The effects of different dosages of HPMC and RDP on the performance of tile adhesive

Abstract
This study employs an orthogonal experimental design to explore the influence and patterns of cellulose ether on the key properties of tile adhesive. By comparing the effects of redispersible polymer powder content and binder-to-sand ratio on certain properties, the main aspects that cellulose ether can optimize are identified. The findings provide valuable insights for adjusting specific properties of tile adhesive.

Keywords: Cellulose ether; RDP, Tensile bond strength; Tile adhesive

Introduction
Currently, China leads the world in the production, processing, and consumption of cellulose ether. The further development and utilization of cellulose ether play a critical role in the advancement of new building materials in China. With the continuous improvement and optimization of tile adhesive performance, the variety of mortar applications in the new building materials market has expanded. However, further enhancing the key properties of tile adhesive has become a new focus for market development.

Experimental Design, Methods, and Materials
2.1 Experimental Raw Materials:

Cement: Conch P.O 42.5 ordinary Portland cement
Sand: Black sand
Redispersible polymer powder: CORESYN POLY 810, produced by Hangzhou Corsyn Chemical co., Ltd.
Cellulose ether: Methyl cellulose ether with a viscosity of 100,000 mPa·s, produced by Hangzhou Coresyn Chemical Co., Ltd.

2.2 Experimental Design and Methods:
The tensile bond strength test was conducted in accordance with the standard JC/T 547-2005. Specimens measuring 40 mm × 40 mm × 160 mm were prepared, demolded after 1 day of curing, and then maintained in a constant temperature and humidity chamber at (23 ± 2)°C and (50 ± 5)% relative humidity for 27 days. Epoxy resin was used to bond the pull-off stubs to the specimens, which were then returned to the same chamber for an additional day of curing. Before testing, the specimens were inspected for cracks. The fixtures were attached to a universal electronic tensile testing machine, ensuring no bending at the connections. The specimens were subjected to pull-off testing at a rate of (250 ± 5) N/s, and the data were recorded.

Experimental Results
The cement content was fixed at 400 g, while the total mass of other materials was 600 g.

Experiment No.	*HPMC Dosage %*	*RDP Dosage %*	*Tensile Bond Strength under standard conditions/MPa*	*Tensile Bond Strength after water immersion/MPa*	*Tensile Bond Strength after 20-min Open Time/MPa*
1#	*0.1*	*3*	*1.29*	*1.00*	*0.65*
2#	*0.2*	*4*	*1.34*	*1.02*	*0.97*
3#	*0.3*	*5*	*1.89*	*1.16*	*1.26*
4#	*0.1*	*4*	*1.02*	*0.71*	*0.52*
5#	*0.2*	*5*	*1.29*	*0.79*	*0.82*
6#	*0.3*	*3*	*0.98*	*0.66*	*0.70*
7#	*0.1*	*5*	*0.90*	*0.50*	*0.44*
8#	*0.2*	*3*	*0.76*	*0.45*	*0.45*
9#	*0.3*	*4*	*0.85*	*0.48*	*0.57*

Discussion of Results

The results indicate that a cellulose ether content of 0.3% increased the wet tensile bond strength by 16% compared to a content of 0.1%. Increasing the redispersible polymer powder content showed a more significant improvement: a content of 5% increased the original tensile bond strength by 46.5% compared to 3%. As the polymer powder content increased from 3% to 5%, the relative decrease in bond strength increased by 23.4%; meanwhile, increasing the cellulose ether content from 0.1% to 0.3% resulted in a 7.6% increase in the relative decrease in bond strength.

According to JC/T 547-2005, the open time of tile adhesive must be no less than 20 minutes. Increasing the cellulose ether content gradually enhanced the tensile bond strength after a 20-minute open time. Specifically, contents of 0.2% and 0.3% improved the bond strength by 48.1% and 59.6%, respectively, compared to 0.1%. Similarly, increasing the polymer powder content to 4% and 5% improved the bond strength by 19.0% and 41.4%, respectively, compared to 3%. The results clearly demonstrate that the cellulose ether content had a more pronounced effect on the bond strength after the 20-minute open time. As the cellulose ether content increased, the relative decrease in strength gradually reduced and stabilized, indicating that cellulose ether significantly enhances the bond strength of tile adhesive after a 20-minute open time.

Conclusions

(1) Increasing the content of cellulose ether and redispersible polymer powder can improve the tensile bond strength of tile adhesive to a certain extent.

(2) The cellulose ether content has the greatest impact on the tensile bond strength after a 20-minute open time, indicating that adjusting its content can effectively enhance this property.

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