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Algae as a renewable energy Source: Potential and feasibility

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Abstract: Algae as a biodiesel is on the verge of being the best alternative for oil although algae are said to be economically viable at the end of 2040, so the algae biodiesel is the future of green technologies. This paper emphasizes on the usage of algae biodiesel the production rate, the amount of biodiesel produced from the per acre crops. The process of extracting biodiesel from algae. The economic viability of algae biodiesel the different products of algae biodiesel the economic viability of algae biodiesel. The advantages of algae and the future usage of algae biodiesel. Also, this paper discusses the possible impact of algae biodiesel on economy.

Keywords: Algae, Biofuel, Economy, Alternative Energy

Introduction

Our oil reserves are declining in a much greater rate than previously thought. We can sustain our oil reserves towards the end of 2047. So, we are trying to find a permanent solution to our problem. Thus, we are presented with alternative fuels. One of them is microalgae, we are facing a great threat towards our economy as the sea levels are rising due to global warming. So, we must find environmentally sustainable energy sources. Like alternative fuels, biodiesels. There has been a considerable increase in using microalgae as a biodiesel, as algae can produce 30 times more energy than other biodiesels per acre, they are very cheap to grow and economically feasible. Algae has been marked as a third-generation biofuel (Firoz Alam, 2015) From wheat barley molt and corn, Bioethanol and biodiesels have been extracted since 1960s, as algae grows 300 times more than any other biofuel crops.
In the following table we can see the comparison between algae and other bio-fuel crops, and the possible difference in per acre output

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Oil Yields	Liter/Hectare/Year	Barrels/Hectare/Year
Soybeans	400	2.5
Sunflower	800	5
Canola	1,600	10
Jathropha	2,000	12
Palm Oil	6,000	36
Microalgae	60,000 – 240,000	360 – 1,500

(Comparisn of Bio-Fuels , 2015)

Microalgae Production

Algae are a source of photosynthetic organisms who form in a wide range of conditions. They can form from the cold plains of tundra to the scorching deserts of Kalahari. Microalgae are grown in airlifted bioreactors. The microalgae production often the microalgae production includes transesterification process. Also, the cultivation of microalgae is done with hydroponics culture and bio-reactor synthesis. There are mainly two systems in algae cultivation, raceway pond systems and photobioreactors (PBRs) The raceway ponds are oval shaped ponds which are comprised of closed loop oval channels. The raceway ponds are usually 0.25e0.4 m deep and they are synthesized to produce algae as biofuels. The current or flow of the algae is maintained through regulated waves and the bioreactors have transparent pipes to regulate the flow of microalgae towards the other ponds from the central reactors. Thus, the reactors who produce algae for the fuel transesterification process must go through several steps before the algae is transfused as biofuel.

Algae Bio-signature and reduction of CO2

According to modern research algae biofuels can significantly reduce the amount of carbon-di-oxide emission, it has been tested that algae biofuel can lower the carbon output towards even to 68% the next table can show us this process in a nutshell

