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ISSN 0543-5846
METABK 57(1-2) 35-38 (2018)
UDC – UDK 66.094.5:622.368:541.127:669.7.0.621.745:539.26=111

STUDY OF DESULFURIZATION WITH MAGNESITE DESULFURIZER UNDER HOT METAL PRETREATMENT

Received – Primljeno: 2017-06-28
Accepted – Prihvaćeno: 2017-09-20
Original Scientific Paper – Izvorni znanstveni rad

In this paper, MgO 38 %, C 10 %, Al 12 %, Fe_2O_3 34 %, SiO_2 + CaO 5,3 %, CaF_2 0,7 % as the new desulfurizer ratio composition. Adding FeS, heating in a high temperature furnace, and then studying the reaction product composition by phase analysis. Found that the formation of MgS, indicating that the new desulfurization agent can be used for desulfurization. When the temperature is the same, the higher the initial sulfur content, the higher the desulfurization rate of the new desulfurizer. When the initial sulfur content is constant, the desulfurization rate increases with the temperature increasing. Desulfurization is mainly concentrated in the first 15 minutes, the best desulfurization temperature is 1 500 °C.

Key words: desulfurization, magnesite, desulfurization rate, hot metal pretreatment, X-ray diffraction (XRD)

INTRODUCTION

With the new desulfurizer instead of the traditional desulfurization agent [1] is the current stage of research and development of desulfurization at home and abroad. China's magnesite reserves as a relatively large country. How reasonable and full use of magnesite resources is an urgent need to solve the problem. Nearly ten years of literature, few people concerned about the magnesite to restore the metal magnesium steam for desulfurization. Magnesite as the main raw material for the production of magnesium metal, in the application of hot metal pretreatment desulfurization, metallurgical industry will be another major move. It will replace the traditional passivation of metal magnesium particles desulfurization, the use of magnesite in the carbonate by the high temperature release of CO_2, the hot metal mixing effect is very good, the resulting CO_2 and C reaction generated CO will be a great degree of optimization desulfurization process [2, 3]. It will improve the quality of steel and reduce costs for enterprises to achieve high returns, in line with the development trend of low-carbon and green metallurgy.

This experiment is based on Gao Xin, Xing Fei topic [4, 5] of a progress study. The effect of temperature and sulfur content on the in situ desulfurization of metallic magnesium was analyzed by the addition of FeS in the process of hot metal pretreatment.

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EXPERIMENTAL MATERIALS AND METHODS

This paper is the basic research on the new desulfurizer, the use of industrial magnesite but the use of high purity experimental chemical reagents for the experiment, the required materials such as Table 1.

Table 1 **Experimental materials**

Name	Molecular formula
Graphite powder	C
Magnesium oxide	MgO
Aluminum powder	Al
Ferric oxide	Fe_2O_3
Calcium fluoride	CaF_2
Calcium Oxide	CaO
Silica	SiO_2

In order to make the MgO in the raw material completely and the graphite powder reaction, this experiment uses a graphite crucible, its specifications: height of 100 mm, diameter 45 mm, diameter 65 mm. From the economic point of view of the price of graphite crucible cheap; from the reduction conditions, in the graphite crucible can create a good reduction conditions, the magnesium desulfurization favorable.

In this experiment, the temperature of MgO and C is about 1 400 °C in the case of aluminum heat agent, so the three temperatures are 1 400 °C, 1 450 °C and 1 500 °C respectively. It is set to initial sulfur content of 0,2 %, 0,3 %, 0,35 % and 0,4 %.

The initial sulfur content and temperature as a variable, each variable to control the variable method for comparison experiments, a total of 14 groups. In order to meet the blast furnace iron temperature, this experiment also set the temperature of 1 350 °C desulfuriza-

tion experiments. The specific experimental scheme is shown in Table 2.

