

Algae Biofuel: Futuristic Trends in Fuel Industry

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Abstract - The need of energy is increasing constantly because of increase in population and industrialization globally. Human population, technological integration, and improved lifestyle continuously add the pressure for generation of energy. Energy and related services are the backbone of growth and development of any country. The present scenario indicates use of non-renewable sources namely coal, petrol, diesel, nuclear fuel, natural gas, etc. for the production of energy. Fossil fuels are limited in amount and are major cause for pollution and emission of green house gases (GHG). Hence, efforts are being made to investigate alternative source of energy which must be readily available, environmentally acceptable, technically feasible and economically competitive.

This research paper talks about energy from biomass (one of the renewable source of energy). Algae can be used as a fuel for the automobile. Sewage water algae are having calorific value around 15000kJ/kg which is comparable with the Indian coal used for power production.

Key Words: fossil fuel, algae, calorific value .

1. INTRODUCTION

Most of the Indian demand of energy is satisfied with the importing petroleum products from the foreign country. Power consumption per capita symbolizes the development of the said country and living standard of their citizens. Affordable energy contributes to rise in productivity, reduction in poverty and improving betterment of life. Reduction in the availability of fossil fuel in the earth with a rising fuel demand causing global worry and hence opens new doors for the research on alternative sources of energy. Hence, efforts are being made to investigate alternative source of energy which must be readily available, environmentally acceptable, technically feasible and economically competitive.

Solar energy, wind energy, tidal energy, hydal energy, energy from biogas, energy from biomass, fuel cell, geothermal energy etc. are different resources for production of energy via renewable energy resources. Biodiesel production from biomass is now considered to be the most recent, challenging and interesting field for researchers.

Recent research shows that biodiesel from algae (third generation for biofuel generation) is the most promising renewable fuel derived from biomass. Figure 1 shows SWOT analysis of potential of biofuel in India.

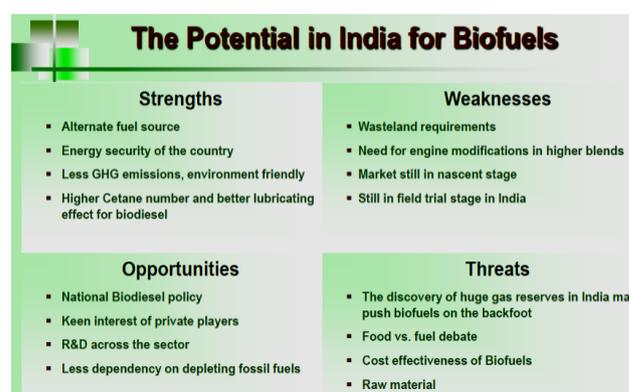


Figure 1: SWOT Analysis [DBT-CII Report 2010]^[2]

The first generation of biomass was using groundnut, cottonseeds, risebrans, coconut, mustard, palm etc. has a raw material for the production of biodiesel. In above case, there is a matter between food v/s fuel and in that case always food will win. Hence, the first generation of biomass was not feasible solution for production of biodiesel. The second generation of biomass contains jojoba, mahuva, karanj, Jetropha, kokum, castor been, neem etc. as a raw material for the production of biodiesel for production of power or to run vehicles. Table 1 depicts generation of biofuels;

Table 1: Generation of biofuel^[3]

First generation Biofuels :	Grains and sugar to Ethanol , Vegetable oil to Biodiesel.
Second Generation Biofuels :	Lignocellulose to Alcohols , Lignocellulose to Green Diesel ,Vegetable oils to Green Diesel.
Third generation Biofuels:	Biomass to Hydrogen , Algal Hydrogen , Algal Oil/Biodiesel.
Fourth generation Biofuel :	Biofuel from high solar , efficiency cultivations

2. ABOUT ALGAE

Algae are one of the most photosynthetically efficient plant sources available in the entire world with the single

cellular structure. There are various ways to classify algae, like;

- 1) According to plant kingdom,
 - Spore Bearing Plants- algae, ferns, mosses,
 - Seed Bearing Plants- flowering plants,
- 2) Based on pigment,
 - Green algae,
 - Red algae,
 - Brown algae,
 - Green-blue algae.

Like plants, algae require primarily three components to grow: sunlight, carbon-dioxide and water. Photosynthesis is an important bio-chemical process in which plants, algae, with some bacteria convert the energy of sunlight to chemical energy.

