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# Renewable Energy Source Algae Biodiesel as Alternative Fuel

**Hemendra C. Patil[1], Ritesh R. patil[1], Chetan C. Patel[1]**

**Raju G. Mundhe[2]**

*[1]Students, department of mechanical engineering, DILKAP Research institute of engineering and management studies, Neral, Tal-Karjat, Dist- Raigad, Maharashtra, India.*
*[2]Professor, department of mechanical engineering, DILKAP Research institute of engineering and management studies, Neral, Tal-Karjat, Dist- Raigad, Maharashtra, India.*

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**Abstract -** *Today energy demand is increasing rapidly all over the world along with it pollution is also increasing, with the use of nonrenewable sources of energy like coal, natural gas, and fossil fuels. So as to maintain the pollution level all over the world renewable energy sources are used. In liquid fuels currently petrol and diesel are widely used. These are the non renewable sources of fuel and because of these fuels the environmental pollution is rapidly increasing. Therefore it is necessary to research on the renewable alternative fuel especially biodiesel. Biodiesel is a natural fuel and may be a good source or substitute for fossil fuel in future. Biodiesel has been derived from oil crops. Biodiesel is a potential renewable and carbon neutral alternative to petroleum fuels. Unfortunately, biodiesel from oil crops, waste cooking oil and animal fat cannot realistically satisfy even a small fraction of the existing demand of fuels. The use of algae can be a suitable alternative because algae is the most efficient biological producer of oil on the planet. It is a versatile biomass source and may soon be one of the Earth's most important renewable fuel crops. Higher photosynthetic efficiency, higher biomass production, a faster growth rate than higher plants, highest CO2 fixation and O2 production, growing in liquid medium which can be handled easily makes the algae as a better option compared to other oil seed crops.*

***Key Words***: Algae, Algae biodiesel, Trensestrification, Pollution, Green energy.

## 1.INTRODUCTION

Today, pollution and global warming problems are biggest problems in the world. But day by day our energy demand also increases rapidly, so to fulfill these demand many countries are deploying renewable energy sources. Alternative fuel has recently become more attracting due to higher cost and emission by fossil fuels. Table:1 indicates pollution level in the world. Ghana has highest pollution index of 98.83 and united state has least pollution index of 31.19.

**Table 1.1:** pollution level in world [27]

| Rank | Country | Pollution index |
|---|---|---|
| 1 | Ghana | 98.83 |
| 2 | Afghanistan | 95.60 |
| 3 | Mongolia | 93.80 |
| 6 | China | 88.96 |
| **26** | **India** | **76.53** |
| 57 | South Africa | 63.56 |
| 88 | Japan | 41.01 |
| 97 | United state | 31.19 |

**Table 1.2:** Pollution Level In India (April 2017)[27]

(min.) 0 ⟶ 100 (max.)

| Rank | City | Pollution index |
|---|---|---|
| **1** | **Faridabad** | **97.07** |
| **2** | **Ghaziabad** | **95.76** |
| **3** | **Kanpur** | **92.47** |
| **4** | **Delhi** | **89.32** |
| **5** | **Varanasi** | **89.32** |
| **8** | **Mumbai** | **87.63** |
| **11** | **Patina** | **85.21** |
| **13** | **Bangalore** | **83.94** |
| **18** | **Kolkata** | **80.70** |
| **21** | **Pune** | **77.21** |
| **27** | **Jaipur** | **68.22** |
| **37** | **Goa** | **54.70** |

Fossil fuel extracted from the earth has high carbon content and because of these carbon content the air pollution increases rapidly which is harmful to the human as well as environment. Therefore to reduce the pollution use of more efficient and less harmful to environment alternative source of energy such as biodiesel is the best option. Biodiesel is produced by the oil seeds, waste cooking oil, algae, etc. Also the biodiesel is the renewable source of the energy. Biodiesel can be made available from plants and animals. Biodiesel can be produced by soybean oil, rapeseed, canola, palm, cottonseed, sunflower, peanut, and Algae. The biodiesel

extracted from the plants and these plants can be replenished through farming and recycling. Current researchers found that algae is one of the most efficient source of energy. Algae is environment friendly which also reduce $CO_2$. Generally algae is classified into two types Macro algae, and microalgae. Macro algaes are big plants having large leafs and lives in sea. Microalgaes are micro size algae and are unicellular commonly found in lakes, ponds and rivers.

Microalgaes are large source of energy. Microalgaes are photosynthetic micro organism requires simple growing environment which can produce lipids, carbohydrates and proteins in large amount with short period of time. Micro Algae have fastest growing rate, hence production is easy in all countries.

**Some Species Of Algaes Are:**

1. Diatoms
2. Chlorophyta
3. Euglenophyta
4. Dinoflagellata
5. Chrysophyta
6. Phaeophyta
7. Rhodophyta
8. Cyanobacteria

There are 8000 species of algae found all across the world, among them about 1500 species of blue green algae [cyanobacteria] and nearby 600 species of red algae. Red algaes are also called as rhodophyta. It does not use agricultural land and has no effect on human food. Algae is rich source of $O_2$ therefore it is used to make biodiesel. These biodiesels is alternate fuel for conventional diesel. While growing it absorb $CO_2$ from atmosphere via photosynthesis processed by algae. Table 1.3 indicates the rate of algae production kilogram per hector per year as compared to sunflower, soybean, coconut and palm.