Table 2 **Experimental program**

Program number	Initial sulfur content /%	Temperature / °C
1	0,2	1 400
2	0,3	1 400
3	0,35	1 400
4	0,4	1 450
5	0,2	1 450
6	0,3	1 450
7	0,35	1 450
8	0,4	1 450
9	0,2	1 500
10	0,3	1 500
11	0,35	1 500
12	0,4	1 500
13	0,3	1 350

EXPERIMENTAL RESULTS AND ANALYSIS

In this experiment, 10 g of FeS was added to 20 g of MgO 38 %, 10 % graphite powder, Al 12 %, Fe_2O_3 34 %, SiO_2 + CaO 5,3 %, CaF_2 0,7 %, and placed in a graphite crucible Heating in a high temperature heating furnace. The required temperatures are 1 400 °C, 1 450 °C and 1 500 °C.

XRD phase analysis of slag sulfur

The desulfurization slag was subjected to XRD phase analysis after heating at high temperature to determine whether the phase composition was MgS.

It can be observed from Figure 1, a), b), c) that MgS can be detected in the magnesite-based desulfurizer with FeS addition, indicating that the formation of metallic magnesium in the reaction of graphite powder and MgO under three temperature conditions, FeS desulfurization reaction to produce MgS. In addition to the formation of MgS, the unreacted MgO, MgO-Al_2O_3 and C are formed by the reaction of MgO with Al_2O_3. Temperature is 1 400 °C and 1 450 °C also generated Fe_2O_3. When the temperature is 1 500 °C, there is the formation of Fe_2MgO_4.

Through the experiment can explain the new type of magnesite-based desulfurization agent can be used to desulfurization. But how desulfurization in the desulfurizer magnesite yl new hot metal pretreatment process, further research is needed.

The effect of initial sulfur content on desulfurization

Due to the presence of (Mg) (S) concentration, the initial sulfur content has a significant effect on the desulfurization effect during the magnesium desulfurization process.

Changing the initial sulfur content of respectively 0,2 %, 0,3 %, 0,35 %, 0,4 % desulfurizer 20 g, experimental results are shown Figure 2.

