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EXPERIMENTAL STUDY ON SINTER POT TEST WITH ADDED LIGHT BURNT DOLOMITE IN SINTERING PRODUCTION

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Reasonable matching structure of sintering flux has great effect on improving the sinter quality and reducing energy consumption. In this paper, the feasibility of replacing part or all of quick lime in sintering production with limestone, dolomite, light burnt magnesium powder and light burnt dolomite is studied by sinter pot test in the lab. The result shows that when with 5,47 % of light burnt dolomite replacing part of the quick lime, the results such as the weighted average of sinter granularity, the production yield, the utilization coefficient, the tumbler index and the reduction degree meet the actual production requirements.

Keywords: sintering, chemical composition, dolomite, structure, quality

INTRODUCTION

China is one of the countries where sinter is the main charge of blast furnace[1-3], and sinter generally accounts for more than 85 % of the raw material of blast furnace. With the development of blast furnace concentrate technology, blast furnace has higher and higher requirements on the quality of sinter. In recent years, with the substantial growth of Chinese iron and steel output, the demand for iron ore has increased rapidly[4-5], and the shortage of domestic iron ore supply has become increasingly prominent. Chinese iron and steel industry has become increasingly dependent on imported iron ore. However, the continuous sharp rise of iron ore price brings high sinter cost and hot iron cost[6-7]. Under the environment of basically stable iron-containing raw materials, combined with the existing raw material conditions of sintering, appropriate mature flux is used to optimize the ratio of sintering flux and achieve a reasonable flux blending structure, so as to achieve the purpose of saving energy and reducing consumption and reducing cost and improving sinter output[8-9]. In this paper, the sinter cup experiment is used to replace part or all of the quick lime with limestone, dolomite, light burned magnesium powder and light burned dolomite, respectively, in order to find the optimal type and ratio of sintering flux without reducing the production quality of sinter and achieve the purpose of reducing sintering cost.

METHODOLOGY

Experimental methods

The reducibility of sinter was measured by “Iron ore reducibility Tester” of iron-making laboratory of University of Science and Technology, Liaoning. The chemical composition analysis of sinter adopts the conventional chemical analysis method in metallurgical enterprises.

Experimental conditions

This experiment adopts the sintering method of laboratory sintering cup, diameter of sintering cup φ=200 / mm, ignition negative pressure of 3 000 / Pa, sintering negative pressure of 12 500 / Pa, cooling negative pressure of 10 000 / Pa, ignition time of 1 / min, sintering ignition temperature of 1 150±30 / °C, bottom layer thickness of 15 / mm, material layer thickness of 600 /

Table 1 **Sintering materials chemical composition / %**

Items	TFe	SiO_2	CaO	MgO	Al_2O_3	Burning Loss
Return Mine	54,84	5,50	10,45	2,85	1,96	0,40
Iron Sheet	70,80	1,30	-	-	-	-
Pilbara Mixed Ore	62,40	4,20	-	-	2,21	5,50
Brazil Powder	64,98	4,06	-	-	0,78	1,43
Gravity Dust	21,49	7,69	6,10	3,21	2,40	54,00
Slag	30,00	12,00	26,52	6,24	2,61	4,69
Dry Sludge	49,19	2,74	15,60	4,00	3,00	6,00
Sintered Ash	50,30	6,50	16,98	7,86	2,00	2,96
Mexico powder	57,70	11,00	0,57	0,35	3,59	2,41
FMG Iron Ore	57,82	4,20	-	-	1,92	8,60
Indian Powder	52,64	7,64	-	-	6,62	2,50
Limestone	-	1,32	52,00	1,00	-	45,00
Dolomite	-	5,80	30,10	19,50	-	44,00
Light-Burned Dolomite	-	6,30	47,20	30,50	-	13,70
Caustic-Burned Magnesia Powder	-	8,98	2,84	65,00	-	22,00
Quick Lime	-	5,50	78,40	1,42	0,71	11,20

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Table 2 **Ore matching scheme / %**

Scheme	Blending Material	Coke Powder	Limestone	Dolomite	Light-Burned Dolomite	Caustic-Burned Magnesia Powder	Quick Lime
1	80,26	3,47	8,03	8,24	-	-	-
2	81,68	3,53	-	8,39	-	-	6,40
3	84,47	3,65	-	-	-	2,29	9,59
4	84,28	3,64	-	-	5,47	0	6,61

mm. The ratio of ore return is 30 %, and the ratio of fixed carbon in the mixture is 3,3 %.

