Investigation of Char-Slag Interaction Regimes in Entrained-Flow Gasifiers: from Experimental Evidence to Numerical Simulations

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Entrained-flow gasifiers are characterized by operating conditions aimed at favoring ash migration/deposition onto the reactor walls, whence the molten ash flows. Previous investigations have shed light on the fate of char particles as they impinge on the wall slag layer: both char entrapment in and carbon-coverage of the slag can occur, as it can be also verified by experimental investigations carried out on ashes generated by full-scale plants.

Because of the very large range of scales involved in these phenomena, numerical simulation of the flying small char particles is a very difficult task. Present tools are mostly based on the RANS approach in which the particle-confinement interaction needs to be modeled by means of empirical models, that already postulate the leading interaction mechanism. The adoption of more detailed models on the full-scale configuration is, conversely, computationally prohibitive. Therefore detailed simulations adopting an Eulerian LES approach for the turbulent gas phase and a Lagrangian particle tracking approach for the solid phase have been conducted to explore in much simpler configurations the effective role of single parameters among those that can be argued to play a major influence. In this work the role of the properties of the slag layer, specifically its inelastic behaviour, has been investigated. Numerical simulations results have been critically discussed with reference to the experimental observations.