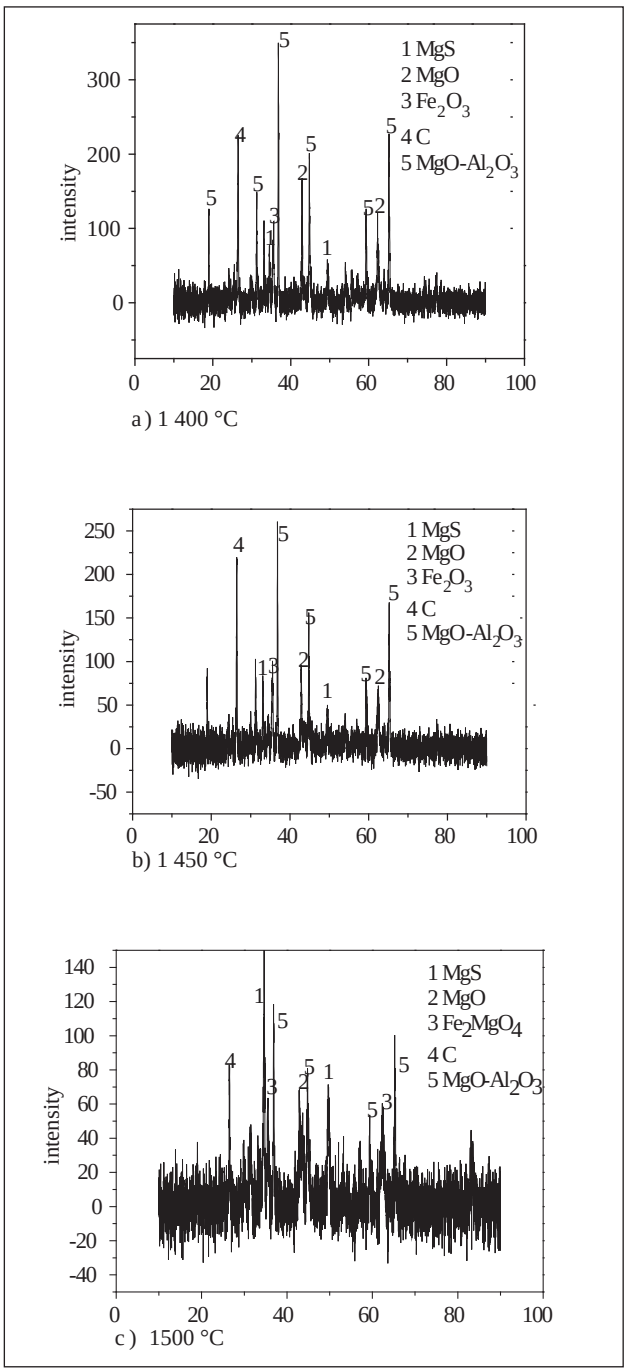

Figure 1 XRD diffraction pattern at different a) 1 400 °C, b) 1 450 °C, c) 1 500 °C

The average desulfurization rate for calculating the initial sulfur content is shown in Figure 2. As the initial sulfur content increases, the average desulfurization rate increases. When the initial S content increased from 0,2 % to 0,4 %, the average desulfurization rate increased from 67,3 % to 72 %. Indicating that the higher the initial sulfur content desulfurization effect is better, the higher the desulfurization rate.

Effect of temperature on desulfurization

It is found that the rate of magnesium formation is accelerated and the desulfurization is beneficial to magnesium desulfurization. However, the higher the disso-

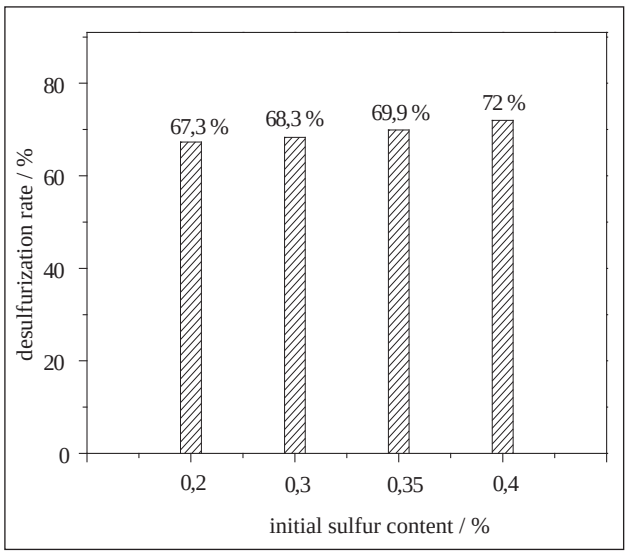

Figure 2 The average desulfurization rate

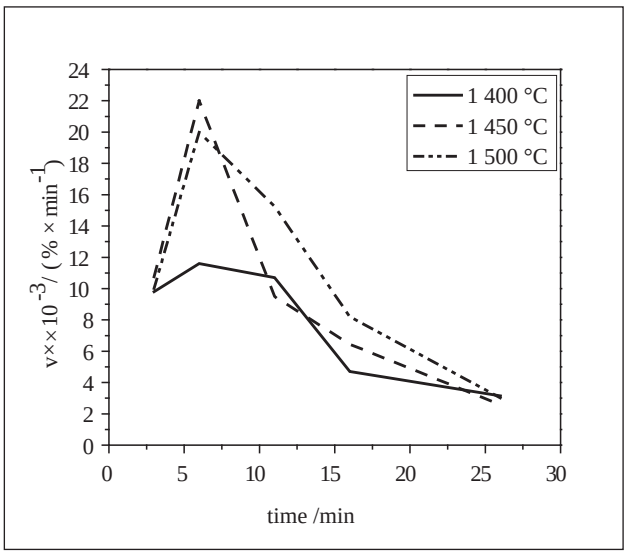

Figure 4 Average desulfurization rate at different temperatures for the same period

lution temperature of the magnesium in the molten iron is increased, and the effect of desulfurization is reduced. So it is necessary to explore the effect of temperature on the desulfurization effect.