**Table-1.3:** Yield Of Various Plants Oils (Kilogram Per Hector Per Year) [26]

| Plants Oil | Kilogram Per Hectare Per Year |
|---|---|
| Sunflower | 800 |
| Soybean | 375 |
| Coconut | 2260 |
| Palm | 5000 |
| **Algae** | **80000** |

Microalgae biodiesel is non toxic and highly bio degradable in nature. Waste material produce after oil extraction is further used to form fertilizers.

## 2. LITERATURE SURVEY

Algae can be converted into biodiesel, Bioethanol, bio hydrogen, bio oil and bio methane through bio-chemical and thermo chemical methods in [1] by *Ayhan Demirbas, et al.* The growth and oil content in blue green algae has been analyzed. The growth factor of algae with a significant change in quantity of nutrients noticed that under nitrogen deficit condition, the oil content (lipid) was increased in algae with respect to time *Meng Chen, et al.[2]*

Microalgae have high biomass and high lipid productivities per unit of area in comparison with other crops. Chisti [3] reported that the demand for fuel in the transportation industry can only be covered by microalgae as a renewable source. It was reported that microalgae can produce the same amount of biodiesel (for 30% w/w oil content) compared to rapeseed or soyabean crops using around 49 to 132 times less land. Furthermore, microalgae are non-edible and can grow under various conditions in which there is no significant impact on the human food supply chain.

The properties of biodiesel depend on its fatty acids (FA) composition. The biodiesel fuel properties are the outcome of its individual fatty ester's properties and structure such as chain length, degree of unsaturation and branching of the chain. These parameters of the fatty acid esters influence cetane number, heat of combustion, cold flow viscosity and exhaust emissions. Ramírez-Verduzco, et al. [4] estimated density, viscosity, cetane number and the higher heating value for tallow and soybean biodiesel using a developed empirical equation. They found that the increase in the number of double bonds in the fatty acid methyl esters (FAMEs) causes a reduction in the values of cetane numbers, viscosity and the higher heating values. The other way of utilizing microalgae or its constituents is by producing emulsion fuels. Emulsion fuels is a term usually used to describe mixtures of diesel and/or biodiesel with water. Owing to the differences in the physical and chemical properties of the mixture components (i.e., water, diesel or biodiesel), emulsifiers are normally used to facilitate the interaction between the mixture components and prolong the stability of the emulsion.

## 3. BIODIESEL PRODUCTION FROM ALGAE

In biodiesel manufacturing method, parent oil is used to make biodiesel which is extracted from microalgae. It consists of Triglyceride in which three fatty acid molecules are esterified with molecule of glycerol. "Transestrification" or "Alcoholysis" is the process of making biodiesel Triglyceride reacted with methanol which produce methyl ester of fatty acid and glycerol. Methyl ester is known as biodiesel. In these reaction Triglycerides are converted into Diglyceride then Monoglyceride and finaly into glycerol.

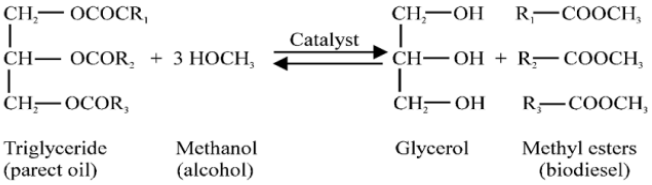


**Figure 1:** Transestrification Process [20]

**Triglyceride + Methenol →Methyle Ester (Biodiesel) + Glycerol**

Generally these reaction are catalyzed by using acids and alkalis but alkalis are 4000 times faster than acids hence alkalis are preferred.

**Table 3.1:** Properties Of Algae Biodiesel [11]

| Properties | Algae Biodiesel | Pure Diesel |
|---|---|---|
| Density Kg $l^{-1}$ | 0.864 | 0.838 |
| Viscosity Pa s | $5.2\times10^{-4}$(40° C) | $1.9\text{-}4.1*10^{4}$ ($40^{0}$C) |
| Flash Point ° C | 65-115° C | 75 |
| Solidifying point ° C | -12 | (-15)-10 |
| Cold filter plugging point ° C | -11 | -0.3(-6.7 max) |
| Acid value mg KOH $g^{-1}$ | 0.374 | 0.5 max |
| Heating value MJ $kg^{-1}$ | 41 | 40-45 |
| Hc ratio | 1.18 | 1.18 |

As seen the properties of the Algae biodiesel is near to the pure diesel but the viscosity of the algae biodiesel is more than a pure diesel. If only algae biodiesel is used as a primary fuel for the engine then it may cause problem to the engine even it may damage the engine permanently. Therefore it is necessary to blend the algae biodiesel with pure diesel. These blends must be within the range for high efficiency and for low emission.

## 4. CONCLUSION

By above all research it is clear that for reducing the pollution renewable source of the energy is the best way. the algae biodiesel because of its quality of high content of the bio oil, less emission of pollutant, fast growing and many different properties it is the best and efficient source of producing renewable biodiesel.

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