R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Gasification Technologies

10/2006

Fluidized Bed Applications and Validation

Background

Fluidized beds provide excellent mixing and homogeneous temperature distribution throughout the reactor allowing sustained lower temperature operation and no hot spots. Fluidized beds often allow improved handling and transportation of hot solids among various process steps. Many fossil fuel utilization processes could benefit from incorporation of fluidized bed technologies including transport coal gasification, gasification of low rank coals, sulfur sorbent regeneration, hydrogasification, oxycombustion, and CO_2 capture to name a few. NETL's cold flow facility can be used to study the properties of fluidized beds. It is the largest such facility in the public domain in the country. It is being used to investigate the hydrodynamics of various fossil fuel utilization technologies. The advanced instrumentation in the cold flow facility can be used to collect information that can then be used to validate predictions made using computational fluid dynamic models of fluidized beds.

Accomplishments

The cold flow simulation of char fines from circulating fluidized bed of glass beads was completed without observing any signs of segregation in the standpipe. Hydrodynamic correlations with cork, coke and glass beads have been updated to identify critical factors in solids residence times and mixing. A detailed analysis of the impact of PSDF modifications to the transport reactor was completed. A manuscript has been submitted for publication.

Graduate research assistant, Angela Sarra, from WVU makes electrostatic measurements on NETL's industrial-scale circulating fluid bed cold-flow riser facility.

Benefits

The cold flow facility is equipped with advanced instrumentation that measures detailed flow structures and regimes, solid/gas velocities and concentrations at various points within the reactor. Computational fluid dynamic models of fluidized bed reactors require detailed input information such as viscosity of the gas/solid mixture, temperature at various points in the reactor, drag and shear rates. All of these properties can be measured in NETL's cold flow facility. Detailed data obtained using the cold flow facility enables researchers to evaluate new fluidized bed concepts, process

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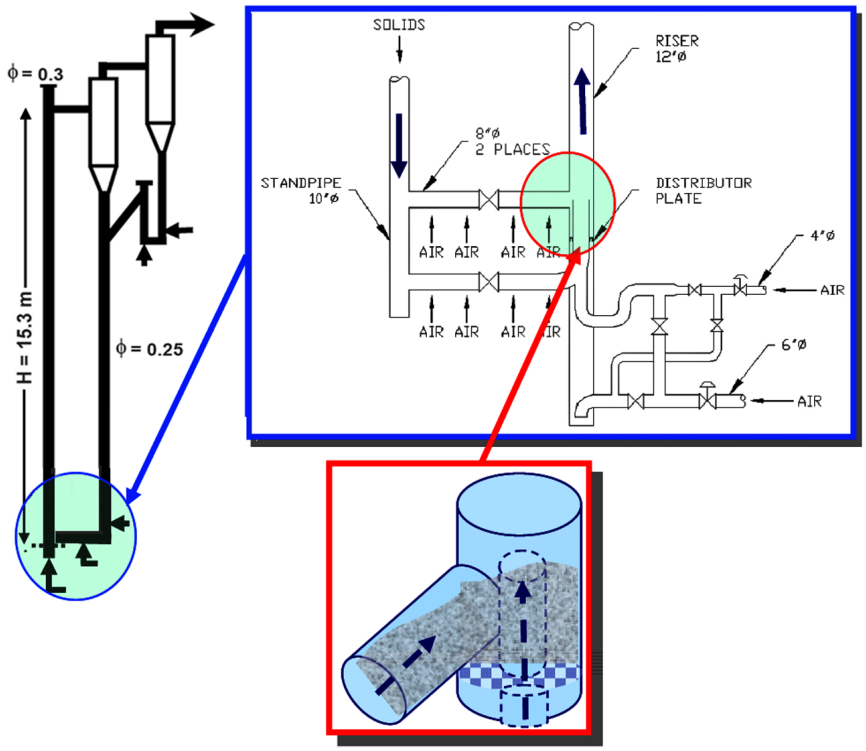
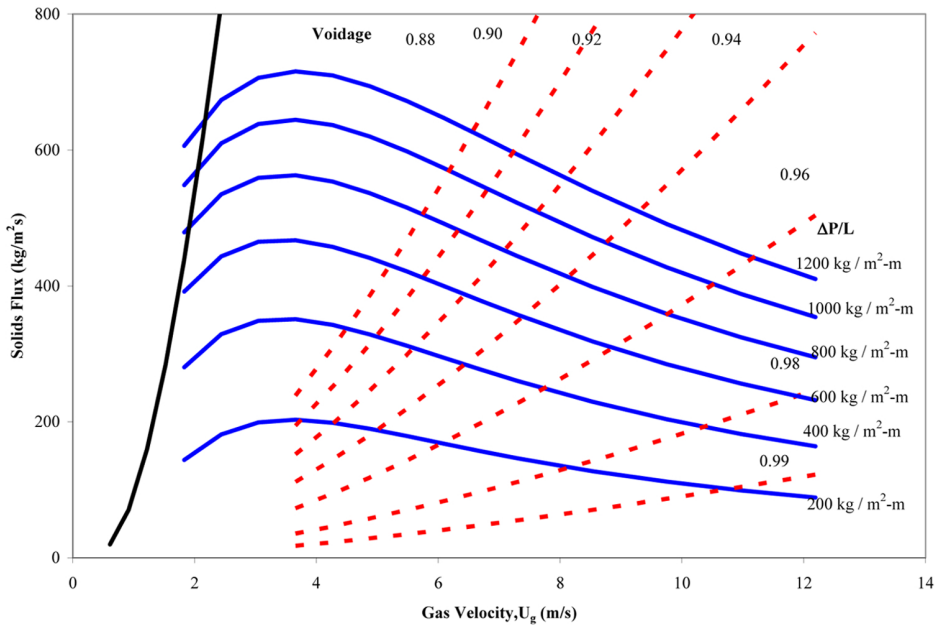
modifications and scale-up. The data collected using the cold flow facility can be used to compare predictions made using CFD. The experimental data is then used to refine and improve the simulations. In particular, the data from cold flow tests on variations in riser configuration will be used to validate CFD simulations and enable designers to foresee and solve problems, reducing time and cost to commercialization of fluidized bed technologies.



Schematic of NETL adjustable riser inlet configuration.



NETL operating map for densely loaded transport reactor using 180 micron glass beads.

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