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Perspective

Formation of Biobutanol, Methane and Jet Fuel from Algae

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DESCRIPTION

Algae are the source of the energy dense oils used in algae fuel also known as algae biofuel or algae oil which is a substitute for liquid fossil fuels. Algae fuels are a substitute for well-known biofuel sources like corn and sugarcane as well. It can be referred to as seaweed oil or fuel when manufactured from seaweed.

Several businesses and governmental organizations are sponsoring initiatives to lower startup and running costs and make the sale of algae fuel feasible. Algae fuel and other biofuels only emit CO_2 that has recently been extracted from the atmosphere through photosynthesis as the algae or plant developed in contrast to fossil fuels which release all CO_2 when burned. Interest in algaculture for producing biodiesel and other biofuels utilizing land unsuitable for agriculture has increased as a result of the energy crisis and the global food crisis. Algae fuels are appealing due to their high flash point, ability to be created utilizing salty and wastewater, ability to be cultivated with little disruption to freshwater resources, biodegradability and relative environmental safety. Algae have higher capital and operating expenses than other second-generation biofuel crops but they are reported to produce 10 to 100 times more gasoline per unit area. According to the US Department of Energy 15,000 square miles or roughly half of Maine's geographical area would be needed to replace all of the country's petroleum-based fuel if algae fuel were to be used instead. Less than 1/7th of the maize harvested in the US in 2000 was grown on this area.

Depending on the manufacturing techniques and the component of the cells being used algae can be transformed into a variety of fuels. As with any other vegetable oil, the lipid or oily component of algae biomass can be recovered and processed into biodiesel or it can be refined into "drop-in" substitutes for petroleum-based fuels. Algae's carbohydrate content can also be fermented to create bioethanol or butanol fuel after lipid extraction.

Biobutanol

Only a solar-powered bio refinery is required to produce butanol from algae or diatoms. This fuel has an energy density that is 10% higher than ethanol and 10% higher than methanol but 10% lower than gasoline. Butanol can replace gasoline without requiring any adjustments in the majority of gasoline engines. Butanol consumption was shown to be comparable to that of gasoline and it offers superior performance and corrosion resistance when combined with gasoline. Butanol can be made from the green waste left over after extracting the oil from the algae. Furthermore, it has been demonstrated that the genus Clostridia of bacteria may ferment macro algae into butanol and other solvents. It is also feasible to transesterify seaweed oil using species like Chaetomorpha linum, Ulva lactuca and Enteromorpha compressa.

Methane

Algae can be used to produce methane the primary component of natural gas through the processes of gasification, pyrolysis and anaerobic digestion. Methane is extracted under conditions of high pressure and temperature in gasification and pyrolysis processes. Anaerobic digestion is a simple process that involves breaking down algae into its simplest components then using microbes like acidogenic bacteria to convert those components into fatty acids. Next, any solid particles are removed, and then methanogenic archaea are added to release a gas mixture that contains methane. The microalgal biomass can be anaerobically digested to produce biogas.

Therefore, it is recommended to recover the energy present in waste biomass *via* anaerobic digestion to methane with the purpose of improving the overall energy balance of microalgae growing operations.

Jet fuel

Even though there is no evidence that using algae is a viable source for aircraft biofuels, Lufthansa and Virgin Atlantic conducted tests of using algae as fuel as early as 2008. The production of fatty acid methyl esters and alkenones from the algae Isochrysis was being probe as a potential feedstock for

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aircraft biofuel in 2015. With a prediction that only 3% to 5% of fuel requirements may be met by algae by 2050, there had been minimal development in the production of jet fuel from algae as of 2017.

Additionally, businesses that were founded in the early 21st century to serve as the foundation for an industry producing algae-based biofuels have either shut down or altered their focus to produce other goods like cosmetics, animal feed or specialty oil products.