II.B.13 Reducing Ultra-Clean Transportation Fuel Costs with HyMelt® Hydrogen

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Projected End Date: September 2006

Objectives

- Develop appropriate HyMelt® injection technology for hydrocarbon feed that maximizes melt stirring, produces optimum carbon dissolution, and minimizes solid accretion during the hydrogen production step and for the oxygen and steam feeds that restore molten iron bath to its original temperature and carbon composition while minimizing the formation of carbon dioxide.
- Develop the design of a 10 MW gas generator.
- Understand HyMelt® reactor chemistry, model experimental operations using commercially available modeling software, and prepare a HyMelt® Design Basis Memorandum incorporating data collected during experimental testing into a form usable for preparation of a full commercial plant design.
- Assess economic impact of HyMelt® hydrogen on refinery operations, and evaluate use of the carbon monoxide-rich fuel gas for production of electricity by conducting sub-scale validation combustion tests and gas turbine combustor modeling studies.

Introduction

The HyMelt® Process offers the potential to produce large volumes of high pressure, high purity hydrogen from fossil fuels, such as petroleum coke, pitch, and coal, at a cost much lower than conventional production methods. In this process, the fossil fuel is injected into a molten iron bath which releases the hydrogen from the fuel as a relatively pure stream. The objective of this project is to perform complete experimental development of the HyMelt® Process to collect all data necessary to support a commercial design. The experimental development activities will attempt to resolve all known and potential technical barriers so that the potential of the HyMelt® Process to dramatically improve the conversion efficiency of fossil energy sources to ultra-clean transportation fuels can be determined.

Approach

The work to be performed during this effort is divided into two budget periods. Budget Period 1 includes project initiation and HyMelt® testing at atmospheric pressure. Budget Period 2 includes HyMelt® testing at elevated pressure and evaluating commercial-scale HyMelt® process conceptual designs. A decision point at the conclusion of Budget Period 1 will determine whether to (1) initiate HyMelt® testing at elevated pressure, (2) continue with HyMelt® testing at atmospheric pressure, or (3) abandon the project.

Accomplishments

- Established the data base needed to design, construct, and operate innovative, pre-commercial scale, clean fuel production facilities that are intended to be either stand-alone or integrated with an existing refinery.
- Developed the appropriate HyMelt® injection technology (lances and/or tuyeres) for the hydrocarbon feed that maximizes melt stirring, produces optimum carbon dissolution, and minimizes solid accretion during the hydrogen production step and for the oxygen and steam feeds that restore the molten iron bath to its original temperature and carbon composition, while minimizing the formation of carbon dioxide.
- Characterized the HyMelt® reactor chemistry as a function of pertinent independently controllable process parameters via modeling and experimental operations using commercially available modeling software and pilot plant operations with standard analytical techniques.
- Prepared a HyMelt® Design Basis Memorandum that incorporates all data collected during the experimental testing into a form usable for the preparation of a full commercial plant design.

- Assessed the economic impact of HyMelt® hydrogen on refinery operations using linear programming analyses.
- Evaluated the use of the carbon monoxide-rich fuel gas for the production of electricity by conducting sub-scale validation combustion tests and gas turbine combustor modeling studies.

Future Directions

None – Project completion date September 2006.