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STUDY ON PHYSICAL AND CHEMICAL PROPERTIES OF NEW DESULFURIZER MAGNESITE

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In the hot metal pretreatment conditions, the direct current electric field is applied to study the new desulfurizer of magnesite to achieve the goal of in situ desulfurization instead of metal magnesium. A total of three desulfurizers were selected and the melting point, viscosity, primary crystal temperature, density and conductivity were measured and analyzed. The results can be shown that 18 %NaF-63 %MgF_2-12 %CaF_2-7 %MgO is the study of the latest desulfurization agent.

Key words: desulfurization agent, magnesite, melting point, viscosity, conductivity

INTRODUCTION

At present, the domestic and foreign metallurgical industry in the exploration of new desulfurization agent to replace or partially replace the metal magnesium desulfurizer, through the retrieval of the relevant literature at home and abroad over the past decade, found that the study of magnesite-based desulfurization agent for more desulfurization literature.[1]And the study of the use of magnesite electrolysis out of the direct magnesium desulfurization of the literature is rare.[2] China is the world's largest magnesite resources in the country, the use of magnesite electrolysis out of the direct magnesium desulfurization can be achieved, will replace the existing magnesite → metal magnesium → passivation of magnesium particles → hot metal pretreatment desulfurization production Process, to simplify the production process, reduce energy consumption and production costs for the metallurgical industry energy efficiency, improve product quality, to achieve low carbon emissions and green metallurgy made a great contribution. [3]

Laboratory equipment

The RTW-12 type physical property measuring instrument produced by Northeastern University was used in the experiment.[4] The equipment was mainly composed of computer, high temperature furnace and conductivity, primary crystal temperature and density device. The heating element is molybdenum silicide and the furnace temperature range is 0-1 600 °C. During the experiment, 1,5 L / min of nitrogen is passed to protect the graphite crucible and the graphite sleeve from being oxidized at high temperatures.

The melting point of the desulfurizer is measured by melting point melting rate tester. The melting point melting speed measuring instrument is mainly composed of point light source system, high temperature heating furnace system and slag image enlarging imaging system.[5]The resulting melting temperature is measured by the hemisphere method. Since the measured conditions are not in the constant temperature state or in the equilibrium state, the temperature obtained by the measurement is not the melting point or the melting temperature defined in the usual thermodynamics, but a relatively comparative Simple and practical with semi-empirical properties of the temperature.[6]

Experimental program development

As the molten metal in situ electrolytic magnesium oxide desulfurization, hot metal temperature is 1 300 °C, MgO melting point is 2 850 °C, MgO melting point is much higher than the molten iron temperature. If the desulfurization agent in the hot metal MgO can not be completely melted, then the molten iron in situ electrolytic magnesium oxide desulfurization technology will be difficult to achieve, electrolytic desulfurization efficiency is difficult to guarantee. (LiF-MgF_2-CaF_2-MgO) and sodium-based desulfurizer (NaF-MgF_2-CaF_2-MgO) were used to ensure the smooth progress of the experiment. MgF_2-CaF_2-MgO Desulfurization agent for comparative experiments to obtain the melting point and the primary crystal temperature are in line with the requirements, low viscosity, high conductivity of the new desulfurization agent composition.

Magnesium desulfurizer, lithium desulfurizer and sodium desulfurizer system ratio as shown in Tables 1,2,3.

