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# Extraction of Bio-Fuel from Algae by Anaerobic Digestion

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**Abstract**---The growing energy demand across the globe has instigated us to synthesize bio-fuel from algae, a renewable resource. Algae Botryococcus braunii when subjected to anaerobic digestion and broken down by enzymes liberate methane and $CO_2$. The $CO_2$ obtained is cultivated in open ponds and are passed through a fluidised bed chamber after pre-treatment. The chamber contains enzymes which breakdown the algal colloid into fatty acids. These fatty acids on decomposition release $CO_2$ that is internally cycled for algal cultivation and the methane can be profitably and cleanly extracted. This methane can be used as a fuel in vehicles (CNG) and also in various industrial and domestic fields, providing a low-cost solution to the global energy crisis.
**Keywords**--- algae, open ponds, CNG, renewable, methane, anaerobic digestion.

## I. INTRODUCTION

Algae are a diverse group of autotrophic organisms that are naturally growing and renewable. Algae are a good source of energy from which bio-fuel can be profitably extracted [1].Owing to the energy crisis and the fuel prices, we are in an urge to find an alternative fuel that is environmentally acceptable and cost effective.

Our proposal is to extract methane from algae by anaerobic digestion process which can be used a vehicular fuel in the form of CNG. Methane obtained from algae is clean, green and can be made available at a cheaper cost. It also finds various applications in the fields of industries and as rocket propellants which is expected to be proved by NASA in the near future.

## II. UNIQUENESS

Our product Algal methane is completely different and unique from the existing bio-fuels. The process is very much simpler and can be done faster. An added asset to our proposal is that algae are largely available in nature and can also be cultivated in open ponds[2]. This process involves less investment and hence can be sold at very cheaper rates.

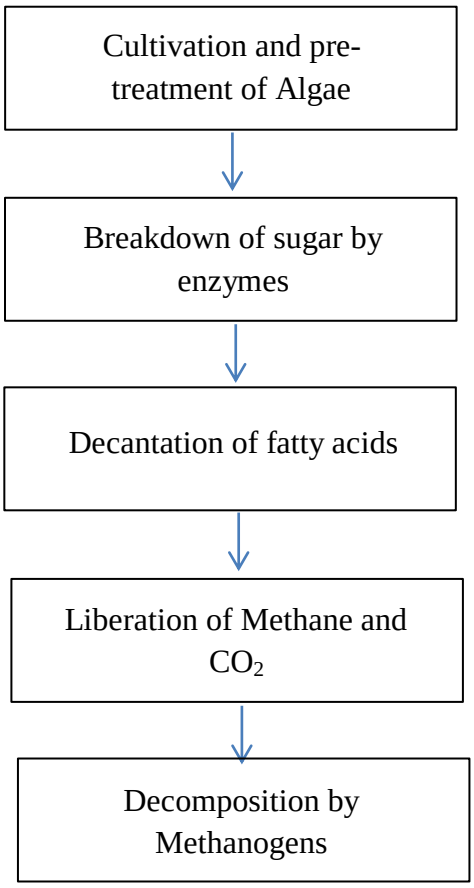
## III. ISSUES WITH EXISTING BIO-FUELS

Though there are various bio-fuels existing in India and other parts of the world they are not found to be successful because of various issues. The major issues include the exploitation of water and land resources and $CO_2$ reductions in atmosphere. Also it is found that various bio-fuels decrease the efficiency of engine and damages the engine parts. One of the major concerns is that these bio-fuels involve high investments and hence they are costlier than fossil fuels.

Our product is a clean, green and cheap alternative source of energy that will provide a viable solution to the global energy crisis

## IV. PROCESS DESCRIPTION




### 4.1 CULTIVATION OF ALGAE

The algal being cultivated here is "Botryococcus braunii" which is proved to have the highest methane yielding capacity. Algae can be cultivated by various methods like

