

Microalgae Play Important Role in Waste Water Treatment and Biofuel Production

Abstract

Using photosynthetic activities & capability, microalgae an algae play key role in remediation & treatment of domestic waste water. Polluted water was collected from different sources like industrial source, agricultural source, food processing source, leather industry, & cotton industry for the investigation of role of algae in waste water treatment. Many such algae like *Chlorella pyrenoidosa* has important role in treatment of milk industry waste water & biofuel production & extraction. This experiment is set up in two parts the first part is about the role of microalgae in waste water treatment & the second part focuses on the production of biofuel by harvesting of biomass (algal strain) growing water sources. The aim of this review to explain the function of algae not only in waste water treatment but also in the role of production of biofuel.

Keywords: Bioremediation, Waste Water, Microalgae, & Industrial Waste.

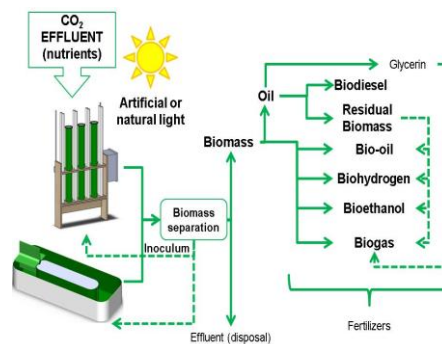
Introduction

Microalgae is also called microphyte, belong to family of lower plant. These are microscopic in nature & generally found in fresh water & marine water, fresh water may be running or stagnant.^{1,2} They are basically unicellular species & they exist individually or in chain or in groups. The nature of the species of living depends on the size & morphology of the algal species, size range of microalgae ranges from few micrometers to 100 micrometers. Microalgae are thallus like structure without root, stem & leaves. They are capable of performing photosynthesis, and play crucial role in maintaining the ecological balance of earth. Microalgae produces half of the atmospheric oxygen & utilizes simultaneously the green house gases (CO₂). Microalgae are the key part of the food chain & produces energy for different levels of the food web.³ The biodiversity of microalgae is widely spread & they have potential of unknown resources. It has been approximately calculated that about 200000-700000 microalgal species exist, in which only 50000 species are fully known & are described.⁴ Approximately 12000-14000 compounds have been discovered from algal biomass & the chemical properties of the microalgae are fully known & described.⁵



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Microalgae have the tendency to survive under extreme environment & the cultivation can be carried out even in saline & brackish water/ coastal sea water. Biomass energy one of the clean source of regenerative energy have been producing rapidly in form agriculture & aquaculture. The biofuel energy generally produce by marine algae for conversion into biofuel & biogas.⁶ The most serious issue regarding the sustainability is the requirement of land to provide food to an increasing population. Every day 25000 people dies because of hunger in the world and in other words one person dies of hunger for every 3.4 seconds.^{7, 8} Recently are focussing on prominent source for biofuel production and they have discovered that microalgae have potential to produce a clean source of energy or bioenergy. Biofuel are produced from source like biomass &

other feedstocks which are an alternative source for conventional fuel like petroleum & diesel.⁹

Bioremediation (microalgae) is the process which utilizes biological microbes & other feature of the environment for treatment of waste water. It is economical than other sophisticated technologies & are helpful in cleaning different types of wastes.¹⁰ Microalgae play important role in bioremediation & in water purification.¹¹ The use of microalgae for removal of nutrients from different wastes has been explained by many authors.^{12, 13, 14, 15}

