Internal mixing of sand particles in semi-dual fluidized-bed biomass gasifier

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This study reports a semi-dual fluidized-bed (sDFB) biomass gasifier by introducing the internal mixing between riser and gasifier to improve the heat and mass transfer between them. The mixing of circulating solids in the gasifier-riser interconnection area of the sDFB has been simulated to clarify its design improvement. A cold-rig experiment of sDFB (0.8 m × 0.2 m ×3.85 m high) was constructed to investigate fluid hydrodynamics and solids circulations. Pressure drops were measured at 34 sample points along the gasifier, an external circulation rate of sand was identified after 30 seconds of run time. In order to predict the amount of direct back-mixing particles through the gasifier-riser interconnection area, an Eulerian-Eulerian two-fluid two-dimensional computational fluid dynamics (CFD) model incorporating with the kinetic theory of granular flow was developed based on experimental design. The CFD simulation results are validated with experiment data at the particle packing limit of 0.74. About 17.4% back mixed particles through gasifier-riser interconnection area was found from the CFD simulation. This indicates that the sDFB has a possibility of obtaining higher heat and mass transfer than the conventional DFB.