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Experimental Study and Numerical Simulation of the Reaction and Flow on the Membrane Wall of Entrained Flow Gasifier

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Abstract : In an entrained flow gasifier, the combustible components are converted into the gas phase, and the mineral content is converted into ash. Most of the ash particles or droplets are deposited on the refractory or membrane wall and form a slag layer that flows down to the quenching system. The captured particle reaction process and slag flow and phase transformation play an important role in gasifier performance and safe and stable operation. The reaction characteristic of captured char particles on the molten slag had been studied by applied a high-temperature stage microscope. The gasification process of captured chars with CO2 on the slag surface was observed and recorded, compared to the original char gasification. The particle size evolution, heat transfer process are discussed, and the gasification reaction index of the capture char particle are modeled. Molten slag layer promoted the char reactivity from the analysis of reaction index, Coupled with heat transfer analysis, shrinking particle model (SPM) was applied and modified to predict the gasification time at carbon conversion of 0.9, and results showed an agreement with the experimental data. A comprehensive model with gas-particle-slag flow and reaction models was used to model the different industry gasifier. The carbon conversion information in the spatial space and slag layer surface are investigated. The slag flow characteristic, such as slag velocity, molten slag thickness, slag temperature distribution on the membrane wall and refractory brick are discussed.

Keywords : char, slag, numerical simulation, gasification, wall reaction, membrane wall
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