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Concurrent of Different Techniques For Biofuel Production Fromalgal Biomass

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Abstract: Biofuel can be made from edible, no edible and animal fats by different oil extraction and conversion techniques can be directly used as alternative fuel in diesel engine. This paper argues the different conversion technique for biofuel production. Conversion technique affect the economic viability of the process, which affect the commercialized of the biodiesel.

Keyword: Biodiesel, oil extraction, conversion.

1. Introduction: The increasing fuel costs, environmental degradation with the use of fossil fuels promotes the production of renewable fuel [1]. Biodiesel has attracted the researcher attention as a source of renewable fuel [2]. Renewable energy deal with issues raised by the fossil fuel, like GHG emissions and provide greater energy security.

In India consumption of diesel is five times more than gasoline fuel and biodiesel is the best candidate for the replacement of diesel fuels. Biofuel can be used as blending or direct replacement for diesel fuel in existing diesel engine without any modification and in term of environmental perspective, carbon dioxide, carbon monoxide and sulfur emissions were reduced [3].

The edible and non-edible oils which used for production of biodiesel included high raw material cost, collection difficulty and adverse impact on the food chain are the major reasons for non-commercialization of biofuel production. Algal biomassis more efficient than other biomass to produce oil with one or two times higher oil production capacity than any other crop[4].

The algal biomass can be converted into different energy forms by using biochemical and thermo-chemical process. These processes can produce different biofuels like, bio-oil, biodiesel,bio-syngas and hydrogen. This investigation focused on different biofuel production from algal biomass.

2. Biomass to biofuel conversion: The different conversion technologies i.e. thermochemical, biochemical and direct combustion as shown in figure 1 are discussed in this section.

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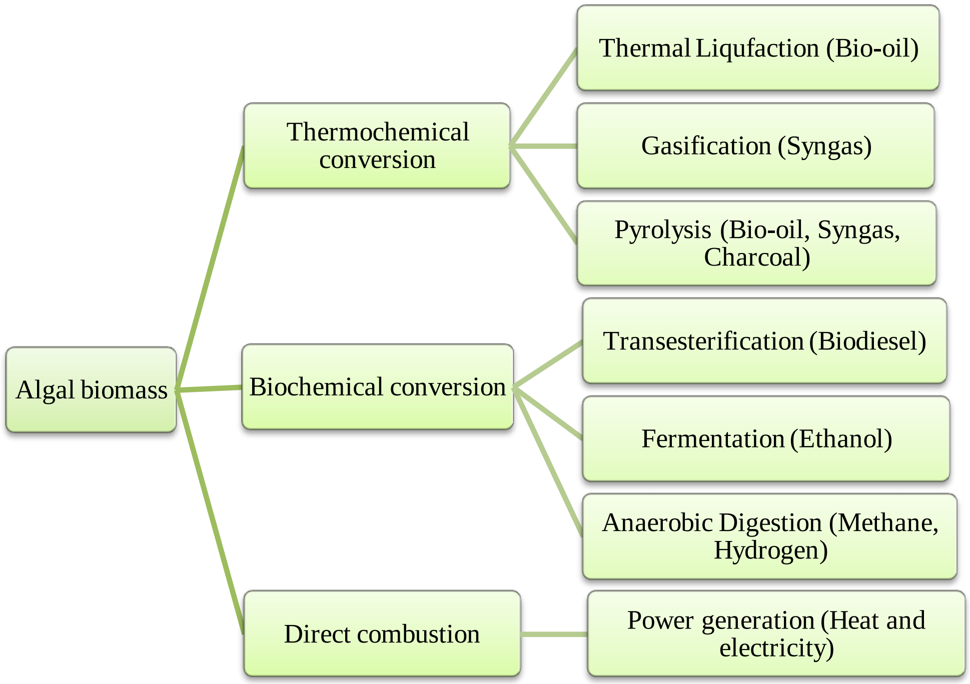

2. Thermo-chemical conversion: The process such as hydrothermal liquefaction (HTL), gasification, pyrolysis and supercritical fluid extraction (SFC) can be used for the conversion of algal biomass into biofuels. These processes convert the whole algal biomass into biofuels [4].