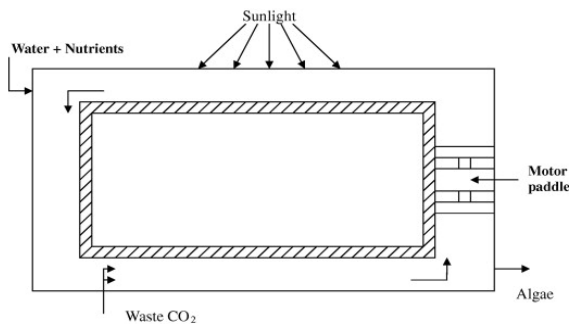
Methodology

Cultivation of algae

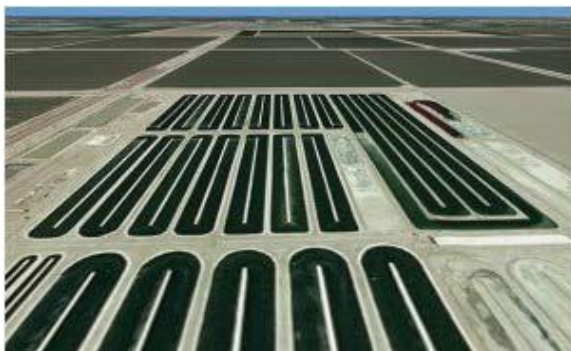
Cultivation of microalgae is the primary step for the production of energy in system. According to microalgae studies various characteristics properties of microalgae have been well defined and some well cultivation techniques have been developed. Currently the cultivation technology uses two methods 1: The open pond system, 2: The close photobioreactor system.¹⁶

The open pond system

The open system is traditional technology for cultivation of microalgae. The concept of this method involves, microalgae sample are dipped in an open pond with water, which contains nutrients and which helps the microalgae to photosynthesize for the proper growth. This open system is similar to a raceway like track and it contains a paddle like structure for proper mixing of algal cells, for proper growth of microalgae carbon dioxide is necessary. In this method the physiological condition such as pH should be maintained to ensure proper cultivation of microalgae.¹⁷



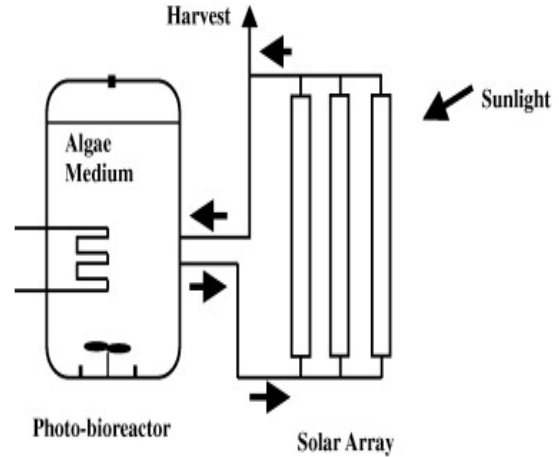
Source : ¹⁶Open pond cultivation method.



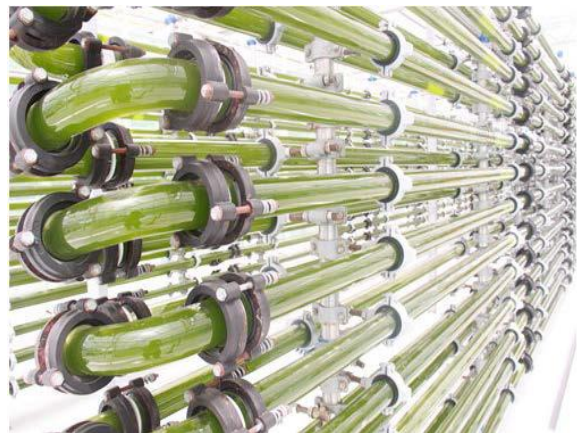
Source : (Tracey, 2013) Open pond system raceway like track.

The close photo bioreactor

The close photo bioreactor provide a closed environment for culturing of microalgae with different sophisticated tools. The various types of bioreactors which are used, tubular photo bioreactor, fermentation tank & plate bioreactor.¹⁸ The most suitable photo bioreactor used for internal & external cultivation of microalgae is tubular bioreactor.¹⁹



