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Evaluation of the adhering layer ratio of iron ore granules and its influence on combustion-generated NO_x emission in iron ore sintering

Key Words:

iron ore sintering; granulation; adhering layer; adhering ratio; NOx emission

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Environmental Problems in the iron ore sintering



Adhering Layer



Fig. 1 Granule types commonly observed in granulation tests Fig. 2 the adhering ratio(SHATOKHA, Application of 3D X-ray tomography to investigation of structure of sinter mixture granules, 2009)

How to evaluate the thickness of the adhering layer and the diameter of the granules?

The Granulation Model

Assumptions:

- 1) Fine particles under 250 microns adhere to the coarse particles.
- 2) For a given ratio of fine particles to nuclei particles, the thicknesses
- of adhering layers are proportional to the size of the nuclear particles.

The model predicts the final granule size distribution based on the particle size distribution of the raw materials based on a simplified population balance model.



Fig. 3 The model results and the experiment results

What the influences of the adhering layer to the NOx emission are?

The tube furnace Experiment

- Granules with two different adhering ratios are made, R=1.83/3, R=1.83/2
- R means the adhering ratio between the mass of the adhering layer and the mass of the core particle.
- Ig granules are put into the tube furnace under two different temperatures(1173K and 1373K).
- The NOx emissions of all the experiments are measured by the Testo350.

Temperature(K)	1173 NO _x (mg)	1173 CNC (% in	1373 NO _x (mg)	1373 CNC (% in
		weight)		weight)
Granules	6.11±1.390	25.44±5.79	2.25 ± 0.60	9.43±2.51
(AR:1.8/2)			·	
Granules	4.84 ± 0.032	20.15 ± 0.13	2.86 ± 0.20	11.98 ± 0.84
(AR:1.8/3)				
Coke	4.25±0.275	18.00 ± 1.17	4.22±0.32	17.88±1.36

 Table 1 NO_x emission from the experiments involving coke and granules with different adhering layer ratios

 AR: Adhering Ratio; CNC: Coke Nitrogen Conversion

Research Priorities and Conclusions

- Granules Size Distribution can be calculated through the granulation model.
- Adhering layer's influence on the NOx emission are studied.
- Thicker adhering layer has a greater influence for the S type granules during sintering

at both low and high temperature.

> The NOx emission increases with the thicker adhering layer at lower temperature(1173K),

but decreases at higher temperatures(1373K).

The adhering layer is an important part of the granule, which would influence the combustion of the

coke particle, as shown in the figure below(Zhao JP, 162(2015),P1019-1034,Combustion&Flame):



