PRESSURE FLUCTUATIONS AS A DIAGNOSTIC TOOL FOR FLUIDIZED BEDS

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Abstract

The viability of matching hydrodynamic conditions in a hot bubbling fluidized bed (BFB) combustor and a cold BFB model are being evaluated. Similitude parameters are being matched in a 20.32 cm diameter BFB combustor and a 5.08 cm diameter cold BFB. In addition, tests are planned to investigate the effect loaded solids above the L-valve have on the flow rate.

Objective

The purpose of this project is to investigate the origin of pressure fluctuations in fluidized bed systems. The study will asses the potential for using pressure fluctuations as an indicator of fluidized bed hydrodynamics in both laboratory scale cold-models and industrial scale boilers.

Progress

According to Glicksman, hydrodynamic similitude in bubbling fluidized beds can be achieved by matching the following dimensionless parameters

Using these parameters, a 20.32 cm diameter bubbling fluidized bed combustor has been scaled to match a 5.08 cm diameter cold bubbling fluidized bed. Differential pressure fluctuation data taken at taps located 5.08 and 15.24 cm above the distributor plate in the 20.32 cm bed and 1.27 and 3.81 cm above the distributor plate in the 5.08 cm cold bed are used to test for hydrodynamic similitude. Characteristic Bode plots and power spectral density plots of the pressure fluctuations are produced using standard FFT analysis techniques discussed in previous reports.

Using Glicksman's dimensionless terms as listed above, the fluidized bed combustor prototype is fluidized with 600 micron round sand and fired with natural gas to 725 °C to match the 5.08 cm diameter cold model fluidized with 150 micron diameter round copper particles. The particles necessary for these experiments have recently been purchased and acquired. After modifications to the BFB combustor data acquisition setup, experiments will proceed. Runs will also be completed in a 10.16 cm cold fluidized bed to test the importance of the D/d_p dimensionless term. The size of particles becomes important when scaling large industrial reactors down to laboratory scale models.

It has been hypothesized from past experiments that the solids flux dimensionless term be replaced by a dimensionless solids loading in the riser. In addition, it is hypothesized that the height of solids above the L-valve affects the flow rate of solids through the L-valve and into the circulating fluidized bed. To test this hypothesis, the amount of solids having left the L-valve is recorded versus time under conditions of varied particle diameter, particle density, and L-valve aeration rates. If this hypothesis is correct, the rate at which particles leave the L-valve will decrease with the height of the particles above the L-valve due to the decreasing hydrostatic head above the L-valve.