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ALGAE AN ALTERNATIVE SOURCE OF BIODIESEL

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ABSTRACT

Due to increase in GHG emissions and industrial development the pressure on fossils fuels has increased tremendously. Developing Alternative energy has become one of the serious problems and constant increase development and technology is creating instability in environment, economy and industry. An alga has tremendous power to fight energy shortage all around the world because of its effective energy balance and carbon sequestration potential. The objective of this article is to cover the process for using microalgae as a potential feedstock for bio-diesel production.

To overcome these hurdles and develop one country future is to speed up the research efforts to develop appropriate technologies with available resources. The best investment will be to invest in the current available technologies to modify it in the best possible way.

KEYWORDS: GHG Emissions, Industrial Development, Biodiesel

INTRODUCTION

In recent years due to emerging economies and rapid increase in global population, demand for energy sources has highly increased. Based on the current usage, the available supply of non-renewable sources may last for next fifty years only. In addition to global warming and need for an alternative source it has put a tremendous pressure on ecological system. To meet the rapid increase of energy demand researchers are looking for a best alternative source of energy. In this context, hydrogen, biodiesel from algae and agro based biomass, bio-ethanol and shale gas etc. Plant based feedstock provides a sustainable source of renewable energy but developments are made to be made to meet the required composition of petrochemicals. The best sustainable and renewable feedstock which has the capacity to meet the world energy needs is algae. Microalgae feedstocks are gaining interest in the present day energy scenario and are the most promising source due to their fast growth potential coupled with relatively high oil content. Currently the most widely used form of biofuel is from food crops i.e., palm, oilseed rape and soybean. But the half of the energy savings will be spent in biodiesel processing itself if lifecycle of biofuel is considered. [1] This is why microalgae feedstock is better option. Advantages of microalgae over other feedstocks are:

- No agricultural land is required to grow biomass.
- They have much higher biomass than agricultural crops and less doubling time.
- They need less renewal water than terrestrial plants required for irrigation. They can be grown even in brackish water.[2]

Microalgae are highly specialized group of organisms that belongs the largest and complex group which can grow and survive in wide range of pH and changing temperature conditions. The ability of algae to exhibit a wide range of environmental conditions, to a large extent to survive is due to changing pattern of cellular lipids as well as the ability to modify lipid pathway in response to changes in environmental factor. The advantage of algae over other available

feedstock is their rapid growth rate and productivity. Other than that it has the ability to produce value-added co-products or by-products (e.g. lutein, DHA, EPA, biofertilizers and biomaterials). Microalgae have the capacity to produce high oil content e.g. (20-50% dry cell weight) of neutral lipids (Triacylglycerol) under stress conditions. Fatty acids are the building blocks of lipids and acetyl CoA is the major enzyme involved in lipid synthesis. Biodiesel consistently shows reduced exhaust emissions compared to petroleum diesel; many studies have concluded that biodiesel use results in the reduction of unburned hydrocarbon, particulate, and CO emissions. [3] Biodiesel demand has been constantly increasing due to fluctuations of world petroleum market. [4]

Overall Approach

Feedstock

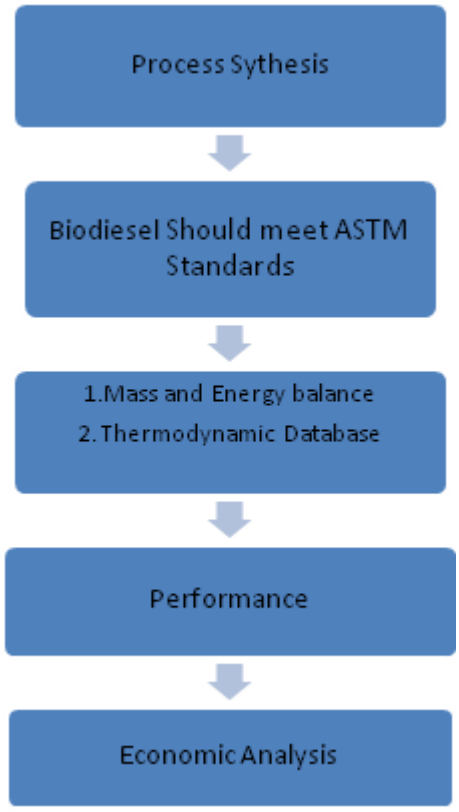

Figure 1

BIODIESEL PRODUCTION SYSTEM

The system consists of two major areas:-

Upstream Processing Section: Sequestering the carbon dioxide i.e., harvesting the algae and extracting lipids.