2.1 Hydrothermal liquefaction (HTL): The HTL of algae is performed with or without catalysts at high temperature and pressure, i.e. 250-500°C and 5-20 bar [5]. Algal biomass is much better than lignocellulosic biomass as feedstock for HTL. In case of spirulina sp. Shown 54% yield via HTL without catalyst.

2.2 Gasfication: In gasification process the combustion of algal biomass is performed at 800-1000°C in the absence of oxygen or air, with the help of conventional gasification process, hydrogen, methane and syngas can be produced. In new and advanced super-critical water gasification (SCWG) process the temperature and pressure range are 375-550°C and 22.1-36 MPa with aiding some catalysts (NaOH and KOH) [5].

2.3 Pyrolysis: The thermal decomposition of algal biomass by heating of it in the absence of air at 400-600°C temperature and atmospheric conditions is known as a conventional pyrolysis process. In microwave pyrolysis the temperature range is up to 800°C and minimum 300°C is required catalytic [6]. Algal biomass is better feedstock for pyrolysis than lignocellulosic biomass because bio-oil is produced from algal biomass.

3. Biochemical conversion: In biochemical conversion enzymes/micro-organisms plus heat and some catalysts are used to breakdown algal biomass into liquid fuels. The less energy is utilized in the biochemical conversion as in thermochemical conversion of algal biomass into fuel. The

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transesterification, fermentation and anaerobic digestion, these conversion process are included under biochemical conversion process.

3.1 Transesterification: This process includes two steps for biodiesel production from algal biomass, first: extraction of algal oil from algal biomass and second: conversion of extracted oil into biodiesel via multiple chemical reactions. This process has gained a lot attention in now a days for biodiesel production but the economic feasibility is the major issue due to high enzyme cost [4]. This issue can be overcome by in-situ transesterification process which eliminate the oil extraction and purification process and convert algal biomass into biodiesel. Chlorella sp. of algae shown 98% yield with sulfuric acid (20 wt.%) at 60°C in 4 h [7].

3.2 Fermentation: In this chemical breakdown of like cellulose, starch and sugar are occurring and converted into bioethanol, there is a high amount of starch is available in algal biomass which make it more suitable for fermentation process. Chlorocoum sp. showed ethanol concentration of 14.25 g/L^{-1} [8]

3.3 Anaerobic digestion: In this process the organic wastes are converted into carbon dixode and bio-methane with some traces of hydrogen sulfide via breakdown into enzymes/micro-organisms. This biochemical conversion process is most suitable for wet biomass, includes three sequential steps, first: hydrolysis, second: acetogenesis and third: methanogenesis. The process depends upon the hydraulic retention time and digester design. C. sinuosa and G. bursa-pastoris had great potentials to produce 74.68 and 86.35mL/g VS respectively [9].

4. Direct combustion: Thermal power plant released 3000t of carbon dioxide per day, which can be utilized for algal cultivation plant and with the help of 5.4t of carbon dioxide around 3t of algal biomass can be produced per day, which is also coupled with 1.19t of biodiesel prodcution capacity. The algal biomass has 28 MJ/kg calorific, but coal have 27 MJ/kg, so algal biomass can burn in the presence of air in the furnace for reducing the coal usage. Arround 430 t per day coal is used in 126MW power plant, but via co-firing of 3t algal biomass per day can reduced 1026 t of coal usage per year [10].

5. Conclusion: Based on the review of different process for biofuel production from algal biomass, different conversion technologies have highlighted and recommended. Almost all biofuel conversion techniques are suitable for biofuel production form algal biomass. The production of algal biomass is fixed the carbon dioxide and produced green fuel.

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