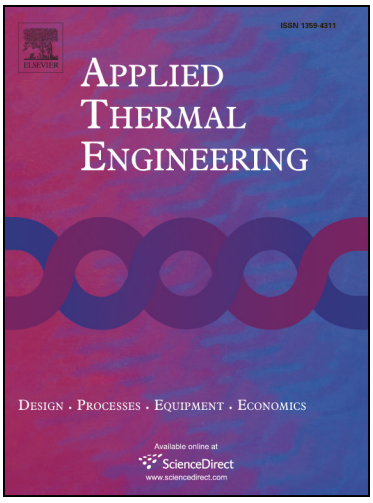

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Prediction of Sinter Yield and Strength in Iron Ore Sintering Process by Numerical Simulation

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Abstract: Sinter yield and strength were predicted by the method of numerical simulation in this study. An unsteady two-dimensional mathematical model for the iron ore sintering process was developed by taking most of the significant physical phenomena and chemical reactions into consideration. By employing FLUENT software and C language programming via custom code, numerical simulation was carried out. A sinter pot test was performed and experimental data reasonably agreed with the numerical results, which validated the model. By analyzing temperature profile and melt fraction, parameters including peak temperature, residence time, cooling rate, melt formation heat and melt fraction were analyzed. Relationship between cooling rate and sinter strength was discussed as well as relationship between melt fraction and the yield of product sinter. Results indicated that sinter strength and yield could be predicted by simulation. The effects of different coke contents and additional heat supplement on sinter strength and yield were discussed. Results showed that increasing coke content improves sinter strength. Lower coke content will lead to increasing of under-melted sinter while higher coke content will lead to increasing of over-melted sinter and decreasing of the yield. Additional heat supplement technology can not only enhance sinter strength, but also promote sinter yield significantly.

Keywords: mathematical model; numerical simulation; iron ore sintering; sinter strength; sinter yield; prediction

1. Introduction

Iron ore sintering is a complicated thermo-chemical process which involves a vast amount of chemical reactions and physical changes. Feed materials which contain ores, coke, flux, gangue, returned mines, and etc. are granulated and charged into the sintering machine. Sintering commences at the top of the bed and progresses downward along with the flame front. Small particles melt partially and bond at a temperature high enough. Then the mixture is cooled and turned into sinter cake when cold air is drawn through, and the sinter is produced as the main burden for blast furnaces in most iron and steel plants[1].

Sintering is a complicated thermo-chemical and high energy consumption process. In order to improve productivity and reduce fuel consuming, many researchers have strived to investigate the sintering process by numerical and experimental methods[2]. As an effective theoretical method complementary to laboratory investigation, numerical simulation is being increasingly applied in analyzing iron ore sintering. Many mathematical models of the iron ore sintering have been developed in the last decades. The early model of Muchi and Higuchi[3] developed a rate equation for the combustion of coke, and the Ranz equation was used for heat transfer. Young[4] put forward an one-dimensional model which focused on coke combustion and heat exchange between the gas phase and solid phase; changes of particle size were also considered, but formation of CO was neglected.

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