HYDRODYNAMICS OF HIGH VELOCITY CIRCULATING FLUIDIZED BED RISERS

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Fluid catalytic cracking risers operate at solids fluxes of 400 to 1400 kg/s.m2 and gas velocities of 15 to 20 m/s. However, most literature studies are for low gas velocities (< 10 m/s) and modest solids circulation rates (< 200 kg/m2s). Circulating fluidized bed (FCC) risers were found to consist of a top dilute region and a relatively dense region near the bottom. The top region has a dilute core of rapidly upflowing solids surrounded by a descending dense annulus. The bottom zone also has a core-annular flow structure, but with little or no net downflow of solids in the annulus. This paper discusses measurements from three CFB risers 15, 22, and 24 m in height, all 0.3 m in diameter, for FCC catalyst particles at gas velocities between 12 and 16 m/s and solids fluxes of 70 to 700 kg/s.m2. The measurements were total riser pressure, axial pressure gradient profiles and local solids flux. The extraction tube technique was used the solids flux measurement. The apparent density decreased exponentially with increasing height at low solids fluxes and a dense lower region formed as the solids flux was increased. Its height reached nearly half of one of the risers' height at the highest solids flux. Three types of radial solids flux profiles were obtained; nearly flat, parabolic with maxima in the core as well as bell shaped profiles with highest fluxes near the riser walls. The net solids flow direction at all locations was upward.