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STUDY ON THE EFFECT OF METALLURGICAL WASTE ON THE WATER RESISTANCE OF MAGNESIUM OXYSULFATE CEMENT (MOS) COATINGS

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In this paper, in order to achieve the resource utilization of metallurgical waste, this article studied the water resistance of magnesium oxysulfate cement coating using blast furnace slag powder and iron tailings powder as fillers, and characterized its hydration products using X-ray diffraction (XRD) and scanning electron microscopy (SEM). The results indicate that an appropriate amount of slag powder and iron tailings powder can make the internal structure of the coating more dense, effectively improve the softening coefficient, and enhance water resistance.

Keywords: metallurgical waste, granulated blast furnace slag powder, magnesium oxysulfate cement coatings, $MgSiO_3$, water resistance

INTRODUCTION

The metallurgical industry produces a large amount of solid waste, such as blast furnace slag particles and iron tailings powder. When stored, it not only occupies a large amount of land, but also causes environmental ollution[1]. Therefore, it is of great significance to treat metallurgical solid waste as a resource and promote the concept of green development[2]. This experiment used blast furnace slag powder and iron tailings powder as fillers to study the effect of blast furnace slag powder and iron tailings powder on the water resistance of magnesium oxysulfate cement(MOS) coatings.

EXPERIMENT ANALYSIS

Basic ratio of MOS coatings

In order to meet the requirements for slurry consistency during the molding process, the basic ratio of magnesium oxysulfate cement coating in this experiment is: $MgO/MgSO_4$ molar ratio is8:1,9:1,and 10:1, and the concentration of $MgSO_4$ solution is 30 °Be. On this basis, granular blast furnace slag powder, which accounts for 10 %, 20 %, and 30 % of the mass of lightly burned magnesium oxide powder, is added as active filler to the coating, and 20 % of iron tail powder is added as non active filler, Although iron tailings powder cannot undergo hydration reaction, it can play a filling role and make the structure dense[3]. The experimental plan and results are shown in Table 1 and Table 2.

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The experimental results show that with the increase of slag powder content and the molar ratio increases, the 28 days compressive strength of magnesium oxysulfide cement coatings gradually increases, from 30,6 MPa of sample D1 to 40,0 MPa of sample C3; After

Table 1 **Different proportions of slag powder and iron tailings powder**

No.	Molar ratio	Slag powder /%	Iron tailings powder /%
A1	8:1	10	20
A2	8:1	20	20
A3	8:1	30	20
B1	9:1	10	20
B2	9:1	20	20
B3	9:1	30	20
C1	10:1	10	20
C2	10:1	20	20
C3	10:1	30	20
D1	8:1	0	20
D2	9:1	0	20

Table 2 **The compressive strength and Softening coefficient**

NO.	28d /MPa	Immersionwater for 24h/ MPa	Softening coefficient
A1	31,8	16,5	0,52
A2	32,1	18,0	0,56
A3	32,4	20,1	0,62
B1	34,3	23,0	0,67
B2	34,4	23,4	0,68
B3	35,7	25,0	0,70
C1	38,8	29,1	0,75
C2	39,1	30,9	0,79
C3	40,0	35,6	0,89
D1	30,6	15,3	0,50
D2	32,1	16,7	0,52

immersion in water for 24 hours, the compressive strength increased from 15,3 MPa of sample D1 to 35,6 MPa of sample C3; The softening coefficient increased from 0,5 of sample D1 to 0,89 of sample C3.

XRD analysis of coatings

According to Figure 1, the mineral phase in magnesium oxysulfide cement coating with different ratios is composed of 5.1.7 phase, unreacted MgO, $MgCO_3$, $Mg(OH)_2$, and hydrated $MgSiO_3$.