When the initial sulfur content unchanged, change the temperature, the experimental results shown in Figure 3.

Figure 3 shows the average desulfurization rate at three temperatures. From the histogram can be seen with the temperature rise, the average desulfurization rate is gradually increased. At a temperature of 1 400 °C, the desulfurization rate is less than the other two temperatures. This is because the lower the temperature when the reduction rate of MgO is relatively low, seriously affected the desulfurization efficiency of magnesium. At a temperature of 1 500 °C and 1 450 °C magnesium is reduced more, more metallic magnesium for desulfurization, the desulfurization rate higher than 1 400 °C. When the temperature increased from 1 400 °C to 1 500 °C, the desulfurization rate increased from 52 % to 69,4 %, indicating that the higher the temperature,

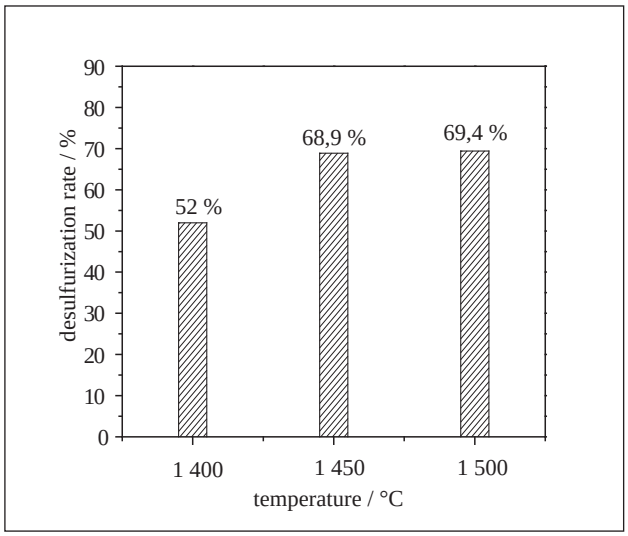

Figure 3 Average desulfurization rate at different temperatures

the more magnesium metal reduction, the better the desulfurization effect. However, as the temperature increases, the solubility of metallic magnesium in molten iron is decreasing. So the solubility of metallic magnesium may also be a factor limiting the desulfurization rate.

Figure 4 shows the average desulfurization rate at different temperatures for the same period. It can be seen from the figure. With the reaction time, the average desulfurization rate showed first increase and then reduce the trend. At 7 minutes, the desulfurization rate reached a peak. The desulfurization rate is minimum at 1 400 °C. During the 7 minutes before the start of the reaction, the desulfurization rate at 1 450 °C and 1 500 °C is substantially the same. As the reaction continued, the desulfurization rate of the former was gradually lower than that of the latter. As can be clearly seen from the figure, the reaction in the first 15 minutes to maintain a high desulfurization rate. So the experimental desulfurization reaction mainly in the first 15 minutes.

CONCLUSION

Through the experimental study, the following main conclusions are obtained:

(1) FeS in the new desulfurizer was heated at high temperature in a high temperature heating furnace, and the presence of MgS is found by XRD phase analysis of the slag. Indicating that the slag has a metal magnesium generation, can achieve the purpose of desulfurization.

(2) The desulfurization rate increases with the increase of the initial sulfur content. When the initial sulfur content is constant, the desulfurization rate increases with the increase of the temperature.

(3) The optimum desulfurization temperature of the new desulfurizer is 1 500 °C, and the desulfurization reaction is mainly carried out in the first 15 minutes.

Acknowledgments

The authors are grateful to the Program of the National Natural Science Foundation of China (No. 51374126) for financial support of this research.

The authors are grateful to the Liaoning Provincial Department of Education key project (No. 601009817-03) for financial support of this research.

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Note: Kun Liu is responsible for english language, Anshan, LiaoNing, China.