |
|---|---|---|
| Density(g/cm$^3$) | 0.8634 | 0.8424 |
| Viscosity(mm$^2$/s) | 4.2802 | 3.4301 |
| Cloud Point ($^o$C) | 7 | -4 |
| Pour Point ($^o$C) | 12 | -6 |
| Flash Point ($^o$C) | 132 | >52 |

### 4.5 Significance of characteristic points

#### 4.5.1 Cloud Point

As the temperature drops, small solid crystals appear on fuel which results in clogged fuel filters. It is seen that engine still works even when the temperature is below cloud point.

#### 4.5.2 Pour Point

In this minimum temperature the flow characteristic is almost lost and a lubricant turns into semi solid.

It is seen that engine stops working if temperature is below the pour point.

However there are fuel line heaters which effectively work if such condition is encountered.

#### 4.5.3 Flash Point

It is the lowest temperature at which risk of fire exists.

## V. Result and Discussion

### 5.1 Biodiesel Analysis

In Table 2, the quality of biodiesel was assessed by measuring its properties such as cloud point, flash point, viscosity, density and fire point.. It is safer as flash point of biodiesel is higher as compared to Petro diesel. Cetane number is higher hence it makes Biodiesel an excellent alternative fuel. Other properties of Petro diesel are also similar to Biodiesel

### 5.2 Comparison of $CO_2$ Emission

Table3 shows the $CO_2$ emission of various fuel when they are burnt.

**Table3. $CO_2$ Emission Table**

| Type of Fuel | $CO_2$ Emission |
|---|---|
| Wood | 0.39 |
| Peat | 0.38 |
| Lignite | 0.36 |
| Hard Coal | 0.34 |
| Fuel Oil | 0.28 |
| Diesel | 0.27 |
| Crude Oil | 0.26 |
| Kerosene | 0.25 |
| Gasoline | 0.25 |
| Refinery Gas | 0.24 |
| LPG | 0.23 |
| Natural Gas | 0.20 |

The presence of hydrocarbons in the bio-fuel is indicated by the presence of the functional group Alkane, Alkenes, ether, alcohol, aromatic in the oil sample The presence of different functional group of compounds indicates the presence of the hydrocarbons in the fuel and the (O-H) broad peak when observed indicate the presence of water contents in bio-fuel.

## 6. Conclusion

The main objective of this project is to use cladophora goensis specie as an alternate source of energy[1] and hence to come up with different procedures so minimum chemical will be used. Biodiesel is non-toxic, contains no sulfur, and is biodegradable. The methodology here characterized in two parts that is collection and pre-treatment of microalgae and oil extraction. Microalgae have proved to give higher yield compared to other vegetable crops. It also helps in mitigating $CO_2$. Results shows higher cetane no. and flash point makes it safer and excellent alternate fuel. Biodiesel was obtained through transesterification at 70$^0$C.

## References

1. http://dx.doi.org/10.21474/IJAR01/6414
2. en.m.wikipedia.org/wiki/Algal bloom
3. researchgate.net/publication/45148740_Algal_biodiesel_economy_and_competition_among_bio-fuels
4. Causes, Effects and Solutions of Algal Bloom on Aquatic Ecosystems – Conserve Energy Future, conserve-energy-future.com/causes-effects-solutions-algal-bloom.php
5. ceicdata.com/en/indicator/India/oil-consumption
6. hindawi.com/journals/jc/2012/285185
7. Ihsanullah1, Sumaira Shah, Muhammad Ayaz,Iftikhar Ahmed, Murad Ali, Naveed Ahmad and Irshad Ahmad5Journal of Pure and Applied Microbiology · March 2015
8. Bast, FR., John, A. & Bhushan, S. (2105). Cladophora Goensis sp. nov. (Cladophorales,

Ulvophyceae) – a bloom forming marine algae from Goa, India. Indian Journal of Geo-Marine Sciences44(12): 1874-1879.

9. Felix Bast, Aijaz Ahmad John and Satej Bhushan, Indian Journal of Geo-Marine Sciences June, 2014

10. Khan, N.A., Dessouky, E.H. Prospect of biodiesel in Pakistan. Renew. Sust. Energ. Rev., 2009; **13**: 1576–1583.

11. Srivastava, A., Prasad, R. Triglycerides-based diesel fuels. Renew. Sust. Energ. Rev., 2000; **4**: 111-133.