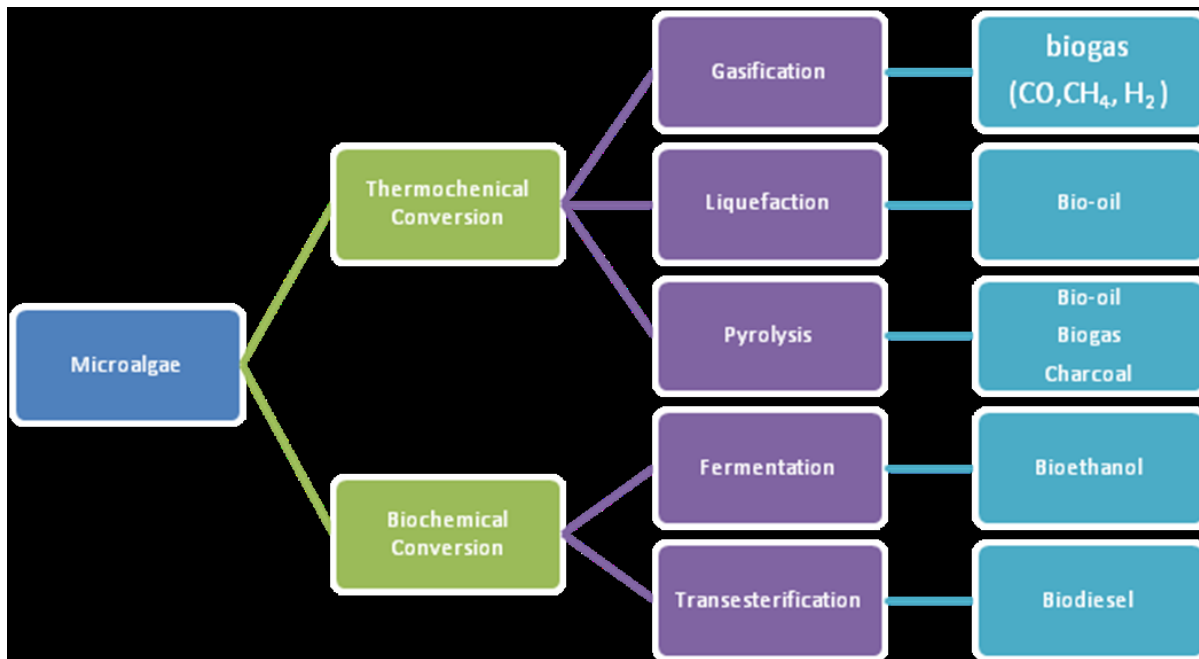
Source: A Tubular photobioreactor¹⁶



Source : A close photobioreactor system (Zhu, 2010)

Biofuel Production from Microalgae

The basic principle to obtain energy (biofuel) from microalgae biomass involves various chemical & biological methods. The two main methods which are commonly used for the conversion of energy are Thermochemical conversion & Biochemical conversion which are responsible for producing different types of biofuel at laboratory & industrial levels.²⁰ The energy from microalgae for various kind of biofuel uses different types of techniques which involves gasification, liquefaction, pyrolysis, fermentation & transesterification.



Source : Biofuel production from different methods²¹

Bioremediation by Microalgae

Bioremediation of waste water which contains various hazardous materials. Microalgae have great potential of removing excess amount of nitrogen & phosphorus impurities from waste water. They have ability to absorb carbon dioxide from coal

fired plant which is helpful in producing biofuel. Some scientists have performed various experiments with microalgae & found that algal cells have capability to degrade petroleum, hydrocarbon and other toxic materials which are found in waste water.

Microalgae	Bioaccumulation	Biotransformation
<i>Chlamydomonas sp.</i>	Mirex	Lindane, naphthalene, phenol
<i>Chlorella sp.</i>	Toxaphene, methoxychlor	Lindane, chlordimeform
<i>Chlorococcum sp.</i>	Mirex	
<i>Cylindrotheca sp.</i>	DDT	
<i>Dunaliella sp.</i>	Mirex	DDT, naphthalene
<i>Euglena gracilis</i>	DDT, parathion	Phenol
<i>Scenedesmus obliquus</i>	DDT, parathion	Naphthalene sulfonic acid
<i>Selenastrum capricornutum</i>	Benzene, toluene, chlorobenzene, 1,2-dichlorobenzene, nitrobenzene, naphthalene, 2,6-dinitrotoluene, phenanthrene, di-n-butylphthalate, pyrene	Benzo[a]pyrene

Source: Bioremediation practices using microalgae²²

Conclusion

This article focuses on implementation of microalgae in different streams such as biofuel production and in bioremediation for the development of clean regenerative energy source and also for maintaining the proper ecological balance by reducing the green house gases by elimination of waste from the environment. In the upcoming years the conventional fuels will be finished and an alternate source of energy will be required and microalgae will be the best potent source.

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