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GASIFICATION OF RESIDUAL MATERIALS FROM COAL LIQUEFACTION

TYPE I EVALUATION OF H-COAL LIQUEFACTION RESIDUE FROM ILLINOIS NO. 6 COAL AS A FEEDSTOCK FOR THE TEXACO GASIFICATION PROCESSES

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ABSTRACT

A laboratory evaluation of a 20-pound sample of Atmospheric Tower Bottoms from the H-Coal liquefaction pilot plant at Catlettsburg, Kentucky was completed at Texaco's Montebello Research Laboratory. The sample, which was obtained from the liquefaction of Illinois No. 6 coal, was judged to be a suitable feedstock for the Texaco Synthesis Gas Generation Process. It can be charged directly to the gasifier at a temperature of about 350°F.

Based on these results, operating conditions and yields were estimated for gasifying 1000 pounds per hour of molten undiluted residue at 1200 psig.

Introduction

Almost all coal liquefaction processes, which are being developed to reduce our dependence on foreign oil, require hydrogen or synthesis gas (a mixture of hydrogen and carbon monoxide) to solubilize the coal. In order to obtain a favorable product mix in such a coal liquefaction plant it is desirable to produce the needed hydrogen or synthesis gas primarily from the non-liquefied fraction of the coal. This material, together with the inorganic ash and some fraction of the converted coal, may be recovered in various forms depending on the particular process. Many of these waste streams will make excellent feedstocks for gasification using one of the Texaco Gasification Processes.

To determine the suitability of various residual material from DOE sponsored coal liquefaction projects as feedstocks to the Texaco Gasification Processes, DOE is sponsoring a series of tests to be conducted at Texaco's Montebello Research Laboratory under contract EX-76-C-01-2247 and modification DEAC 01-76ET10137.

Objective and Scope of Work

The objective of a Type I evaluation is to estimate by laboratory scale tests the suitability of a given material as a feedstock to the Texaco Gasification Processes. DOE will select samples of approximately 20 pounds each for evaluation by Texaco from residual solids and ash containing carbonaceous materials which are the products of coal liquefaction projects.

The material evaluated in this report is designated as "H-Coal Flaked Residue". It was obtained from the H-Coal liquefaction pilot plant at Catlettsburg, Kentucky from the liquefaction of Illinois No. 6 coal. The two 5-gallon pails were labeled "Sample No. 409-821" and were received on May 26, 1981 from Ashland Synthetic Fuels Company. The residue was assigned MRL Sample No. 21035. This laboratory was advised orally that the sample was atmospheric tower bottoms.

This work was authorized by DOE Delivery Order Number 5 dated March 25, 1981.

Presentation and Discussion of Results

The sample of H-Coal Liquefaction Residue is a brittle solid at ambient temperatures. It was received in random sized flakes of about 1/8 inch thick. At 158°F the residue begins to soften. At 350°F it is a fluid with a viscosity of 198 centipoise. A higher temperature is not required to pump this fluid with the charge pump used in the Montebello Research Laboratory pilot plant, and no solvent addition will be necessary for viscosity reduction.

The mineral matter is uniformly suspended in the carbonaceous material and the suspension is stable at 350°F. Because of its rather low viscosity at elevated temperatures there is some concern that at the elevated temperatures in the H-Coal liquefaction plant at the exit of the vacuum distillation tower the solids will tend to settle rapidly requiring agitation to keep the solids suspended so they can be charged to the Texaco Gasification Process.

Figure 1 is an estimate of operation based on gasifying 1000 pounds per hour of undiluted H-Coal Residue at 1200 psig in the Montebello Research Laboratory pilot plant. About 37,100 standard cubic feet of hydrogen plus carbon monoxide should be produced with 99 percent of the carbon in the feed being gasified. Thirty six pounds per hour of char, containing approximately 20 percent carbon, should be produced as should 114 pounds per hour of carbon-free slag.

The ash has an initial softening temperature of 2025°F and a fluid temperature of 2165°F in a reducing atmosphere.

Dry grinding of this material was not successful because of its low softening point. Wet grinding in water yielded a poor quality slurry. A stable slurry of sufficient concentration was not achieved to allow consideration of this alternate form of feeding the residue to the Texaco gasifier.

Conclusions and Recommendations

The H-Coal Liquefaction Residue from Illinois No. 6 coal (Sample No. 409-84) should be a suitable feedstock for the Texaco Synthesis Gas Generation Process. It can be fed directly to the gasifier as a molten fluid at a temperature at or above 350°F.

At 1200 psig, 1000 pounds of this residue is estimated to yield about 37,100 standard cubic feet of hydrogen plus carbon monoxide.

Feeding this residue to a Texaco gasifier as a water slurry is not an attractive alternative because of its poor slurrying characteristics.

Figure 1

Texaco Synthesis Gas Generation Process

Estimate of Operation

For: DOE Contract EX-76-C-01-2247
Location: Montebello Research Laboratory Pilot Plant
Charge Stock: Molten H-Coal Liquefaction Residue
From Illinois No. 6 Coal
Ultimate Product: Hydrogen

Sample No.	409-321
Charge to Gasifier	
Residue (Fresh, Dry), Pounds per Hour	1000
Ultimate Analysis, Weight Percent, Moisture Free	
Carbon	75.07
Hydrogen	5.94
Nitrogen	0.91
Sulfur	1.47
Oxygen	2.30
Ash	14.31
Higher Heating Value, BTU per Pound	14,390
Pure Oxygen, Pounds per Hour	852
Steam, Pounds per Hour	400
Product Composition, Mole Percent	
Carbon Monoxide	48.82
Hydrogen	37.17
Carbon Dioxide	5.49
Water	7.76
Methane	0.05
Argon	0.02
Nitrogen	0.29
Hydrogen Sulfide	0.38
Carbonyl Sulfide	0.02

Figure 1 (Cont'd)

Texaco Synthesis Gas Generation Process

Estimate of Operation

Dry Product Gas, Standard Cubic Feet per Hour	39,800
Hydrogen plus Carbon Monoxide Standard Cubic Feet per Hour	37,100
Slag, Pounds per Hour	114
Carbon Content, Weight Percent	< 0.5
Char Discharge, Pounds per Hour	36
Carbon Content, Weight Percent	20
Unconverted Carbon, Percent of Carbon in Feed	1
Gasifier Pressure, PSIG	1200