Following unique characteristics of algae makes attentions of researcher, scientist, industrialists, R & D peoples etc, towards it;

- a) It is renewable source of energy (cleaner and greener alternative),
- b) It is available worldwide,
- c) It is eco-friendly in nature or less pollutant, negligible emission of SO_x and NO_x,
- d) In India, algae is not used as a fuel,
- e) It requires very less or no need of fresh water for growth,
- f) Under optimal conditions, algae mature within 18 to 20 hours (daily production is possible for oil),
- g) Algae possess self contained oxygen and hence complete combustion of derived fuel in the engine cylinder is possible,
- h) Algae act as cleaning agent. And hence for cleaning of waste water or for water treatment algae can be used,
- i) One can earn carbon credit by carbon sequestration using algae,
- j) Its co products / process outputs are mainly biochar and glycerol. Biochar can be used as animal feed, seeds for poultry farms, or can be used as fuel pallets for production of biogas / methane for generation of carbon free electrical energy. Glycerol has also many applications in the market.

Algae range from small, single-celled organisms to multi-cellular organisms, some with fairly complex and differentiated form. Algae are usually found in damp places or bodies of water like sea, lakes, ponds, rivers, canals, bogs, marshes, blackish water and swamps - salt marshes, salt lakes and places where the water is stored and thus are common in terrestrial as well as aquatic environments. Table 2 represents the strong comparison of algae v/s other crops for the production of biofuel.

Table 2: Comparisons of different crops^[5]

Sr. No.	Crop	Oil yield (L/ha per year)	Land area needed (M ha)
1	Corn	175	1542
2	Soybean	444	595
3	Canola	1193	225
4	Jetropha	1895	139
5	Coconut	2690	96
6	Oil palm	5951	44
7	Microalgae	136905	2.1

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3. STEPS FOR ALGAE TO BIODIESEL CONVERSION

Algae-to-biofuel production is divided into four stages, namely a) Algae cultivation, b) Biomass harvesting, c) Algae oil extraction, and d) oil and residue conversion. Each of the first four stages is further subdivided into basic, individual, or multiple processes to explain the primary components of algal biofuel production that may have positive or negative environmental externalities^[6].

4. COLLECTION OF ALGAE

The saline water which contain more amount of impurities like carbon, phosphorus, sulfur etc. with sufficient 08 to 10 hours of sunlight and average atmospheric temperature of 20°C to 28°C cause favorable condition for the algae to mature faster. Hence, test sample from sewage water is collected and laboratory testing (proximate analysis) is decided.

The sample of waste water algae was collected near Panchamahall dairy, Godhra. The cultivated algae was collected, dewatered and dried with help of natural sunlight. The dried algae samples were sent for laboratory test at Vadodara and at Vallabh Vidyanagar, Anand. Figure 2 represents various steps of algae harvesting and dewatering of sewage water algae.



Figure 2: Harvesting and dewatering of sewage water algae

5. RESULT AND DISCUSSION

Proximate analysis [31] is the one in which only fraction of moisture, volatile matter, ash, carbon etc. are determined. Thus proximate analysis is not exact and gives only some idea about the fuel composition.

Proximate analysis of coal gives various constituents in following range, Moisture 3–30%, Volatile matter 3–50%, Ash 2–30% and fixed carbon 16–92%.

Comparison of conventional fuel (diesel and Indian coal) with different collected algae samples using proximate analysis (in which only fraction of volatile matter, ash, moisture content, carbon etc. are determined) is shown in Table 3.

Table 3 : Comparison of various algae samples and other fuels with proximate analysis

Sample Type	Moisture (%)	CV (KJ/Kg)	Ash (%)	FC (%)	VM (%)
Diesel	0	41000-44800	0.006	-	-
Coconut shell powder [32]	----	19601	0.35	20.58	79.07
Almond [32]	----	19582	1.63	21.54	76.83
Coal[29]	4.5	15039	34.56	24.6	25.04
Algae from Sewage Water	5.04	13041.6	37.38	7.01	50.12

- % moisture content in algae is very nearer to the Indian coal used for power production in the thermal power plants.
- Calorific value and fixed carbons in the algae samples are less than the coal .
- % ash content and % volatile matters in algae sample is found more than that of coal.

6. CONCLUSION

From the laboratory test reports, the calorific value of sewage water algae is found competitive with that of coal. So product obtained from the above algae i.e. algae biodiesel may have considerable calorific value compare to the diesel. And hence algae can be used as a fuel and thereby the oil obtained from it may be used as a fuel for automobile.

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BIOGRAPHIES



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