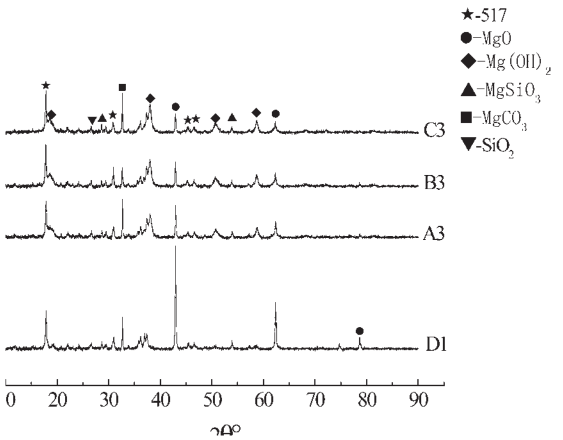


Figure 1 XRD of MOS coating

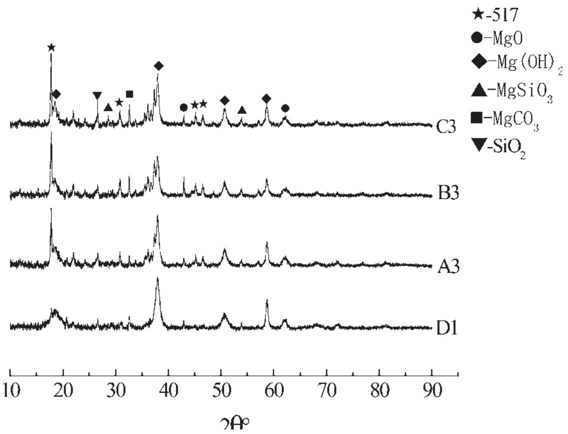
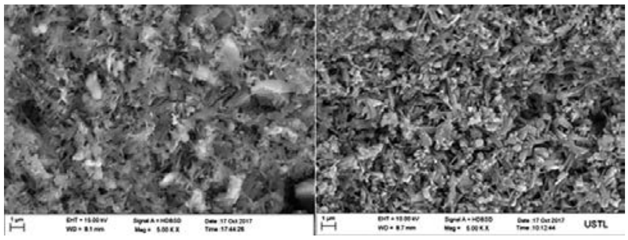


Figure 2 Immersion water for 24 h XRD of MOS coating

With the increase of slag powder content, hydrated $MgSiO_3$ is generated in MOS coating, and the diffraction peak of $MgSiO_3$ gradually becomes stronger, resulting in an increase in content. According to Figure 2, after 24 hours of immersion, the 5.1.7 phase in MOS significantly decrease, but the trend is inversely proportional to the amount of slag powder added. Among them, D1 without slag powder added is the most severe, resulting in a significant decrease in compressive strength and the worst water resistance.

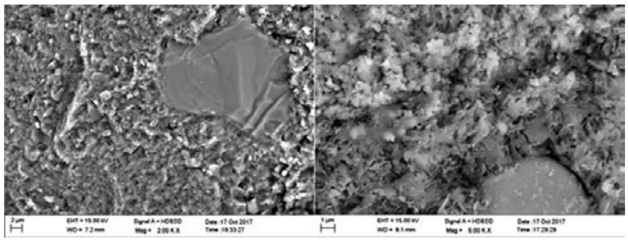
SEM Image analysis of coatings

Figure 3,4,5 and Figure 6 respectively show the microstructure of samples A3, B3, C3, and D1 before and after immersion in water. From the figures, it can be seen that after the hydration of MOS coatings, a large number of needle shaped 5.1.7 crystal phases are generated internally. As the molar ratio increases, the 5.1.7 crystal phase gradually increases, the structural matrix is relatively dense, and the strength gradually increases [4]; At the same time, with the addition of slag powder, the amount of $Mg(OH)_2$ generated by the hydration of MgO inside the sample decreases, and hydrated $MgSiO_3$ appears. As the content of hydrated $MgSiO_3$ gradually increases, the matrix becomes denser, resulting in a further increase in strength. When the sample is soaked in water, the 5.1.7 crystal phase in the sample undergoes hydrolysis, leading to a decrease in strength. Among them, sample D1 is the most severe, so the softening coefficient is the lowest; However, when a large amount of slag powder is added to the specimens, due to the protective effect of $MgSiO_3$, the hydrolysis of the 5.1.7 crystal phase is inhibited, the strength decreases



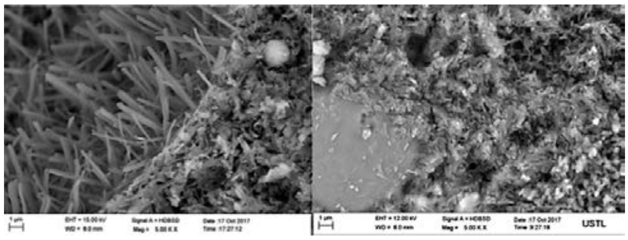
(a) (b)

Figure 3 Microstructure of sample A3



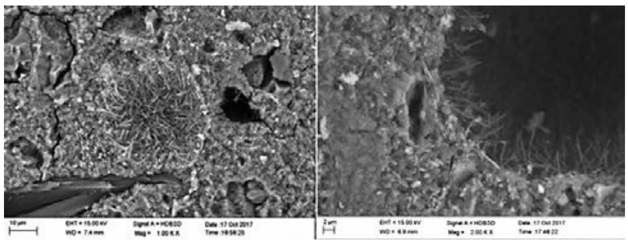
(c) (d)

Figure 4 Microstructure of sample B3



(e) (f)

Figure 5 Microstructure of sample C3



(g) (h)

Figure 6 Microstructure of sample D1 less, and the softening coefficient is higher. This indicates that the addition of slag powder can significantly improve the water resistance of the specimens.

CONCLUSIONS

When the molar ratio of $MgO/MgSO_4$ gradually increases, the strength also gradually increases, and the softening coefficient gradually increases; After the addition of slag powder, a large amount of $MgSiO_3$ was generated inside the sample, making the structure more dense and the strength further improved. Moreover, due to the protective effect of $MgSiO_3$, the softening coefficient was further increased. Among them, the best effect was $MgO/MgSO_4$ is 10:1 and add 30 % slag powder. The experimental results showed that the addition of slag powder can significantly improve the water resistance of MOS coating.

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Note: The responsible translator for English language is L. Bao, Anshan, China