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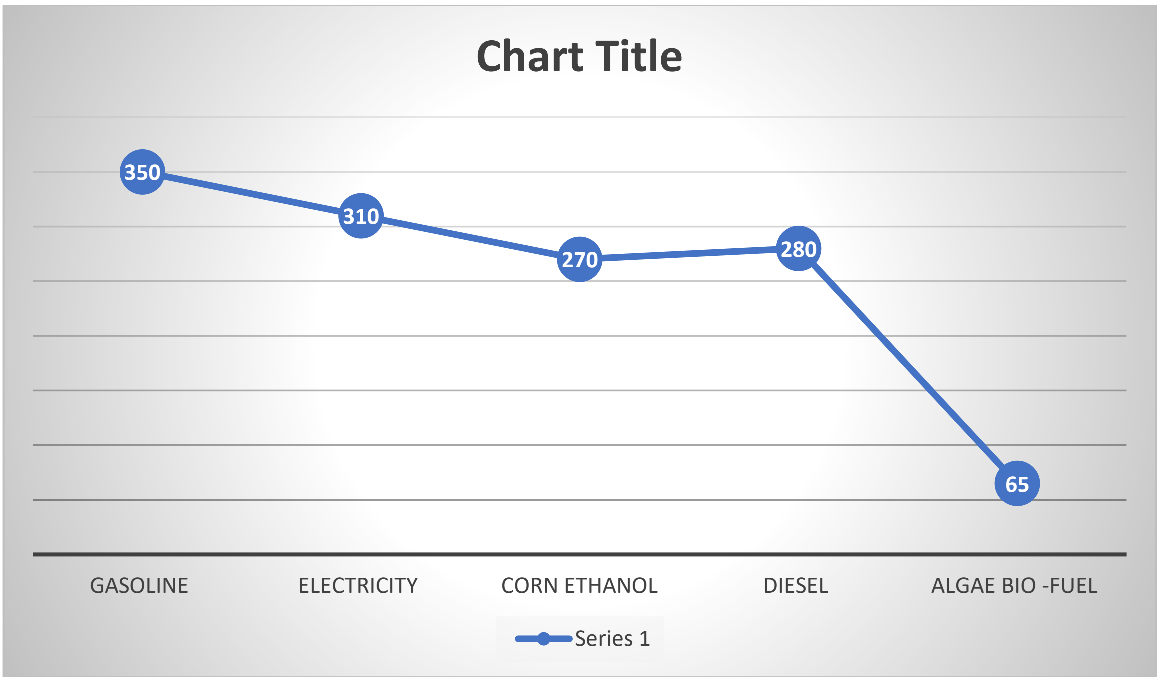

Chart: Carbon footprint of different fuels.

USA consumes about 6.95 billion barrels of oil every year, that is 19.5 million barrels per day. In this large equation biofuels only consist of 5% of all the fossil fuels that are burnt in USA. We can increase this number to a significant margin and can also reduce the amount of carbon-di-oxide to be precise, using microalgae as a fuel alternative. Not only microalgae can reduce the carbon footprint by almost 68% it can also re-use CO_2 and produce energy from it. The CF associated with the microalgae can be traced back to building phase and production phase The CF related with the building phase is 1.72 kg CO_2-eq/kg dry biomass, with stainless steel contributing the highest (approximately 45 percent of GHG emissions), borosilicate glass contributing 37 percent, and cast iron contributing around 12 percent. A carbon footprint of 66.62 kg CO_2-eq/kg dry is estimated for the PBR operation/microalgae culture stage.

Microalgae biofuels are also a very efficient source of energy production it has been forecasted that if we turn all of USA fuels to alternative biofuels it will take half of the USA land on the other hand if we use algae biodiesel, we can only grow it inside an area as large as Maryland.

Methods for extracting algae

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The most renown method for converting algae into biodiesel consist of the downstream method, where the water is used in different reactors and then the entire population of algae are transferred towards the reactor where they are converted into biofuel.

Aside from the economics, the microscopic size of a microalgal cell (>10 m in diameter) in a diluted culture media (less than 2 g/L) and a density close to that of water make microalgal harvesting one of the main obstacles for microalgal biodiesel production. Furthermore, the negatively charged surfaces of the microalgae prevent these organisms from settling naturally. Unfortunately, the optimum method for harvesting different microalgal species has not yet been established. Because of it, an appropriate harvesting technique that improves both the economics and the efficiency of the process based on the intended products and/or the biology of the microalgal species must be devised.

Most microalgae techniques for harvesting are generally borrowed from the water purification technique. The techniques which are used in the downstream method must meet the choices and the possible remedies for the microalgae extraction.

When developing an efficient harvesting plan, keep the following factors in mind.

(1) The harvesting process used is determined by the features of the microalgae species and the type(s) of product sought (s).

(2) The combination of several harvest procedures can compensate for the shortcomings of the individual approaches.

(3) The cell separation must be done in a separate area and so the areas that are covered in that phase can be properly used and the maximum extraction in the lowest cost can be made possible from that.

(4) The post extraction effects must be minimized

(5) The study and scientific pursuit of finding more efficient algae production should be implemented.

There are several methods which exist today. Main of them is centrifugation.

Centrifugation

Centrifugation is a physical dewatering method that relies on the creation of a centrifugal force that operates radially and accelerates particle movement and separation based on the density differential between the particle and the medium around it. The denser particles will flow outwards in this instance, while the less dense particles would move inwards.

