Numerical Simulation on Dynamics and Heat Transfer Characteristics of Granulated Molten Slag Particle by Air with Moisture

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Abstract: In order to investigate the dynamics and heat transfer characteristics of granulated molten blast furnace slag by blast air, a mathematical model for the dynamics and heat transfer of high temperature molten slag granulated by gas was established and solved through the fourth order Runge-Kutta algorithm, the calculation program was compiled by FORTRAN. Considering that the efficiency of air cooling is low, a method of spray cooling was presented to improve the cooling rate. And the effect of varied particle size on movement and cooling was also researched. The variation of main thermal physical properties of slag and air with temperature was taken into account during the calculation progress that in order to enhance reliability of the study. And the temperature recovery method was used to deal with the solidification of molten slag. The results indicate that the motion trail of the slag particle is parabolic curve after granulation, and velocity of the slag particle is firstly increased and then decreased by the influence of quenching gas during the flight, the cooling rate of slag particle is mainly influenced by the convective heat transfer coefficient which varies with the relative velocity of blast air and slag particle. Meanwhile, the cooling rate of slag particle is significantly improved due to the addition of spray because of the evaporation of droplet and enhancement of convective heat transfer. With different size of the particle size, the results show that the final temperature of the slag particle is reduced with the decreasing particle size, which means that the smaller particle size can make better cooling effect. And the motion parameters of the particle which has smaller size is more susceptible to the blast air. Generally, the smaller size of slag particle, the better of blast air cooling, and the smaller the space needed for granulation.

DOI:10.32604/icces.2019.05590