In any kind of ore blending scheme, it is required that the TFe, SiO_2, MgO and R of theoretical calculation results of sinter remain consistent, meanwhile the fuel blending ratio remain unchanged, which meet the current technical and economic indicators of sinter: TFe is from 53 % to 54,2 %, FeO 9,5 % or less, MgO style 2,5 % or higher, R is from 1,84 to 1.96.

Chemical composition of various materials is shown in Table 1.

The ore blending scheme is shown in Table 2, in which the blending material is made of various iron-containing raw materials in a certain proportion.

RESULTS AND ANALYSIS

Chemical composition results and analysis

The stability of chemical composition of sinter is one of the quality indexes of sinter. The stability of chemical composition can ensure both the smooth running of blast furnace and the permeability of high charge column, which will improve the output of blast furnace and reduce coke ratio. After the sintering experiment, its chemical composition is analyzed. Table 3 shows the chemical composition of sinter obtained by four schemes.

Table 3 shows the chemical composition of sinter obtained by different schemes basically meets the requirements of current technical and economic indicators of sinter, and each component is stable with little fluctuation, and the grade of optimized batching sinter is improved. Under the same constraint conditions, the constraints of various algorithms for chemical components are satisfied.

Table 4 shows the comparison between the theoretical and experimental TFe values of the four schemes. It can be conculded that there is little difference between the theoretical and experimental values. As the basicity of the experimental ingredients is 1,9, compared with the basicity of the calculated ingredients is 1,88, the amount of flux added is reduced and the experimental TFe measured is increased.

The TFe contents of the four schemes are increased by about 0,2 %, but the change rule of each scheme is consistent, indicating that the accuracy of chemical composition calculation is high in the calculation of ingredients.

Physical performance measurement results and analysis

The rational energy of sinter minerals measured in this experiment mainly focuses on drum index and particle size distribution of sinter. Other parameters include utilization coefficient and yield rate. The main physical performance indexes of four sinters are tested, and the test results are shown in Table 5.

As can be seen from Table 5, in terms of drum index and utilization coefficient, scheme four indexes are the highest, which are 1,69 % and 0,191 % higher than the lowest value respectively. In terms of yield, scheme 4 is 2,04 % higher than the lowest value. In terms of particle size distribution, scheme 2, Scheme 3 and Scheme 4 have each reasonable particle size distribution. Scheme 1 has more small particle .

The weighted average particle size of each scheme is calculated according to the proportion of each particle size range. The weighted average particle size of scheme 1 to Scheme 4 increases successively. The size distribution of sinter affects the permeability of sinter layer, and then affects the structure and strength of sinter. With the increase of weighted average grain size, the yield, utilization coefficient and drum index shows an increasing trend, as shown in Figure 1.

Table 3 **Sinter chemical composition / %**

Scheme	TFe	FeO	SiO_2	CaO	MgO	Al_2O_3	S	R
1	53,82	9,82	5,91	11,11	2,68	2,35	0,038	1,88
2	53,66	8,91	5,98	11,18	2,78	2,33	0,038	1,90
3	53,71	8,69	5,93	11,15	2,73	2,29	0,042	1,88
4	53,59	7,02	6,01	11,23	2,76	2,35	0,041	1,87

Table 4 **Contrast of calculated values and measured values of TFe / %**

	1	2	3	4
Theoretical Calculation	53,65	53,48	53,52	53,32
Experimental Determination	53,82	53,66	53,71	53,59