Centrifugation is a reliable method for separating very dilute liquids when used at appropriate rotating rates. The separation process in this context is primarily based on the particle size and density difference of the medium components. Using this technique, it is possible to attain a higher biomass concentration. depends mostly on the settling properties of the cells, the slurry retention period in the centrifuge (which is regulated by the flow rate), and the settling depth, which may be reduced by centrifuge design [23,52,53]. Centrifugation, according to Javed et al. [54], may be employed successfully to recover microalgal biomass, with 80–90% biomass recovery within 2–5 minutes. Another significant advantage of this approach is the absence of the need for chemical additives

Centrifugation Method can be used for following reasons

*It can achieve a production efficiency of 20% watery solution mass

*It can be used to produce a biomass recovery of >90%

*As no chemicals are used the production cost goes down a lot.

Economic Feasibility

There is certainly a need for sustainable biofuel production, but whether a specific biofuel will be employed ultimately depends on economic efficiency rather than sustainability. As a result, research is concentrating on lowering the cost of algae biofuel production to a level where it can compete with traditional petroleum. [45] [151] The ability to produce variety of products from algae has been identified as the most essential aspect in making algae production commercially feasible. Other variables include increasing the efficiency of solar energy to biomass conversion (now 3 percent, although 5 to 7 percent is theoretically achievable [152]) and making oil extraction from algae simpler.

With present technology, the cost of generating microalgal biomass is projected to be $2.95/kg for photobioreactors and $3.80/kg for open ponds. These figures assume that carbon dioxide is free. When the yearly biomass production capacity is expanded to 10,000 tons, the cost of production per kilogram falls to around $0.47 and $0.60, respectively. If the biomass contains 30% oil by weight, the cost of biomass for producing a liter of oil would be around $1.40 ($5.30/gal) for photobioreactors and $1.81 ($6.85/gal) for raceways. Oil extracted from low-cost biomass generated in photobioreactors is expected to cost $2.80 per liter.

While the industry is effectively addressing technical issues like harvesting, many consider the expensive up-front investment of algae-to-biofuels plants as a key barrier to the development of this technology. Simply a few studies on economic viability are publicly available, and they frequently rely on the little data (typically only engineering estimates) that is available in the public domain. Dmitrov [157] evaluated the Green Fuel photobioreactor and calculated that algal oil would be competitive only at $800 per barrel of oil. Alabi et al. investigated raceways, photobioreactors, and anaerobic fermenters to produce biofuels from algae and discovered that photobioreactors are too costly to produce biofuels. Raceways may be cost-effective in warm areas with low labor costs, while fermenters may be cost-effective with substantial process improvements. The researchers discovered that the capital, labor, and operating costs (fertilizer, power, etc.) are all too expensive for algal biofuels to be cost-competitive with conventional fuels on their own. Others discovered similar results, implying that until new, less expensive methods of harnessing algae for biofuel production are discovered, its tremendous technical potential will be wasted.

Advantages of Algae fuel production

1.Low carbon emission: The algae biodiesel has the lowest carbon emission of all the bio-fuels algae can be used to reduce carbon emissions by 68%
2.Ease of land: Algae can be grown into lands that are unsuitable for regular crop growth. Algae can be grown in marshlands and other watery inhabitable landmasses.
3.Minimization of Waste: Algae wastes are minimum, as algae can be converted almost entirely into oil, and it has very low wastage or by-products.

Disadvantages

High water consumption: Algae consumes very high water to produce, algae biodiesel production requires 607 to 1744 liters of water per liter.
Lower Stability: The polyunsaturated fats can become very unstable in regular seasonal situations.
Economic Viability: The algae biodiesel is only 30-year-old project, algae productions are highly made from unprofitable sources, the economic feasibility of algae biodiesel is almost 25 years away. Although research has shown that the production costs can be reduced by 100%

Conclusion

Although economically unprofitable the algae biofuel projects remain the most potential project ever, as it has very low carbon emission can be used to non-food supplements can be used to produce jet fuels. It Has a lot of biproducts. Can be used to reduce pollution

Can be made economically viable can be the solution for the green technological revolution. The environmentally friendly technology revolution also can be used for a post oil economy. The world needs a better solution than oil and can be considered to end the energy conflict for all time. The algae can hold the key to produce our global energy as efficient low carbon emitting and economically

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cheap effective low-cost alternative fuel. Which can contribute towards our growing economy and energy need.