Title: Pulverization Induced Charge: In-Line Dry Coal Cleaning (DE-PS22-94PC94225)

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1. Grant Objective: No change

2. Technical Approach Changes: No changes.

3. Progress Report by Task:

Task 1. Charge Determinations

Direct firing coal pulverization systems, both pressurized and suction types, are the predominate design for utility pulverized coal (PC) boilers. Pressurized systems incorporate a fan prior to the pulverizer, which blows prepared coal after pulverization through a classifier and into burner pipes. Suction systems utilize an exhauster fan to pull prepared coal after pulverization through a classifier and blows the coal into the burner pipes. On-site measurements on a pressurized system at the Spurlock Station of East Kentucky Power in Maysville, KY have already been performed, the results from which were presented in previous reports. During this quarter, a second series of on-site tests were performed on a suction pulverizer system at the Widows Creek Plant of the Tennessee Valley Authority (TVA) in Stevenson, AL.

The furnace on which tests were performed at Widows Creek was a 500 MW tangentially fired unit, burning high sulfur (non-compliance) bituminous coal. The inclusion of a non-compliance, high sulfur coal in the test matrix provides for direct comparisons to the compliance coal tests conducted at the EKP site. The TVA furnace had a total of 20 burners, 5 on each corner, each of which was supplied by five pulverizers. The crushed coal is pulled from the pulverizer, through the exhauster and exits via a 32" pipe which subsequently splits into the individual burner pipes leading to the burners. Measurements were made in the 32" pipe immediately downstream of the exhauster.

A 55 gallon drum of crushed coal was collected from the first pulverizer for the tests to be performed at the CAER within Task 2. A one inch probe was used to withdraw a stream of air.
and fine coal, under pressure, into the drum. A baghouse fabric filter was modified and installed on the drum lid to allow air to exit. It took about two hours to fill the drum.

The particle charge and separation tests were performed on the second pulverizer concurrent with the coal sample collection. Five different probe penetration distances were evaluated for particle charge (5, 7.5, 10, 12.5 and 15 inches, measured from the burner pipe wall). After some preliminary test runs, the optimum collection time was determined to be one minute. During the subsequent tests, the current induced by charged particles entering the probe was recorded by use of a portable computer. In addition, separation tests were conducted with our specially designed probe which was described in previous reports. The electric potentials across the parallel plate separator was set at 7, 15, 20 and 30 KV. The time for each separation run was also one minute.

Figure 1 is a real-time trend recording of induced current resulting from the capture of charged particles within the burner pipe. Each point in the figure represents an average of 120 points collected in the time span of one second. At the test start, with the probe inserted to a desired position and with purge air flowing to prevent particles from entering the probe, the current was close to zero. When the sampling started, particles were educted into the probe and the current immediately jumped to 150-200 nA. The gradual decrease of the current with time was likely due to plugging of the filter bag, which would reduce particle influx into the Faraday cage. The erratic signal after sampling was due to handling of the probe, i.e., removing it from the port and opening it to remove the filter bag.

Figure 2 shows the average charge per unit mass at different probe positions. For each test the average charge was near $6 \times 10^{-5}$ to $1 \times 10^{-4}$ C/Kg; its magnitude did not change significantly for different sampling positions within the burner pipe. Figure 3 shows the average sampling rate at each position. The rate varied between 1.0 - 1.9 g/s with the center position being approximately 20% lower than the others.

Samples from the particle separation tests are currently being analyzed. Results from these tests will be presented in the next quarterly report.

**Task 2. Pilot Scale Test Rig Development**

A pilot scale separator was extensively tested during this quarter using model mixtures rather than coal. These mixtures were used to allow for rapid data processing and to provide insight into engineering optimization of the separator design. The overall test rig has been designed and will be configured into a complete unit in the upcoming months. Through use of mixtures, an additional understanding of physical and operational parameters which affect the separation process was provided.

**Task 3. Coal Separation Determinations**

The coal samples collected from the Widows Creek plant were used for analytical scale and pilot scale separation tests. Separated fractions were collected, weighed and subjected to
proximate analysis. These results from these tests will be described in the next report along with size distribution data on the feed and separated fractions.

Numerical modeling of the gas flow inside the separator is being studied by researchers at Clarkson University.

**Task 4. Full-Scale Separator Design**

Conceptual flowsheet diagrams and preliminary sketches of a 20 ton/hr demonstration separation system are under preparation. The design of such a system would enable a preliminary economic evaluation of the separator system.

**Task 5. Economic Evaluation**

No work on this task has been completed. It is due to begin in late summer 1996.

**Task 6. Reporting/Publications**

An abstract for a paper entitled "Characterizing Dry Triboelectrostatic Beneficiation of Coal and Fly Ash Using Recovery Analysis" has been submitted for presentation at the Thirteenth Annual International Pittsburgh Coal Conference, Pittsburgh, PA, September 3-7, 1996.

An abstract for a paper entitled "Pulverizer Induced Charge: Comparison of Separate Utility Pulverizer Configurations" has been submitted for presentation at the Thirteenth Annual International Pittsburgh Coal Conference, Pittsburgh, PA, September 3-7, 1996.
FIGURE 1. Induced current measured during coal collection from burner pipes at TVA plant.
TVA-WC Results: Average Charge

Figure 2. Average charge per mass at different positions within burner pipe.
Figure 3. Average sampling rate at different positions within burner pipe.