the ENERGY lab

PROJECT FACTS

Fuels

Development of Biomass-Infused Coal Briquettes for Co-Gasification

Background

Domestically abundant coal is a significant primary energy source and, when mixed with optimum levels of biomass, has lower carbon footprint compared to conventional petroleum fuels. Coal and biomass mixtures are converted via gasification into synthesis gas (syngas), a mixture of predominantly carbon monoxide and hydrogen, which can be subsequently converted to produce liquid fuels and chemicals by Fischer-Tropsch chemistry. Custom coal/biomass blends can ensure the availability of abundant and affordable domestic feedstocks for production or co-production of clean, low-cost, and environmentally-sustainable power, fuels, and chemicals in support of the Nation's energy economy.

The Department of Energy (DOE) is committed to supporting research aimed at making use of the nation's coal and biomass resources to produce affordable power, fuels, and chemicals using methods that are less damaging to the environment than current methods using coal. One area of research is the development and characterization of multiple coal-biomass mixtures and types that are transportable, storable, and which can be fed directly into gasification systems using existing equipment. In alignment with this commitment, NETL is partnering with CoalTek Inc. (CoalTek) to develop biomass-infused coal briquettes for co-gasification.

Project Description

This project will demonstrate the application of a CoalTek proprietary microwave process for treating energy feedstock materials. The process combines coal and biomass to produce an economically viable and suitable single-stream feedstock for co-gasification. During Phase I of the project, the research team will focus on microwave processing, batch-scale production, and laboratory characterizations of briquettes with the objective of identifying the combinations of biomass and coal types with cost effective binders that provide the most suitable briquetted product for co-gasification. Durable, high-Btu briquettes (>200 lbf compressive strength; ~14,000 Btu/lb) will be sought which exhibit excellent integrity and carbon burn-out characteristics during gasification. During Phase II, the team will use a larger scale, continuous mode process to demonstrate the performance of the co-briquetted fuels during co-gasification in two different pilot-plant designs, one with a fixed-bed gasifier and one with a fluidized-bed gasifier. In addition, the team will use data from the larger scale units to produce realistic cost estimates for the construction and operation of a commercial-scale biomass-coal briquetting plant based on CoalTek's proprietary microwave process.

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PARTNERS

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PERFORMANCE PERIOD

Start Date	End Date
10/01/2010	12/31/2013

COST

Total Project Value
$1,829,288

DOE/Non-DOE Share
$999,472/ $829,816

AWARD NUMBER

FE0005293

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U.S. DEPARTMENT OF ENERGY

Goals and Objectives

The overall goal of the project is to develop and demonstrate a process for combining coal and biomass to produce an economically viable and suitable single-stream feedstock for co-gasification. The main objective of Phase I is to perform batch-mode laboratory evaluations to accurately identify combinations of biomass and coal types that produce a briquetted fuel that will withstand the rigors of shipping and storage and provide a suitable single-stream feedstock for co-gasification. Phase I work includes production of briquettes using four types of biomass added at both 10 and 30 percent dry weight to samples of bituminous, sub-bituminous, and lignite coals; production of briquettes both with and without a binding agent from these combinations; evaluation of briquettes made with a bio-oil binder and a biochar filler produced by fast pyrolysis; and an extensive characterization of the chemical and physical properties of all briquetted products. Phase II objectives include modifying, implementing, and producing biomass-coal briquettes in a pilot-plant facility; evaluating at least two briquetted products in both fluidized-bed and fixed-bed gasifiers; designing a commercial-scale facility; and evaluating the potential environmental impact of briquette production. In addition, the research team will develop a process economic model to include an assessment of the biomass supply chain and an estimate of capital and operating costs for the commercial-scale plant design.

Accomplishments

The most promising coal-biomass combinations evaluated for binderless briquetting were identified as 10% corn stover with sub-bituminous coal and 30% wheat straw with bituminous coal. Evaluations were also conducted on other aspects of the preparation process including studies of particle size and microwave drying effects on briquette durability ad strength. Significant progress has also been made on identifying the best performing binders for MW processing and co-briquetting of coal and biomass.

Benefits

The production of coal-biomass briquettes that are transportable, storable, and suitable for feeding existing gasifiers will allow the U.S. to increase use of domestic resources for energy production and decrease emissions of toxic pollutants and gases that contribute to climate change. This research supports the DOE Office of Fossil Energy Clean Coal Technology Program mission to fuel economic prosperity, strengthen energy security, and enhance environmental quality.

Biomass-Infused Coal Briquettes for Co-Gasification:
a. (left) Briquettes; b. (right) Briquettes in hand