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Algal Biofuels

❑ Amrita Pradhan*
❑ Ragni Mishra*
❑ Renu Yadav*
❑❑ Richa Sharma**

A fuel is nothing more than something from which we human can get energy A biofuel is defined as any fuel whose energy is obtained through a process of biological carbon fixation. As the result of the global fuel crisis of the early 1970s, the use of biofuel has been on the increase in many reasons throughout the world. At present, a total of approximately 30 billion liters of biofuels are utilized worldwide annually.

A biofuel is a hydrocarbon that is made by or from a living organism that we humans can use to power something. In practical consideration, any hydrocarbon fuel that is produced from organic matter in a short period of time is considered a biofuel. Biofues may be Bioalcohals,Aviation Biofuel,Biodiesel, Bioethers, Biogas, Syngas, Solid Biofuels. The class of biofuels is subdivided into three generations, each of which contains a number of different fuels.

1] First generation biofuel: 1st generation biofuels are made from sugar, starch, or vegetable oil. 1St generation biofuels are the "original" biofuels.

2] Second generation biofuel: Fuel derived from feed stock not traditionally used for human consumption.

3] Third generation biofuel: Biofuel derived from algae.Algae produced oil that can easily be refined into diesel or even certain components of gasoline. It can be genetically manipulated to produce everything from ethanol and butanol to even gasoline and diesel fuel directly.

Biofuels are an important to our society due to the insatiable thirst for petrochemicals. Some alternatives to petrochemicals are solar energy; algae based crude oil, boi-diesel and ethanol made from corn and wind energy. Algae have been used to produce up to 9000 gallons of biofuels per acre. It is suggested that yields unto 20000 gallons acre are attainable.

Biodiesel-Biodiesel is a diesel fuel derived from animal or plant lipids. Algae can produce 60% or more of their dry weight in the form of oil. Microalgae are capable of producing a large amount of biomass useable oils in algae ponds or photobioreactors. This oil can be turned into biodiesel. According to the U.S. Department of energy's Aquatic species program 1978-1996-biodiesel could be the only viable method by which produce enough fuel to replace current world diesel. United State is the world's largest single biodiesel market. According for roughly 18% of world biodiesel followed by Germany. Biofuels are seen as a suitable alternative to oil and coal in connection to reduced CO2 and mitigate global warming.

CULTIVATION OF ALGAE

▫ M.Sc. Botany Student, Dept. Of Biological Sciences, SHIATS Allahabad (U.P.) India
▫ ▫ Corresponding Author, Asst. Prof., Department of Biological Sciences, SHIATS Allahabad (U.P.) India

Types of algae: Research into for the mass producing of oil is mainly focused on microalgae organisms which are capable of photosynthesis and are less than .4 mm in diameter, including the *Diatoms* and *Cyanobacteria*. However, some research is being done into using seaweed for biofuels. [Anon Times lines retrieved 14th may, 2015]

Algae derived biofuel: Microalgae has much foster growth rate than terrestrial plants. The per unit area yield of oil from algae is estimated to be between 25000 and 50000 per hectare per year. Studies show that algae can produce up to 60% of their biomass in the form of oil.

Hydrogen production: There are three methods by which hydrogen can be produced from algae namely biochemical process, gasification and steam reforming.

1]Biochemical process: A microscopic green algae known as ***Chlamydomonas reinhardtii*** split water into hydrogen and water under controlled condition.

2]Gasification of algae biomass: During gasification of biomass is converted into a gaseous mixture comprising hydrogen and carbon monoxide by applying heat under pressure in the presence of steam and control amount of oxygen.

3] Steam reformation of Methane: Fermentation of algae biomass produces methane.

Method of cultivation of algae- Microalgae cultivation using sunlight energy can be cultivated open ponds, covered pond or closed photo bioreactors.

1] Open pond system: Open pond system using in monoculture vulnerable to viral infection. In general open pond constitutes the cheapest method of producing algae inlarge quantities.

2] Closed loop system: In closed system there is no contamination by other organisms.The problem for closed system finding a cheap source of sterile CO2. [M. Clyton Science monitor, 2006] although the close loop system are cheaper than photo bioreactor but costlier than open pond system.

3] Photo bioreactor: Most companies pursuing algae as source of biofuel are pumping nutrient rich water through plastic or borosilicate glass tube called bioreactors that are expose to sunlight and so called photo bioreactor or PBR. PBR are flat plate, tubular and vertical column types. Running a PBR is more difficult and also costlier than open ponds.

Advances in ultra-efficient concentrator photovoltaic, as well as high performancelight emitting diodes, creates a practical reality for converting sunlight into pulsed red light and delivering it to indoor photo bioreactors resulting in very high dark reaction of photosynthesis.

4] Algal truf scrubber[AST]: It is system

designed for cleaning nutrients and pollutants out of water using algal turfs. ATS mimics the algal turfs of a natural coral reef by taking in nutrients rich water from waste stream or natural water sources and pulsing it over a sloped surface. [http://www.algalturfscrubber.com]This surface is coated with rough plastic membrane or screen, which allows algal spores to settle and colonize on this surface. Once the algae have been established, it can be harvested every 5-15 days. It can produce 18 metric tons of algal biomass per hectare per year. http://bioscience.oxfordjournals.org/content/61/6/434

Microalgae cultivation by different method- Microalgae species are recently in the spotlight for biofuels production like biodiesel, bioethanol and biohydrogen. Algae are also used as a biofertiliser sources of nutrient and for controlling pollution. Algae being a photosynthetic organism are produced inthe photo bioreactors. Hence the design and development of photo bioreactors for maximum production of algae is very important.

The bioreactors, which are used for the purpose of growing algae, are :

1. Column photo bioreactor
2. Airlift photo bioreactor
3. Flat plat bioreactor
4. Horizontal tubular bioreactor
5. Stirred tank bioreactor

Algae oil extraction : Extraction can be broadly categorized into two methods-

1] Mechanical method:

- Expression\Expeller press
- Ultrasonic-assisted extraction

2] Chemical methods:

- Hexane solvent method
- Soxhlet extraction
- Supercritical fluid extraction

Some other methods which are not well-known

Enzymatic extraction: Enzymatic extraction uses enzymes to degrade the cell wall with water acting as the solvent this make fractionation of the oil much easier. The costs of this extraction process are estimated to be much greater than hexane extraction.

Osmotic shock: Osmotic shock is a sudden reduction in osmotic pressure, this can cause cell in a solution to rupture. Osmotic shock is sometimes used to release cellular components such as oil.

Challenges in oil extraction from algae:

1. Microscopic algae suspended in water are virtually indestructible.2. Cell wall has a high elasticity modulus.
3. Wet biomass retains sufficient in terstitial water to act as lubricant.
4. Rupture of cell wall through mechanical friction and steam explosion is only possible when dry.