Numerical study of biomass gasification in 3d full-loop circulating fluidized beds using a eulerian multi-fluid model

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Abstrak

A three-dimensional Eulerian Multi-Fluid Model (MFM) of biomass gasification in full-loop Circulating Fluidized Beds (CFBs) has been developed. The conservation equations of mass, momentum, and energy are solved by well-known Navier-Stokes formulation types. The Kinetic Theory of Granular Flow (KTGF), common chemical reactions in biomass gasification, and standard k- turbulence model are considered. These equations are used to describe the spatial velocity, temperature, and concentration for each phase and species. The inter-solid phase heat-transfer mechanisms, which consist of direct solid-solid conduction and solid-solid conduction through fluid medium, are also considered. The results are compared to existing experimental data. It is demonstrated that the model which considers all inter-solid phase heattransfer mechanisms provides better predictions in terms of synthetic gas (syngas) compositions than the model considering direct solid-solid conduction through contact area only and the model without solid-solid heat-transfer mechanisms. From this, hydrodynamics and heat and mass transfer inside this complex system are analyzed. The results can be useful for better design and optimization of biomass gasification in CFBs.