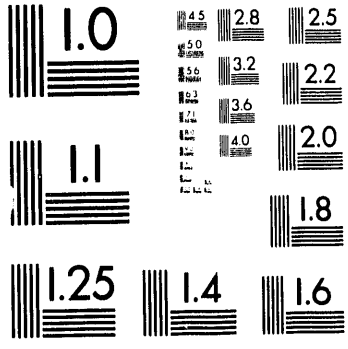
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SCALE-UP OF MILD GASIFICATION TO A PROCESS DEVELOPMENT UNIT

DRAFT

Progress Report for the Period:
November 21, 1992 - February 20, 1993

By

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For

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SUMMARY

The work performed during the fifth quarterly reporting period (November 21, 1992 through February 20, 1993) on the research program, "Scale-Up of Mild Gasification to a Process Development Unit" is presented in this report. The overall objective of this project is to develop the IGT Mild-Gasification (MILDGAS) process for near-term commercialization. The specific objectives of the program are to:

- design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup
- obtain large batches of coal-derived co-products for industrial evaluation
- prepare a detailed design of a demonstration unit
- develop technical and economic plans for commercialization of the MILDGAS process.

The project team that is performing the initial phases of the PDU development are: Kerr-McGee Coal Corporation (K-M Coal), the Institute of Gas Technology (IGT), Bechtel Corporation (Bechtel), and Southern Illinois University at Carbondale (SIUC).

The MILDGAS process is a continuous closed system for producing liquid and solid (char) co-products at mild operating conditions up to 50 psig and 1300°F. It is capable of processing a wide range of both eastern caking and western noncaking coals.

The 1 ton/hr PDU facility that is to be constructed is comprised of a 2.5-ft ID adiabatic gasifier for the production of gases, coal liquids, and char; a thermal cracker for upgrading of the coal liquids; a three-stage condensation train to condense and store the liquid products; and coal feeding and char handling equipment. The facility will also incorporate support equipment for environmentally acceptable disposal of process waste.

A program review meeting was held at IGT in Chicago between the new COR and the DOE environmental representative and K-M Coal and IGT on December 16, 1992. Following the program review meeting, the DOE and K-M Coal participants and the IGT Program Manager went to the proposed PDU site where they met with representatives of Southern Illinois University at Carbondale and the Crab Orchard National Wildlife Refuge manager to review the NEPA application. This included a tour of the proposed site as well as a tour of the Refuge.

Also this quarter, the NEPA documentation was revised and sent to DOE. The revised documentation reflects the modifications to the process flow sheet as well as the concerns of the personnel of the Crab Orchard Wildlife Refuge.

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INTRODUCTION

Commercialization of the Institute of Gas Technology's Mild Gasification (MILDGAS) technology introduces a new industry into an economically depressed area. It utilizes a marginally marketable coal to produce char, in an environmentally acceptable manner, that can be used to make form coke, which is vitally needed in our metallurgical industry. It produces coal liquids which address import problems, and it also addresses the use of char for our electric utility industry. The specific objectives of the program are to: design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup; obtain large batches of coal-derived co-products for industrial evaluation; prepare a detailed design of a demonstration unit; and develop technical and economic plans for commercialization of the MILDGAS process.

The MILDGAS process is capable of processing both eastern caking and western non-caking coals. The MILDGAS process is designed to offer options in the product slate by varying the process conditions and by blending different feed coals. The liquids, which can be processed as feedstocks for chemicals (e.g., BTX, phenol, cresols, xylenols, naphthalene, and indene), pitch for use as a binder for electrodes in the aluminum industry, and fuels. Depending on the feed coal characteristics and the operating conditions, the char can be used as an improved fuel for power generation or briquetted hot to make form coke for steel-making blast furnaces or for foundry cupola operations. The hot briquetting process offers options for blending various chars, coals and other additives (like alloying agents) to tailor the properties of the form coke. The mild gasification and briquetting processes are done entirely within closed vessels which offer significant advantages over conventional coking practices for control of fugitive emissions.

The 1 ton/hr PDU facility that is to be constructed is comprised of a 2.5-ft ID adiabatic gasifier for the production of gases, coal liquids, and char; a thermal cracker for upgrading of the coal liquids; a three-stage condensation train to condense and store the liquid products; and coal feeding and char handling equipment. The facility will also incorporate support equipment for environmentally acceptable disposal of process waste.

Coal liquids from the PDU will be evaluated as feedstock for high-value chemicals and fuels by Reilly Industries, Inc. Reilly will also conduct separate modification operations such as thermal treatment with or without a Lewis Acid Catalyst, fractional distillation, and hydrotreating to produce specification-grade products. Reilly will take all the coal liquids produced at the PDU facility.

A major portion of the char produced will be used to make the form coke for blast furnaces and cupolas. The form coke for blast furnaces will be evaluated by several steel companies, including LTV and Armco. The form coke for use in a foundry cupola will be evaluated by General Motors Research Laboratories. In addition, the form coke will also be tested for foundry use at Pellet Technology Corporation's 60-inch cupola. The char from the PDU will also be evaluated at Southern Illinois University at Carbondale (SIUC) for relative reactivity and for suitability as a boiler fuel in a fluidized-bed combustor.

