Experimental study on properties of magnesium oxychloride cement

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Abstract. Magnesium oxychloride cement is an air-hardening cementitious material formed by the reaction of magnesium oxide and magnesium chloride solution. This kind of cement has high strength and high folding pressure ratio, which is the unmatched performance of ordinary cement concrete. This article tests the modification status of magnesium oxychloride cement after adding organic solution, and provides reference for the processing and design of magnesium oxychloride cement components in the future.

1. Introduction
Magnesium oxychloride cement is an air-hardening cementitious material mixed with MgO powder and MgCl₂ solution, and has a series of excellent properties [1]: ① fast setting and hardening; ② good mechanical strength; ③ weak alkaline and low corrosive; ④ good abrasion resistance; ⑤ good adhesion; ⑥ flame retardant performance; ⑦ strong heat insulation; ⑧ good impermeability and low price. However, the water resistance is poor, the fluidity of the magnesium oxychloride cement and the permeability to the carbon fiber must be further improved. Currently, the reaction mechanism of the magnesium oxychloride cement has been studied [2-4]. This article tests the compressive and flexural properties of magnesium oxychloride cement by adding organic solution [5] to magnesium oxychloride cement. Through the work of this paper, the structural strength of modified magnesium oxychloride cement was tested to provide reference for the processing and design of magnesium oxychloride cement components in the future [6].

2. Principle and proportion of experiments
The raw materials of magnesium oxychloride cement (MOC cement) used in the experiment: magnesium oxide, magnesium chloride, water, silica fume (SF), potassium phosphate crystals (KDP), and the raw material ratios are shown in Table 1.

| Material          | Quantity | Stirring time (1'30”~2’) |
|-------------------|----------|--------------------------|
| MgO+SF (solid)    |          | 1000g                    |
| MgCl₂ (solid)     |          | 454g                     |
| KDP (solid)       |          | 23.6g                    |
| Water             |          | 200g                     |
| Compressive       |          | 70~130                   |
| strength (MPa)    |          |                          |

TABLE 1. Magnesium oxychloride cement
Flexural strength (MPa) 15–20

Additional: MgO: SF=10:1 (weight ratio)

The test required material equipment: epoxy emulsion, styrene-acrylic emulsion, concrete mixer, electro-hydraulic servo universal testing machine.

3. experiments situation

According to the formula of magnesium oxychloride cement (Figure 1), we first pour MgO and SF powder into the stirred pot, add water, add MgCl₂, add KDP solid and finally add different proportion of epoxy emulsion and styrene acrylic emulsion. The proportion is 2% and 5%. Prepare the cement slurry, use the concrete mixer (Figure 2), stir the material to make a cement test block (Figure 3), the cement test block made after curing in 28 days after the electro-hydraulic servo. The universal testing machine (Figure 4) was tested to measure the compressive and flexural properties of the cement test block.

4. Test results and analysis

First, the cement test block was subjected to a flexural test and there was no significant change during the loading process. The pressure surface suddenly broke down. The cement test block broke into two pieces and its section was smooth and there was no obvious damage, see Figure 5. Then the compressive test was carried out. The fractured cement test pieces were gradually damaged during the loading process and the loading surface was suddenly destroyed. The cement sample blocks were crushed and stopped loading. For each set of tests, two blocks were taken for data measurement. The specific failure load and shear strength are shown in Table 2 (add styrene-acrylic emulsion), and Table 3 (add epoxy emulsion).
5. Conclusion
According to the test, it can be seen that adding a small amount of polymer emulsion has better effect, and the more the amount, the worse the modification effect. Because the amount of polymer is small, it cannot form continuous in the system. The polymer film has a poor effect on the cement water resistance modification, and when the amount is large, the water resistance is improved. For the epoxy emulsion, the film formation property of the magnesium oxychloride cement is poor, and the modification effect is not ideal, which is the main reason. The styrene-acrylic emulsion has a stronger modification effect than
epoxy emulsion.

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