**DEVELOPMENT OF AN ADVANCED, CONTINUOUS MILD
GASIFICATION PROCESS FOR THE PRODUCTION OF CO-PRODUCTS**

DOE/MC/24116--5283

**Quarterly Report
for the Period April 1, 1996 - June 30, 1996**

RECEIVED

NOV 12 1996

OSTI

By

Glenn W. O'Neal

96 JUL -5 PM 2:40

Work Performed Under Contract No. DE-AC21-87MC24116

**For
U. S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
P. O. Box 880
Morgantown, West Virginia 26505**

**By
Coal Technology Corporation
103 Thomas Road
Bristol, Virginia 24201**

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

TABLE OF CONTENTS

EXECUTIVE SUMMARY

PAGE

INTRODUCTION

1

TASK 5.3 FURNACE TEST

3

EXECUTIVE SUMMARY

Two 20-ton CTC formed coke production runs were completed. The product from the first run was tested at a General Motors' production cupola at a 12.5 percent of total coke charge level successfully. The second 20 tons of CTC formed coke will be evaluated in early August at a General Motors' research facility at Marquette, Michigan, using a 100 percent CTC formed coke charge. Design of a commercial plant continued with emphasis given to the calcining and briquetting operations.

INTRODUCTION

Petroleum currently accounts for over 42% of the total energy consumption in the United States; over 40% of the petroleum consumed in the United States is imported from foreign countries. The remaining oil reserve available in the United States is less than 6% of proven recoverable fossil energy reserves while over 90% of the proven recoverable reserves are coal¹. Total coal resources in the United States are estimated to be more than 3.9 trillion tons². Just the demonstrated reserves, that is, the deposits that are proven and can be economically mined using today's technologies and mining techniques amount to 488 billion tons. At an annual production rate of 900 million tons per year, the demonstrated reserves alone will last more than 500 years. In view of the very abundant coal reserves and limited petroleum reserves, it would seem prudent to make good use of coal in our evermore difficult pursuit of energy independence.

Devising a continuous reactor system that can deliver a good quality co-products which require only minimal upgrading before being marketed is a major challenge. At present, mild gasification reactor configurations tend to fall into two broad categories: circulating or fluidized bed types characterized by high heating rates (up to 10,000 °C per second, or fixed or moving bed types characterized by slow (on the order of 0.2 to 0.5°C per second) heating rates. Circulating or fluidized-bed types produce high liquid yields at the expense of quality. Fixed or moving-bed types produce better quality liquids but in lesser quantities. An optimum reactor is envisioned as one which avoids the secondary reactions associated with slow heating rates and the quality problems associated with high heating rates. Importantly, an optimum reactor would be capable of processing highly caking coals. The reactor concept under investigation in this effort is an advanced derivative of a reactor once used in prior commercial practice which approaches the characteristics of an optimum reactor.

It is important that a mild gasification reactor interface easily with the subsequent product upgrading steps in which the market value of the products is enhanced. Upgrading and marketing of the char are critical to the overall economics of a mild gasification plant because char is the major product (65 to 75% of the coal feedstock). In the past, the char product was sold as a "smokeless" fuel, but in today's competitive markets the best price for char as a fuel for steam generation would be that of the parent coal. Substantially higher prices could be obtained for char upgraded into products such as metallurgical coke, graphite, carbon electrode feedstock or a slurry fuel

¹T. R. Scollon, "An Assessment of Coal Resources," CHEMICAL ENGINEERING PROGRESS, June 1977, pp. 25-30.

²J. M. Eggleston, "Bituminous Coal Marketing," presented at the Third U.S.A.-Korea Joint Workshop on Coal Utilization Technology, Pittsburgh, October 5-7, 1986.

replacement for No. 6 fuel oil. In this effort, upgrading techniques are being developed to address these premium markets. Liquid products can similarly be upgraded to high market value products such as high-density fuel, chemicals, binders for form coke, and also gasoline and diesel blending stocks. About half of the non-condensable fuel gases produced by the gasification process will be required to operate the process; the unused portion could be upgraded into value-added products or used as fuel either internally or in "across the fence" sales.

The primary objective of this project is to develop an advanced continuous mild gasification process and product upgrading processes which will be capable of eventual commercialization. The program consists of four tasks. Task 1 is a literature survey of mild gasification processes and product upgrading methods and also a market assessment of markets for mild gasification products. Based on the literature survey, a mild gasification process and char upgrading method will be identified for further development. Task 2 is a bench-scale investigation of mild gasification to generate design data for a larger scale reactor. Task 3 is a bench-scale study of char upgrading to value added products. Task 4 is being implemented by building and operating a 1000-pound per hour demonstration facility. Task 4 also includes a technical and economic evaluation based on the performance of the mild gasification demonstration facility.

TASK 5.3: FURNACE TEST

In the Second Quarter of 1996 most of the man-hours were spent producing the two 20-ton coke samples for the General Motors' cupola tests. As planned, the coke was shipped on April 15 and the test was done on April 17. The test was done in the production cupola at the Defiance, Ohio, plant and was monitored by CTC and General Motors' personnel. The Coal Technology form coke was charged into the #3 cupola from 0:13 a.m. to 4:04 p.m. Formed coke was charged as 12.5 percent of the fuel/carburizer requirement from 0:13 a.m. to 9:28 a.m. or 62 charges, 25 percent from 9:34 a.m. to 2:59 p.m. or 38 charges and 50 percent from 3:04 p.m. to 4:04 p.m. or 13 charges. A total of 113 charges containing CTC form coke were consumed during the production trial. Fifteen charges represent about 1-1/2 hours of melting time on this cupola, so about 11 hours 18 minutes of actual melting time occurred with CTC form coke as part of the total fuel/carburizer requirement. A preliminary look at the iron temperature and iron composition data indicates that the form coke performed satisfactorily. In fact, no change in the way the cupola performed was noticed. Based on observations made during the Defiance trial and a preliminary look at the data, GM is interested in pursuing the controlled research test.

The controlled research test is to be conducted at the Pellestar, Ltd. cupola. This test will be done with General Motors' technical help in this fully instrumented cupola in Marquette, Michigan. This test will most likely occur in two heats. The first will be a baseline heat using 100 percent conventional slot oven coke as the fuel/carburizer requirement for the cupola. The second heat will utilize 100 percent CTC/DOE form coke as the fuel/carburizer requirement for the cupola. Data from the two heats will then be compared as the basis of a co-authored paper to be presented at the 101st American Foundrymen's Society Casting Congress. If schedule permits, this test will be done in July or August.

In parallel with the General Motors' cupola test coke production, equipment was evaluated for use in a commercial plant. Two tunnel kilns were studied from Bristol and then visited at Frankfort, Kentucky. These kilns appear to be well suited for a commercial plant of about 15,000 tons per year production. Also, other briquetting techniques were evaluated. Presently CTC coke is made on a roll briquetter. This briquetting technique works reasonably well but possibly a type of press could be better. CTC is negotiating with several vendors to test this press technique.

Glenn W. O'Neal
Project Engineer

GWO:mds