The product testing to be conducted in the program will yield a realistic assessment of the quality and economic value of both the coal liquids and solids produced. This input is required to update the market potential of the co-products and determine the slate of products and the economics of the demonstration and commercial plants for the MILDGAS process. The project team for the PDU development are: K-M Coal, Institute of Gas Technology (IGT), Bechtel Corporation, SIUC, General Motors Corporation, Pellet Technology Corporation (PTC), LTV, Armco, Reilly and Auto Research.

K-M Coal, which has large reserves of both eastern and western coals, is very much interested in near-term commercialization of the MILDGAS process. K-M Coal is responsible for the overall management and technical direction of the program. IGT, as the originator of the MILDGAS technology, is responsible for technology development, product evaluation management, and overall technical supervision. Bechtel Corporation is the A&E firm responsible for the process and plant design and construction, development of a demonstration plant design, and input to the commercialization plan revision. SIUC operates the Illinois Coal Development Park at Carterville, Illinois, which will be the location of the PDU. SIUC is responsible for operation of the PDU facility and for evaluation of the char product as a boiler fuel.

The State of Illinois is the major contributor of the cost sharing portion of this program. Their contribution is being supplemented by K-M Coal, SIUC, and GM. Contributions of Reilly and the steel companies are gratefully acknowledged but are not considered part of the cost sharing. All acceptable grades of form coke produced will be sold by Hickman Williams Co., the largest brokers for coke in the midwest.

TECHNICAL DISCUSSION

Task 1.0 Work and Environmental Plans

Objective: The objective of this task is to develop work and environmental plans for the project.

Summary: The Environmental Plan and NEPA Documentation consists of the data that are required by DOE for compliance with the National Environmental Policy Act (NEPA). This quarter, work has concentrated on updating and finalizing the NEPA documentation. A program review meeting was held at IGT in Chicago between the new COR and the DOE environmental representative and K-M Coal and IGT on December 16, 1992. At this meeting modifications to the process flow sheet and their impact on the NEPA application were discussed. It was determined that the NEPA Documentation must be changed to reflect these modifications.

Following the program review meeting, the DOE and K-M Coal participants and the IGT Program Manager went to the proposed PDU site where they met with the Southern Illinois University at Carbondale representatives and the Crab Orchard National Wildlife Refuge manager to review the NEPA application. This included a tour of the proposed site as well as a tour of the Refuge. The main concern of the manager of the Wildlife Refuge is whether their water treatment facility can handle the increased flow of cooling water from the PDU. To facilitate the NEPA application, we have revised the NEPA statement to reflect the use of a closed water cooling loop.

Following the meeting at IGT and at the Crab Orchard Wildlife Refuge, the NEPA application was revised to reflect the modifications to the process flow sheet and to incorporate the suggestions of the DOE COR and Environmental Representative. The revised documentation for the NEPA was sent to DOE in January, 1993.

Subtask 2.1 PDU Design Engineering

Objective The objective of this subtask is to complete the design and engineering for the PDU. The initial phase of this subtask consists of reviewing the conceptual process design and the process performance data with the data obtained from the mild gasification tests in the IGT 100-lb/h Process Research Unit. Other parts of this subtask consist of process design, civil/structural design, electrical and control design, mechanical design, procurement, and a definitive cost estimate.

Summary Prior to NEPA approval, the project work will be limited to preliminary project engineering, which will include the following:

- Development of the process design
- Preparation of environmental data to support the NEPA compliance process
- Preparation of engineering specifications for obtaining bids
- Solicitation of equipment and material pricing and bid evaluation
- Preparation of engineering drawings including P&ID's
- Preparation of the project definitive cost estimate

After reactivation of the program, the preliminary design of the PDU was analyzed and several modifications were considered to simplify the operation, increase the product yield, and improve the quality of the products. These included:

- Supplying all of the heat to the gasifier from combustion of the product gas
- Elimination of the char heater
- Use of enriched air to combust the product gas for heating the gasifier
- Elimination of the coal preheaters

It was found that the use of enriched air (80% oxygen) to combust the product gas gave sufficient heat for the gasifier and at the same time did not dilute the product gas with nitrogen which causes problems in the condensation train and produces a very low Btu product gas. If combustion of recycled char is used to supply 50% of the gasifier heat, approximately 10% of the product char is consumed. For a demonstration size unit, it is estimated that the net savings by not combusting the product char will more than compensate for the additional cost of the enriched air. In addition to the increased char yield, this method of supplying the heat will greatly simplify the operation of the gasifier and may improve the quality of the char product.

This quarter, the revisions to the preliminary design that improved the operation of the PDU and lessened the invironmental impacts were reviewed by IGT engineers. These revisions included the use of the existing ponds at SIUC site for the cooling water reservoir. This in effect eliminates once-through cooling water and lessens the load that the PDU would place on the sewage treatment facility at the Wildlife Refuge.

Plans for Next Quarter Only those items which impact the NEPA will be persued until the NEPA approval is received.

Tasks 2.2 through Task 6.

No work was scheduled on these tasks for this quarter.

Task 7.0 Project Management

Objective The objectives of this task include the normal project management functions of planning, control, and reporting of project progress.

Summary This quarter, project management consisted of preparation and submittal of the usual monthly reports and the revised NEPA documentation.

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