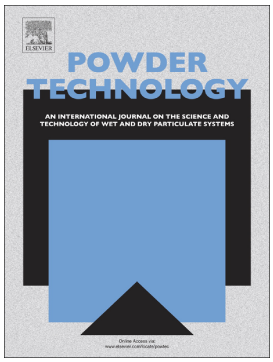

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Numerical investigation of the effects of size segregation on pulverized coal combustion in a blast furnace

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Abstract: Pulverized coal combustion in a blast furnace raceway can play a critical role in blast furnace iron-making operations. This research study integrated the particle combustion and the raceway formation processes using a refurbished coupling method based on computational fluid dynamics (CFD). The CFD model was validated, and there was good agreement between the simulation results and the two sets of experimental data. The combustion behaviors of pulverized coal particles in an industrial blast furnace were also simulated over a wide size range. The simulation results showed that size segregation occurred along the vertical direction in the raceway. Along the coal plume, the effectiveness of the size segregation process can be significantly reduced by the turbulence generated owing to the existence of the lance, the expansion of the gas jet near the tuyere tip, and the gas recirculation at the front end of the raceway. The burnout rate of particles smaller than 60 μm was also shown to be sensitive to the degree of weakening of the size segregation. The particle distribution in the coke bed indicated that the group of particles with diameters equal to 52.5 μm was associated with the largest proportion of unburnt char. This research extended the applicability of the existing numerical methods and provided a better understanding of the pulverized coal injection (PCI) process from the viewpoint of size segregation, which is beneficial to the further optimization of PCI usage.

Keywords: Pulverized coal combustion; Raceway formation; Size segregation; Blast furnace

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