Microalgae for Biodiesel Production

Sripriyanka S Nalla* and Srinidhi
Indian Agricultural Research Institute, New Delhi.
*Corresponding Author: sripriyanka1112@gmail.com

Growing dependence on petroleum as the main source of energy and chemical-based fuel which is creating a lot of problem to mankind and environment by releasing the harmful gases. The release of carbon in the form of carbondioxide and carbon monoxide has increased the pollution and led to the global warming. The best replacement method for this problem is to shift to renewable energy resource. Biodiesel is an attractive renewable transportation fuel because it is biodegradable and non-toxic. Biodiesel is the most promising biofuel which is produced from the process known as transesterification. Furthermore, less hazardous gases emission due to higher oxygen content as well as zero sulfur and aromatic substances. Fatty acid methyl esters (FAME) are well-known type of biodiesel of vegetable oils and animal fats with short-chain alcohols. Majorly the biomass of high oil content is used for the production of the bio-diesel but the comparison of the emissions from the fuel microalgae shows better results. Microalgae because of high photosynthesis and oil production efficiency, growing ability in non-fresh water and low land area requirement is an affordable feedstock for biodiesel production compared with edible sources.

Algae cultivation methods

Open pond system

Open pond systems use shallow ponds, from about one acre to several acres in size, in which the algae are exposed to natural solar radiation which they convert into biomass. Typically, the ponds are called raceway ponds because their shape resembles a race track.

Enclosed photobioreactor (PBR)

Three major types of photobioreactors are vertical column, tubular and plate types

Due to enclosed structure and relative controllable environment, enclosed PBR can reach high cell density. All the factors like light, oxygen, water and culture are controlled as per the requirement for the optimum growth of micro-algae.

Vertical-column photobioreactors

The name itself indicates the vertical glass tubes provided in favourable conditions for the growth of microalgae. These are compact, low-cost and easy to operate.

Flat plate photobioreactors

This type of PBR receives much attention for cultivation of photosynthetic micro-organisms due

large illumination surface area. These are made up of transparent PVC materials for maximum utilization of sunlight

Tubular photobioreactors:

Large illumination surface area, suitable for outdoor cultures, fairly good biomass productivities. Among the proposed photobioreactors, tubular is one of the most suitable types for outdoor mass cultures.

Harvesting of algae

Sedimentation is the initial phase of separating the algae from water. Once agitation is completed, the algae are allowed to settle and densify

Membrane separation is a form of filtration. This method can be used to collect microalgae with low density, but is typically done on a small scale

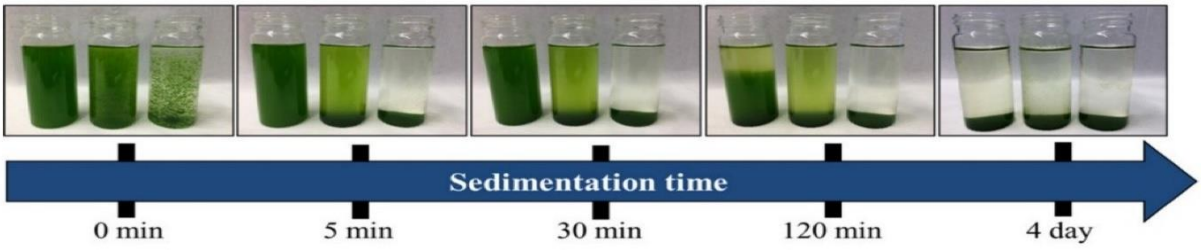
Flocculation is a method where flocculants are added to the mixture of water and algae that causes the algae to "clump" together (or aggregate) and form colloids

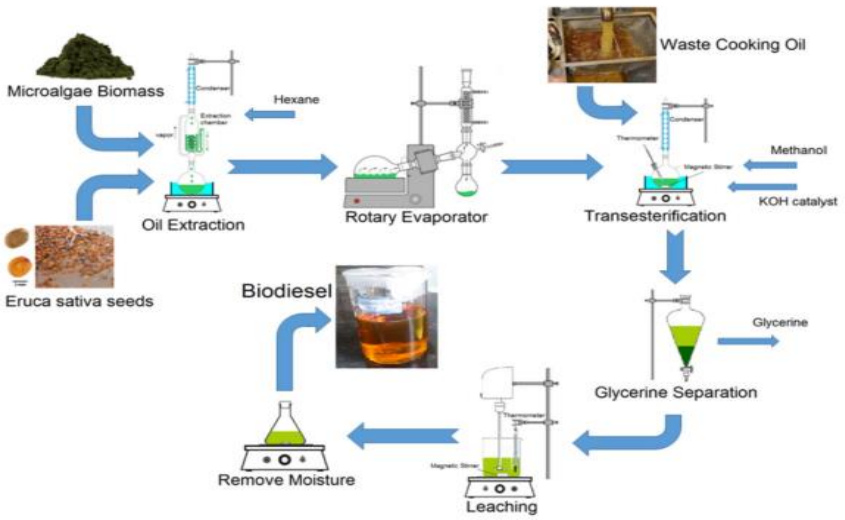
Froth floatation is a method in which air bubbles are incorporated into the unit. Sometimes an additional

organic chemical or adjustment of pH will enhance separation

Extraction of biodiesel from micro algae

After the harvesting and separation of algal biomass, the powder form of microalgae is used for the extraction of oil from it. The below flow diagram depicts the procedure of oil extraction and biodiesel production from the algal biomass through





- The best and most suitable alternative for the costliest and harmful petroleum products.
- All the living organisms can have the better health by reduction in pollution
- This renewable energy source can be produced at a place and need not to be imported from foreign countries.

the process known as transesterification.

In the transesterification process a glyceride reacts with an alcohol (typically methanol or ethanol) in the presence of a catalyst forming fatty acid alkyl esters and an alcohol. The feedstock for transesterification can be any fatty acids from vegetable or animal origin, or used cooking oils (UCO). Typically used vegetable oils originate from sunflower, soy and oil palms. A strong base or a strong acid can be used as a catalyst. At the industrial scale, mostly sodium or potassium hydroxide is used. The end products of the transesterification process are raw biodiesel and raw glycerol. In a further process these raw products undergo a cleaning step. In case of using methanol as alcohol FAME (fatty acid methyl ester) biodiesel is produced. The purified glycerol can be used in the food and cosmetic industries, as well as in the oleochemical industry. The glycerol can also be used as a substrate for anaerobic digestion.

Conclusions

References

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