Pre-Treatment: Lipids treatment followed by transesterification to yield biodiesel. Making biodiesel from algae is a 4 step process that includes algae selection, harvesting and drying, lipid extraction, transesterification and separation.

Algae Selection: The selection of algae is based on algae oil and characterize in term of fatty acid composition. And these characteristics should use flue gas (Industrial gases) as major carbon dioxide source. The proportion of saturated, monounsaturated and polyunsaturated fatty acids should meet the requirements of the ASTM.

Harvesting and Drying: Algae can be cultivated in open (Raceway ponds) as well close system (Photobioreactor). Drying is the most expensive part of the process therefore there are many ways to dry the wet biomass like using industrial waste heat and excess flue gas.

Lipid Extraction: It can be extracted via chemical and physical process both. Bligh and dyer is the rapid method total lipid extraction whereas expeller/press can also be used to extract lipid physically.

Transesterification and Separation: Transesterification of biodiesel can be done three common ways i.e., acid catalyzed transesterification, base catalyzed transesterification or acid catalyzed esterification of feedstock. According to the literature of alkali catalyzed transesterification is the well established means of producing biodiesel. Conversion of one molecule of triacylglyceride in the algal oil reacts with three water molecules of methanol to produce three molecules of methyl esters (FAME), the biodiesel product and one molecule of glycerol.

Key Point 1: In June, 2010 EADS, the European defence company, demonstrated the first public flight of an aircraft with one engine powered by algae derived bio-fuel. This aircraft showed 5-10% fuel consumption as compared to conventional jet kerosene.

GENETIC ENGINEERING OF MICROALGAE

Genetic engineering is used to make wild species feasible for commercial production of biodiesel to improve productivity and yield. Metabolic engineering may lead to higher yield of desired lipids and better performance of biodiesel. Currently there is lot to understand the molecular pathways and lipid synthesis in microalgae. While culturing algae in nitrogen deprived media one can easily induce lipid accumulation which provides a useful experimental setup for studying metabolic activities. [5] Oil synthesis in a photosynthetic cell has very complex enzyme system which occurs in several sub cellular compartments. Current approach is in indentifying a key regulator or transcriptional factor that act as lipid trigger. Like researchers from Scripps Institution of oceanography did by mutating the fat-reducing enzymes called lipases, the researchers were able to increase lipids without compromising growth.

MICROALGAE PROCESS

Carbon source, micronutrients and vitamins are vital for microalgal growth. The appropriate balance between physical and chemical parameters is also very important part of the process – e.g. pH, temperature and light intensity. In order to obtain the desirable results one has to master with manipulation of these physiochemical process in obtaining good biomass and product control.

ECONOMIC ANALYSIS

Even with high advancement in algae biofuel technology the microalgae biofuel is still not viable for commercial use. The global cost associated with biodiesel production split into partial costs associated with biomass growth, harvesting, oil extraction and transesterification. Other operating and maintenance costs including nutrients, carbon dioxide supply and labour cost.

CONCLUSIONS

Renewable energy has become one of the most important issue and increase in usage of fossil fuels will create instability in environment, economy and industry. One can indeed see the potential offered by algae as biofuel in terms of energy balance and carbon sequestration. To provide a clear picture regarding the use of use of algae as biodiesel or bio-ethanol at commercial use one has to R&D centres have to invest and give more focus to this area at large scale and to

look for the ideal species. Major breakthroughs are still needed in developing bioreactor that could use industrial gases as main carbon substrate for harvesting and eventually meet with success. After extracting lipid the biomass residue should be used for fine chemical production. Novel researches are yet to be found to meet the requirements of richer countries due to increase in continuous demand of energy and food supplies.

REFERENCES

1. Helena M. Amaro, A. Catarina Guedes, F. Xavier Malcata, Advances and perspectives in using microalgae to produce biodiesel, Applied energy, Vol. 88, pp. 3402-3410, 2011.
2. Aslan S, Kapdan IK, Batch kinetics of nitrogen and phosphorus removal from synthetic waste water by algae. Ecological Engineering, Vol.28, pp. 64-70, 2006.
3. Lackey L, Paulson G, S. E. Energy Fuels, Vol. 26, pp. 686−700, 2011.
4. Damiani MC, Cecilia AP, Constenla D, Leonardi PI, Lipid analysis in Haematococcus pluvialis to assess its potential use as a biodiesel feedstock, Bioresource Technology, Vol. 101, pp. 3801–807, 2010.
5. Scott SA, Davey MP, Dennis JS, Horst I, Howe CJ, Lea-Smith DJ, et al. Biodiesel from Microalgae: challenges and Prospects. Current opinion in biotechnology, Vol. 21, pp. 277-86, 2010.