- Open pond systems
- Closed pond systems
- Photo bio reactor

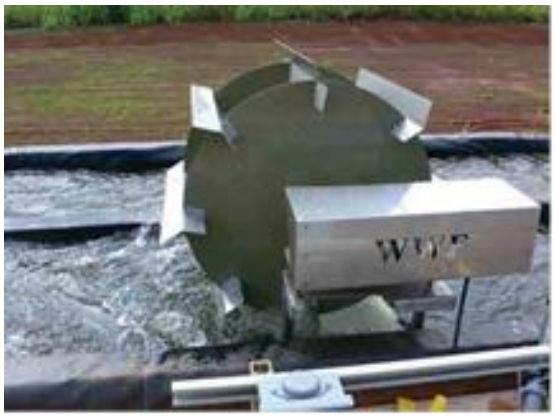
#### 4.1.1 OPEN POND SYSTEMS

The ponds in which algae are cultivated are usually called "raceway ponds". In these ponds, algae water and nutrients circulate around a racetrack. The paddle wheel will provide a flow so that algae are kept suspended in water and circulated back to the surface on water at a regular frequency.
Algal growth is found to be progressive [4] at the following conditions:

| PARAMETER | VALUE |
|---|---|
| pH | 7.7-8.5 |
| Temperature | $25^{o}$-$40^{o}$ |
| Aeration | Continuous |
| Mixing | Continuous |
| Natural Light | Sunlight (Dim) |
| Artificial Light | Blue or red Flourescent lamps |

4.2 PRE-TREATMENT OF ALGAE:
The whole algae cultivated, is converted into a colloidal suspension with lightly suspended algal particles.



4.3 BREAKDOWN OF SUGAR:
The algal colloid is passed through a fluidised bed chamber on which enzymes are placed. The most advantageous enzyme was 'Bob's Big boost'. Best results were yielded at a lower cost. These enzymes break down the algal colloid into fatty acids[5].

4.4 DECANTATION OF FATTY ACIDS:
The fatty acids obtained are allowed to settle in a closed chamber by sedimentation. The acid alone is decanted to another chamber and made to react with methanogens.

*DENSITY OF METHANE: 0.668 Kg/m3*

*DENSITY OF CARBON-DI-OXIDE: 1.7 Kg/m3*

Due to the difference in density, methane rises up in the chamber and can be easily separated from carbon di-oxide. The carbon-di-oxide liberated is sent back to the fluidised bed chamber for the faster fermentation of algae.

This will help in protecting the environment due to the harmful effects of the carbon-di-oxide to the environment.

4.5 LIBERATION OF METHANE:
The methanogens promote decomposition of the fatty acids. This decomposition liberates methane and carbon-di-oxide as main products [6]. The whole timeline takes for about 20-25 days on an average to complete one cycle of fuel production.

## V. FEASIBILITY

The production of algae fuel requires minimum running investment with no need for continuous changes in equipment. Also the equipment requires minimum maintenance. Due to complete automation there is minimum requirement of labour and hence the running costs are reduced even further. Since algae can be cultivated at a very cheap cost without of the usage of bioreactor, the initial investments are also reduced.

## VI. CONCLUSION

'Algal Methane' can be produced with minimum investment and with a process that involves minimal infrastructure requirements. It provides a viable solution to the world's energy requirements and is a 'green' source of energy

## VII. FUTURE SCOPE

The research on this topic is endless. In the near future, the algal yield can be expanded by using photo-bio reactors. Also, the complete cycle can be automated to reduce the production cycle time and can be successful in providing a continuous supply of fuel.

## REFERENCES

1. Haag, A. L., "Algae Bloom Again," Nature, Vol. 447, May 31, 2007, pp. 520-521
2. X. Miao and Q. Wu, "Biodiesel Production from Hetero- trophic Microalgal Oil," Bioresource Technology, Vol. 97, No. 6, 2006, pp. 841-846.
3. S. Rajvanshi and M.P. Sharma. Micro Algae: A Potential Source of Biodiesel. Journal of Sustainable Bioenergy Systems, 2012, 2, 49-59.
4. C. Dayananda, R. Sarada, S. Bhattacharya and G. A. Ravishankar, "Effect of Media and Culture Conditions on Growth and Hydrocarbon Production by Botryococcus braunii," Process Biochemistry, Vol. 40, No. 9, 2005, pp. 3125-3131. doi:10.1016/j.procbio.2005.03.006
5. M. Kumar, M.P. Sharma and G. Dwivedi. Algae Oil as Future Energy Source in Indian Perspective. International Journal of Renewable Energy Research, 2013, 3, 913-921.
6. C. He, P. Baoxiang, W. Dezheng and W. Jinfu, "Biodiesel Production by the Transesterification of Cot- tonseed Oil by Solid Acid Catalysts," Frontiers of Chemi- cal Engineering in China, Vol. 1, No. 1, 2007, pp. 11-15.