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Aspen plus simulation of the conversion of biomass to liquid hydrocarbon fuels: Design and feasibility study

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Energy scarcity suggests that the oil demand would surpass the oil production in near future. As a result, the driving force towards sustainability and renewable energy has increased. Research efforts in the renewable energy and synthetic fuel areas have been increasing promptly as a response to the downshift trend in oil supply. The usage of biomass as a potential feedstock to produce liquid hydrocarbon fuels has been under investigation in the last decade. This paper discusses a preliminary design and a feasibility study of producing liquid hydrocarbon fuels from biomass. The process involves anaerobic digestion (AD) of the biodegradable portion of the biomass to produce methane rich gas. The methane rich gas stream is purified from contaminants and upgraded to liquid hydrocarbon fuel in a gas to liquid facility (GTL). The upgrading unit includes two major steps: Tri-reforming step to produce syngas and Fischer-Tropsch Synthesis (FTS) step to convert syngas to a wide spectrum of hydrocarbons. Separation of the produced hydrocarbon mixture allows production of synthetic transportation fuels. Anaerobic digestion is ranked as one of the best waste management options as it allows for: Energy recovery, nutrient recovery and reduction in greenhouse gases emission. Traditional landfilling can produce greenhouse gases which can eventually vent to the atmosphere even if flaring system is integrated. Economic and profitability analyses are performed for the proposed process design and results are discussed in this paper. The composition of the final liquid hydrocarbon from the Aspen model has been compared to the composition of commercial diesel fuel and results have shown good agreement. As a result, the most current commercial diesel prices were used to evaluate the potential revenue from selling the product in the open market.

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