NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Cost Effective Bioethanol via Acid Pretreatment of Corn Stover, Saccharification, and Conversion via a Novel Fermentation Organism

Cooperative Research and Development Final Report

CRADA Number: CRD-12-485

NREL Technical Contact: Nancy Dowe (Farmer)

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Cooperative Research and Development Final Report

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

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CRADA Title: Cost Effective Bioethanol via Acid Pretreatment of Corn Stover, Saccharification, and Conversion via a Novel Fermentation Organism

Parties to the Agreement: Honda R&D - Green Earth Institute

Joint Work Statement Funding Table Showing DOE Commitment:

Estimated Costs	NREL Shared Resources
Year 1	$ 00.00
Year 2	$ 00.00
Year 3	$ 00.00
TOTALS	$ 00.00

Abstract of CRADA Work:

This research program will convert acid pretreated corn stover to sugars at the National Renewable Energy Laboratory (NREL) and then transfer these sugars to Honda R&D and its partner the Green Earth Institute (GEI) for conversion to ethanol via a novel fermentation organism. In phase one, NREL will adapt its pretreatment and saccharification process to the unique attributes of this organism, and Honda R&D/GEI will increase the sugar conversion rate as well as the yield and titer of the resulting ethanol. In later phases, NREL, Honda R&D, and GEI will work together at NREL to optimize and scale-up to pilot-scale the Honda R&D/GEI bioethanol production process. The final stage will be to undertake a pilot-scale test at NREL of the optimized bioethanol conversion process.

Summary of Research Results:

Biomass sugars can be a challenging feedstock for biofuels production. In the case of the "biochemical" conversion route to biofuels, the biomass sugars produced from the pretreatment and enzymatic hydrolysis of the residual solids contain a mixture of six-carbon and five-carbon sugars along with other compounds that are inhibitory to microorganisms. The challenge is to maximize sugar production, minimize inhibitor production, and develop organisms that maximize product yield and productivity.

In 2011, NREL, Honda R&D, and the Research Institute of Innovative Technology for the Earth (RITE) entered into a research partnership to develop low-cost fuel ethanol from agricultural residues and other cellulosic feedstocks using *Corynebacterium glutamicum (C. glutamicum)*. NREL provided dilute-acid pretreated corn stover (PCS) samples to RITE for initial testing with its organism. As a result of the initial work, NREL prepared a wide range of PCS samples by varying acid loadings (including no acid), pressure, and residence time using a 4-L steam-injected pretreatment reactor. The varying pretreatment conditions produced material with different sugar yields and amounts of potential fermentation inhibitors (acetic acid, furfural, hydroxymethylfurfural, among others). RITE enzymatically hydrolyzed the PCS and performed fermentations with its strain. Fermentation results showed good conversion and sugar utilization by *C. glutamicum* of all the PCS tested. NREL, with assistance from Honda R&D, used the pretreatment and fermentation yield results from the experimental work to develop a techno-economic model specific to the process envisioned by Honda R &D and GEI. New experimental work to address technical gaps in the process economics was proposed for phase two of the CRADA.

Subject Inventions Listing:

No inventions were made.

Report Date:

1-27-2014

Responsible Technical Contact at Alliance/NREL:

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