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Table 1 **MgF_2-CaF_2-MgO desulfurization agent Ratio /wt.%**

MgF_2	CaF_2	MgO
64	26	10
66	25	9
68	24	8
70	23	7
72	22	6
74	21	5
76	20	4
78	19	3

Table 2 **LiF-MgF2-CaF2-MgO desulfurization agent Ratio / wt.%**

NaF	MgF_2	CaF_2	MgO
15	63	12	10
16	63	12	9
17	63	12	8
18	63	12	7
19	63	12	6
20	63	12	5
21	63	12	4
22	63	12	3
23	63	12	2
24	63	12	1

Table 3 **NaF-MgF_2-CaF_2-MgO desulfurization agent Ratio / wt.%**

LiF	MgF_2	CaF_2	MgO
12	64	14	10
13	64	14	9
14	64	14	8
15	64	14	7
16	64	14	6
17	64	14	5
18	64	14	4
19	64	14	3
20	64	14	2

According to the above ratio of desulfurization agent, with the analysis of pure reagent preparation desulfurization agent, mixed even after the melting point of the experiment.(Viscosity, primary crystal temperature, density, conductivity), the most suitable new desulfurization agent system was selected by analysis and comparison, and then the selected new desulfurizer sample was removed. The desulfurization agent was prepared according to the required desulfurizer system. X-ray diffraction experiments were carried out to determine the phase composition.

EXPERIMENTAL RESULTS

Melting point

From the analysis of Figure 1, the maximum mass fraction of MgO is 3 %, 6 % and 7 %, respectively, when the magnesium desulfurizer, the lithium desulfurizer and the sodium desulfurizer can be completely melted at the molten steel temperature of 1 300 °C. At this time, the mass ratio of the three desulfurizer systems was 78 % MgF_2-19 % CaF_2-3 % MgO, 16 % LiF-64 % MgF_2-14 % CaF_2-6 % MgO, 18 % NaF-63 % MgF_2 -12 % CaF_2-7 % MgO. The complete melting temperature of the three groups of desulfurizer system increases with the increase of MgO content in the system. Compared with the magnesium system, the melting effect of the lithium and the sodium system is better, and the content of magnesium oxide is higher, so adding LiF and NaF to the desulfurizer has an important effect on reducing the melting point of MgO.

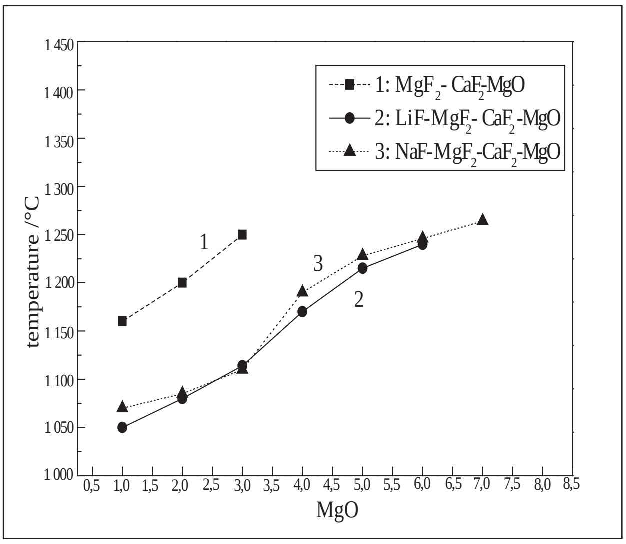

Figure 1 Melting point image

The above three components were selected for the physical properties of the melt analysis, that is, the viscosity, density, conductivity and the initial crystallization temperature of the experimental determination.

Viscosity

By measuring the viscosity of the experiment, the viscosity of the three desulfurization agent system shown in Figure 2. It can be seen from Figure 2 that the viscosity of the desulfurizer system decreases with the increase of temperature, and the viscosity at 1 300 °C is 0,28 Pa·s, 0,16 Pa·s and 0,13 Pa·s, respectively. Com-

