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Scaling of Pressurized Fluidized Beds

**Quarterly Report
January - April 1995**

Leon Glicksman
Paul A. Farrell

July 1995

Work Performed Under Contract No.: DE-FC21-92MC29264

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Massachusetts Institute of Technology
Cambridge, Massachusetts

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Overview

This report provides a summary of the technical progress made during the second quarter of the third budget period on Cooperative Agreement No. DE-FC21-92MC29264, "Scaling of Pressurized Fluidized Beds."

Technical Progress Report

- Solids Mixing

A thermal tracer technique has been implemented in the cold model of the Tidd PFBC. The thermal tracer technique involves injecting thermally-tagged particles into the bed and tracking their motion using an array of thermistors. Tracer particles are drawn in from the bed into an injection tube which is immersed in a pool of liquid nitrogen. Once the particles are cooled sufficiently below the bed temperature, they can be reintroduced into the bed by air injection. Currently, ten thermistor probes have been constructed along with the necessary bridge and amplification circuits. Efforts to install and debug this system were completed during the past quarter.

Figure 1 illustrates the thermal tracer technique. Each of the cross-hatched circles in Figure 1 represents a thermistor probe. The probes are inserted perpendicular to the injector. Figures 2-4 present sample output from the thermistors at different times after the chilled particles are injected. Each bar in Figures 2-4 represents the output (dimensionless temperature) of a single thermistor. There is a one-to-one correspondence between the thermistor probe locations shown in Figure 1 and the bars in Figures 2-4, with the exception of the thermistor directly in front of the injector. The output from the injector thermistor was not shown because it would require a significantly broader scale; this would make visualizing changes in the output of the other thermistors more difficult. In the figures, the tracer particles are injected at the lower right hand corner and the fluidizing gas travels from bottom to top. These conventions are shown on Figure 2.

Consideration has also been given to the use of capacitance probes to relate the local bed hydrodynamics to the mixing data. Capacitance probes have been used by researchers to measure bubble properties such as: velocity, mean pierced length, and frequency. This information is important for developing an understanding of the solids mixing process. The use of capacitance probes to measure the bubble properties was given further consideration during the past quarter, including a visit to a company which manufactures capacitance probes and the required electronics. Another option currently under consideration is the use of a fiber optic phototransistor probe. This may prove to be a less expensive approach to measuring the bubble characteristics.

Emphasis of Work During Next Quarter

Efforts during the third quarter of the third budget period will focus on:

- completing taking mixing data with the current probe configuration, including an investigation of lateral mixing; and
- completing an evaluation of capacitance probe and phototransistor probe methods for measuring the local bed hydrodynamics, and implementing the most desirable approach.

Figure 1: Thermal Tracer Technique - Experimental Setup

Figure 2: Thermistor Probe Output - 0.0 seconds after particle injection

Figure 3: Thermistor Probe Output - 0.5 seconds after particle injection

Figure 4: Thermistor Probe Output - 3.0 seconds after particle injection