Study on gas-solid flow behavior in high-density circulating fluidized beds

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Flow behavior, structures and flow regime were determined in a circulating fluidized bed riser (0.203 m i.d.×5.9 m high) of FCC particles (d_p = 70 μm, ρ_s = 1700 kg/m^3). A momentum probe was used to measure radial momentum flux profiles and to distinguish between local net upward and downward flow regions.Time-mean dynamic pressure decreases towards the wall and, the fast fluidization flow regime was observed to coexist with dense suspension upflow (DSU) in the range U_g = 5-8 m/s, G_S = 10-340 kg/m^{2}s. The annular downflow layer disappears locally with increasing solids mass flux (G_S) at a constant U_g, with achievement of the DSU regime. New correlations are developed to predict the thickness of solids down-flowing layer based on solids mass flux and momentum flux. They account for the effect of height on the thickness, and cover high G_S ranges near the onset of the DSU regime. Also, a new flow regime map is proposed distinguishing the fast fluidization, DSU and dilute pneumatic transport flow regimes.