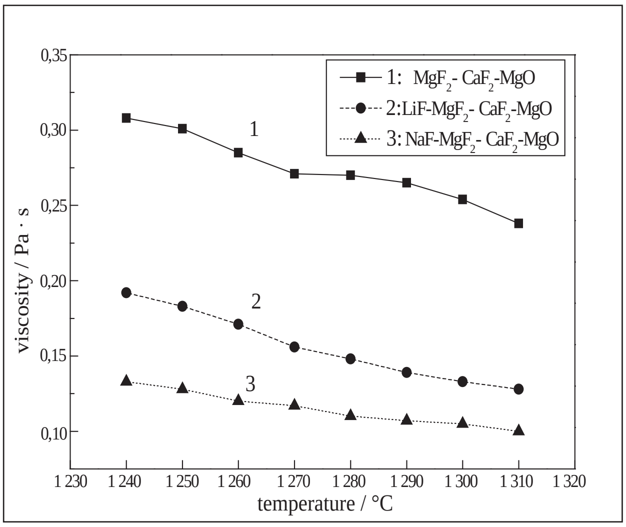

Figure 2 Viscosity image

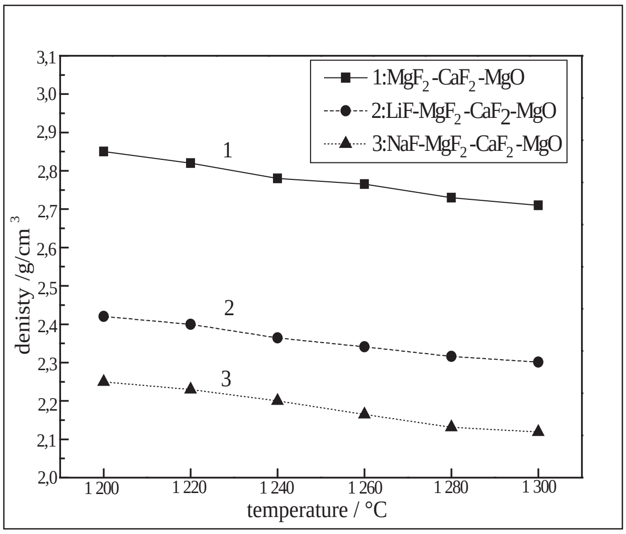

Figure 3 Density image

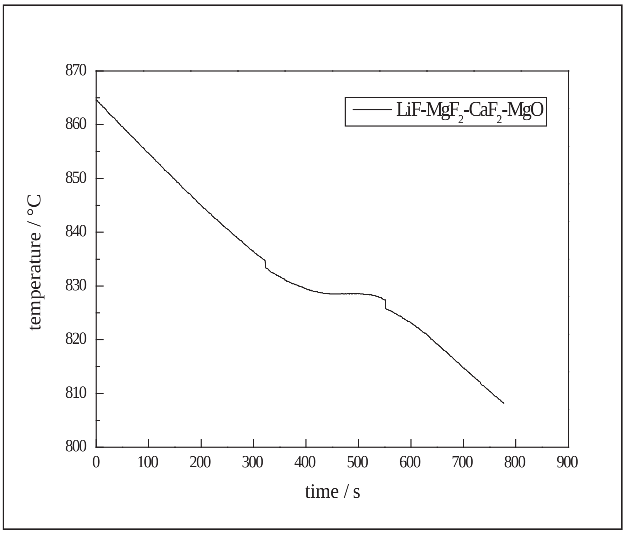

Figure 4 Primary crystal temperature image

pared with the magnesium system, lithium and sodium at a corresponding temperature lower viscosity, so in the desulfurizer by adding the right amount of LiF and NaF can effectively reduce the desulfurizer viscosity.

Density

As shown in Figure 3, the densities of the three groups of desulfurizers at 1 300 °C were 2,8 g / cm^3, 2,4 g / cm^3 and 2,15 g / cm^3, respectively. It can be seen that the densities of the three desulfurizer systems decrease with increasing temperature. When the electrolytic preparation of magnesium metal, if the electrolyte and metal magnesium density difference is greater, the more conducive to the separation of each other. After the electrolysis of magnesium metal in the molten iron in the rapid generation of magnesium vapor floating process to complete the task of desulfurization.

