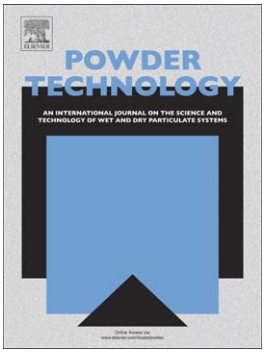

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Experimental characterization of axial fuel mixing in fluidized beds by magnetic particle tracking

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Abstract

A Magnetic Particle Tracking (MPT) system is applied to a bubbling fluidized bed to study how axial mixing and segregation of fuel are influenced by the fuel density and operational conditions (fluidization velocity, bed height and pressure drop across the gas distributor). The MPT system is used to determine the vertical distribution of the tracer particle in a fluid-dynamically down-scaled cold unit resembling a 0.74×0.74 m^2 fluidized bed reactor operating at 800 °C. This work uses a tracer particle of 10 mm in diameter, corresponding to a fuel particle of 44 mm. Different tracer particles are applied with solids density representing biomass, biomass char and that of the average bulk. The MPT system yields a spatial accuracy in the order of 10^{-3} m and a time resolution of 10^{-3} s.

For the operational range investigated, three fuel segregation regimes can be identified from the MPT measurements: 1) *A flotsam regime* which occurs at low fluidization velocities and for low density tracer particles, 2) *A transition regime* over which an increase in fluidization velocity results in the presence of fuel particles at the bed surface decreases rapidly, and 3) *A fully developed mixing regime* in which the presence of tracer particle at the bed surface and the splash zone remains constant with fluidization velocity. The transition velocities between the regimes depend on bed height and density of the tracer particle.

Keywords: Fuel segregation; Fuel mixing; Solids mixing; Magnetic particle tracking; Fluid-dynamical scaling; Fluidized bed