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Numerical simulation on the combustion characteristic of iron ore sintering with flue gas recirculation

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ABSTRACT

Flue gas recirculation sintering (FGRS) technology can reduce pollutant emissions and reuse waste heat effectively in iron ore sintering. The incoming gas conditions, such as temperature, velocity, composition, and contents, may differ across processes because the sources of recirculated gas vary. Numerical simulations have been developed to predict sintering behavior quantitatively. To model FGRS, reactions in which O_2, CO_2, CO, and H_2O participate in as reactants and products should be taken into account. A relatively comprehensive mathematical model for a sinter bed, related to the application of FGRS and the comparison with the conventional sintering (CS), is built. Multiphase theory is employed. This model involves most of the major gaseous and gas–solid reactions that affected significantly by incoming gas conditions. Heat transfers are described in improved manners compared to the previously models. To date, six sinter pot tests based on FGRS technology have been used for model validation, and good agreements between simulated and measured results are obtained. Parametric studies focused on the quantitatively evaluation of the effects of various incoming gas conditions on the combustion characteristics in the sintering process, compared to CS. Results show FGRS can significantly increase the maximum temperature in the sinter bed, improve the uneven distribution of heat, but slightly reduce flame front speed. Thus, the quality of sintered ores, especially for the upper bed, is enhanced, while the productivity is restricted. Velocity exerts the most significant effect, followed by O_2 content, and then temperature.

KEYWORDS: flue gas recirculation, iron ore sintering, numerical simulation, multiphase theory, gaseous reaction, gas–solid reaction, sinter pot test, parametric studies, combustion characteristics