Inventions & Innovation Project Abstract

Fuel Gas Generation from Biomass Waste via Aqueous-Phase Carbohydrate Reforming (ACR) Processes

This project addresses the feasibility of generating medium to high-energy content fuel gas (20 to 34 mJ/Nm^3) from biomass-derived carbohydrates utilizing a novel low-temperature aqueous-phase reforming process. The core of the innovation is the recent discovery that it is possible to generate hydrocarbon-rich fuel gas by reactions of carbohydrates with liquid water at low temperatures (near 200° C). Characteristics of this novel aqueous-phase carbohydrate (ACR) process are: (i) generation of fuel gas at low temperatures without the need to volatilize water, which represents a major energy saving, (ii) operation at temperatures where the water-gas shift reaction is favorable, making it possible to generate high-quality fuel gas with low amounts of CO in a single chemical reactor, (iii) utilization of renewable biomass derived feedstocks grown in the U.S., and (iv) operation at temperatures which minimize undesirable decomposition reactions typically encountered when carbohydrates are heated to elevated temperatures. This novel process would allow a new route for renewable fuel gas generation utilizing aqueous-phase carbohydrates extracted from low-cost biomass waste such as corn stover.

The process is an appropriate complement to the emerging technology of efficient internal combustion engines (ICEs). Some of these engines are being designed to operate on natural gas. The feedstock for this natural gas is currently fossil in origin. Virent's proposed process provides a route to deliver a renewably derived fuel for these engines. The combination of the ACR derived fuel gas and an efficient ICE provides a method for sustainable mechanical and electrical generation that is greenhouse gas neutral. (The CO_2 emitted from the ACR process is consumed by the next year's growth of biomass.) The ACR outputs are scalable within all ICE applications. The energy savings gained by displacing a non-renewable fossil fuel with a renewable, U.S. based fuel is tremendous. Virent calculates that if only ten percent of the available corn stover was used as the biomass feedstock, over 71 trillion BTU of fuel energy would be displaced from fossil origins.

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