Table 5 **Sinter physical performance**

Scheme	Rate of Finished Products / %	Utilization Factor / t/m²/h	Drum Index / %	Graded Composition / %					
				>40	25-40	10-25	5-10	<5	Weighted Average
1	62,59	1,656	67,56	3,85	8,74	47,2	32,82	8,39	18,08
2	62,48	1,721	68,29	8,72	12,15	37,69	31,71	8,72	18,11
3	64,58	1,743	69,03	9,91	12,31	41,44	29,73	6,61	18,19
4	64,51	1,847	69,25	10,89	11,29	44,76	25,8	7,26	19,07

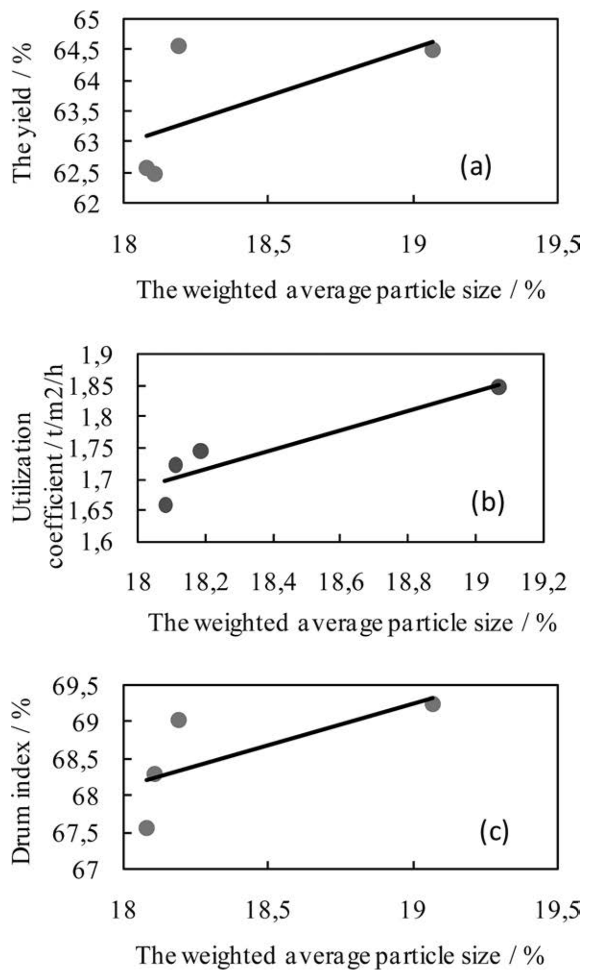

Figure 1 Impact trend with physical performance of sinter by particle size. (a) The yield, (b) Utilization coefficient, (c) Drum index

Determination results and analysis of metallurgical properties

Table 6 shows the reduction degree index of each scheme in the experiment. As can be seen from Table 6, the experimental results show that sinter obtained by other schemes has high reduction degree and can meet the needs of iron-making production and has a better reducibility, except for scheme 1.

Table 6 **Index of reduction**

	1	2	3	4
Weight Loss / g	90,4	101,2	95	101,5
Actual Degree of Reduction / %	77,1	86,7	81,5	86,5
Degree of initial reduction / %	5,2	4,1	4,2	4,2
Degree of standard reduction / %	82,3	90,8	85,7	90,4
Δt / min	37,5	46	34	41
Reduction rate / l/s	0,89	0,73	0,98	0,82

CONCLUSIONS

Some or all of the quick lime is replaced by limestone, dolomite, light burned magnesium powder and light burned dolomite for sinter cup experiment. The chemical composition of sinter obtained is stable and meets the requirements of current technical and economic indicators of sinter.

The weighted average of sinter grain size obtained by lightly fired white cloud replacing part of quick lime is the largest, and the indexes of yield, utilization coefficient, drum index and reduction degree are all good.

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Note: The responsible translator for English is Yan Wu, University of Science and Technology Liaoning, Anshan, China