II.B.9 Co-Production of Substitute Natural Gas/Electricity via Catalytic Coal Gasification

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Objectives

- Develop a commercial application for co-production of electricity and substitute natural gas (SNG) based on a transport reactor-based pyrolysis process, a catalytic fluid-bed reactor for additional methane production and high-temperature high-pressure CO_2, sulfur, and ammonia treatments.
- Develop a procedure that can produce SNG at a cost of <$5/MMBtu.
- Produce a high-pressure CO_2 by-product stream permitting sequestration of >90% of the CO_2 generated.

Introduction

The United States has vast reserves of low-cost coal, estimated to be sufficient for the next 250 years. Gasification-based technology, such as integrated gasification combined cycle (IGCC), is the only environmental friendly technology that provides the flexibility to co-produce H_2, substitute natural gas (SNG), premium hydrocarbon liquids including transportation fuels, and electric power in desired combinations from coal and other carbonaceous feedstocks. Rising costs and limited supply of crude oil and natural gas provide a strong incentive for the development of coal gasification-based co-production processes. This project addresses the co-production of SNG and electricity from coal. Coal is viewed as a potential raw material for SNG production via gasification in a central station facility.

Approach

The approach of this project is to develop a novel process for the co-production of SNG and electricity from sub-bituminous coals and lignite using a transport reactor to almost instantaneously pyrolyze the coal at temperatures between 1,200 and 1,600°F, a catalytic fluid-bed reactor to upgrade the pyrolyzer output into a methane-rich syngas, and a gas clean-up system treating sulfur species, ammonia, and CO_2 with the CO_2 being collected as a high-pressure sequestration-ready by-product stream. In Phase I, experimental testing will be conducted to demonstrate the technical and economic feasibility of the transport pyrolysis process, catalytic fluidized-bed reactor for producing a methane-rich syngas, a simultaneous CO shift and CO_2 capture, and char combustion with CO_2 as a diluent and heat moderator. In Phase II, bench-scale optimization studies will be conducted for the transport pyrolysis process and catalytic fluid-bed reactor guided by the desire to produce SNG at <$5/MMBtu. Phase II studies will also include some pilot plant testing of the transport pyrolysis and catalytic fluid-bed reactor systems with real coal feed. In Phase III, a field test system will be designed, built and tested at an appropriate industrial host site. Phase III will also include other activities supporting commercialization of this process including planning and design for scale up from the field test unit used in Phase III to a full demonstration unit.

Accomplishments

Prepared and submitted the draft Research Management Plan.

Future Directions

- Complete parametric pressurized char combustion experiments with an O_2/CO_2 mixture; and complete multi-cycle parametric testing of RTI's regenerable CO_2 sorbent.
- Conduct parametric pressurized char combustion experiments with O_2/CO_2 mixtures to demonstrate the technical feasibility of char combustion to

optimize extraction of energy from the coal and still produce a CO_2 sequestration-ready CO_2 by-product.

- Complete construction of a bench-scale transportation system to develop a suitable reactor system to permit testing of the transport reactor-based pyrolysis of coal and lignite materials.
- Conduct testing to evaluate interaction of fluid-bed catalyst and coal ash to determine the extent of interaction of the active catalyst components trapped on fluidized support material with the ash fines carried through the fluidized bed reactor with the synthesis gas.
- Complete feasibility testing of the catalysts for the fluid-bed reactor to provide the necessary technical information to assemble and engineer the package for the transport pyrolysis system and to permit economic evaluation of the process.
- Complete feasibility testing of the transport pyrolysis process to provide the necessary technical information to assemble an engineering package for the transport pyrolysis system and to permit economic evaluation of the process.