Primary crystal temperature

The initial crystal temperature of the three desulfurizing agent systems was determined by experiment. The images of the primary crystal temperature are shown in Figure 4 and Fig. It can be seen from Figure 4 that the primary crystal temperature appears at the position where the slope of the image changes for the first time. It can be seen from the figure that the inflection point of the cooling curve first appears at 835 °C, so it can be concluded that the initial crystallization temperature of this group of desulfurizer system is 835 °C with 16 % LiF-64 % MgF_2-14 % CaF_2-6 % MgO The In this study, the molten iron temperature is 1 300 °C, which is obviously higher than the volatilization temperature of LiF. This will lead to the change of the composition of the desulfurizer system in the process of electrolysis. LiF-MgF_2-CaF_2-MgO is not consistent with this study of the new desulfurizer requirements.

Figure 5 for the magnesium and sodium desulfurization agent of the initial crystal temperature diagram, we

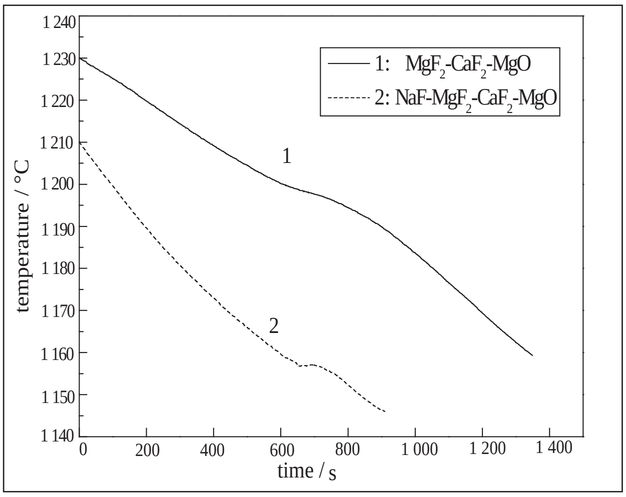

Figure 5 Primary crystal temperature image

can see that the two primary crystallization temperature of 1 200 °C and 1 150 °C, respectively, can meet the requirements of the new desulfurization agent.

The results show that the existence of MgO in the free state can be found by the X-ray diffraction image. It is proved that the proposed method is effective in the desulfurization of molten iron in the presence of external electric field. Finally, the final melting point, Determination of 18 % NaF-63 %MgF_2-12 % CaF_2-7 %MgO for the latest desulfurization agent.

CONCLUSION

(1) Through the comparative analysis of three kinds of desulfurization agent, it was found that the three could be completely melted at 1 300 °C, and the mass fraction of MgO was 7 % when the sodium system was completely melted.

(2) Lithium desulfurization agent in the initial crystallization temperature can not meet the requirements, can not be selected as a new type of desulfurization agent. Sodium desulfurizer which is relatively high

MgO content and meet the low viscosity, the advantages of large conductivity, so the choice of 18 %NaF-63 % MgF_2-12 % CaF_2-7 %MgO.

(3) The results showed that the viscosity of 18 % NaF-63%MgF_2-12 %CaF_2-7 % MgO gradually decreased with the increase of temperature, the temperature increased by 40 °C, the viscosity of desulfurizer decreased about 0,02 Pa·S;

(4) The study found that 18 % NaF-63 % MgF_2-12 % CaF_2-7 % MgO conductivity increased with increasing temperature. After the desulfurizer is completely melted at 1 220 °C, the conductivity of the desulfurizer is increased by about 0,1 s / cm ~ 0,15 s / cm for every 40 °C increase in temperature.

(5) After the physical and chemical properties such as melting temperature, viscosity, primary crystal temperature, molten salt density and conductivity, 18 % NaF - 63 % MgF_2-12 % CaF_2 - 7 % MgO was finally determined.

Acknowledgments

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Note: Wei Ye is responsible for English language, Anshan, China. Kun Liu is the corresponding author.