Preparation and Mechanical Properties of Polyacrylate Latex Modified Fly-Ash/Cement Mortar

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Abstract: In this communication, pure polyacrylates latex (PL) as organic additive, fly ash (FA), Portland cement as inorganic binders (IB), and river sand as fine aggregate were studied. Compressive strength, adhesion strength and flexural strength were investigated with dosage of FA and PL. The flexural strength and adhesion strength of the mortars are improved. However, the compressive strength decreases with increase of FA and PL.

Key words: pure polyacrylate latex; fly ash; cement; polymer modified mortar
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New hybrid materials, such as polymer mortars (PM), stronger, more durable and more efficient than conventional materials, are an essential element in water proofing process and repair of the construction. Many polymers can be used as organic binder in PM. However, waterborne latex draws more interest for environmental reason[1-3]. FA, the solid inorganic waste of thermal power plant, poses problems of its disposal and effective utilization from an environmental and economical point of view. The reemployment of FA has attracted increasing attention from both scientific and engineering communities recently[4-5]. In this communication, FA used as a replacement partially for cement and PL as organic binder in PM were studied. Mechanical properties of compressive, adhesion, flexural strength were investigated varying levels of FA. Mortars produced this way can be used as material for waterproofing.

1 Experiments

1.1 Materials

The PL was obtained by copolymerization of a mixture of butyl acrylate, ethyl acrylate, methyl methacrylate and methacylic acid, and ammonium persulphate as initiator according to reference [1].

The FA is commercial productions as specified in China Standard GB/T 1596-2005. The cement used is ordinary Portland cement as specified in GB 175-1999. The fine aggregate is natural river sand.

1.2 Experiments and test

The mortar specimens of 40 mm × 40 mm × 160 mm were prepared for the mechanical characterization test.

The standard curing procedure (28 days water immersion) was chosen for reference unmodified mortars; a 28 days dry curing procedure (23℃ and 50% RH) was preferred for PM.

2 Results and discussion

The effects of mix proportioning on the mechanical properties base on the FA/cement of 0.0, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35 and 0.4, PL/IB of 0, 0.05, 0.1, 0.15, 0.2 and 0.25, Sand/IB ratio 2.40 and water/IB of 0.4.

2.1 Flexural strength

The flexural strength of PL-modified FA/cement mortars observed as shown in Fig.1. It can be seen that the flexural strength increasing with FA content bellow the FA/cement ratio of 30%. Under the conditions of FA content of 30% and PL/IB of 25%, the flexural strength can be achieved up to 15.9 MPa, which is double the strength of plain cement mortars.

This may be interpreted by the significant synergistic effect in this property due to the FA—Cement combination, and weak bonding between FA and PL is developed in composites with a high loading level of FA. Hence, the reinforcement in flexural strength can be seen to reach maximum at 30% FA content and beyond that this property declines.

2.1 Compressive strength

Fig.2 shows that the compressive strength of PL-modified FA/cement mortars increases with FA content

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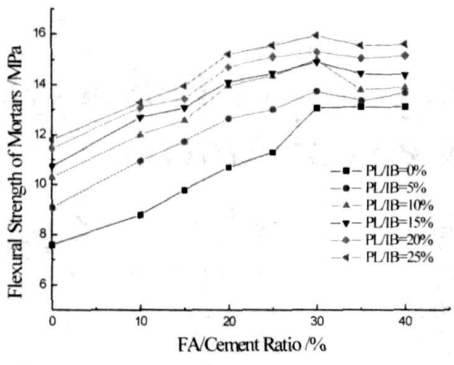

Fig. 1 Effects of FA on flexural strength

without addition of PL. The compressive strength increases in some sort firstly and decreases then with the augment of PL content. This may be induced by FA with higher content of silica and alumina and lower content of calces.

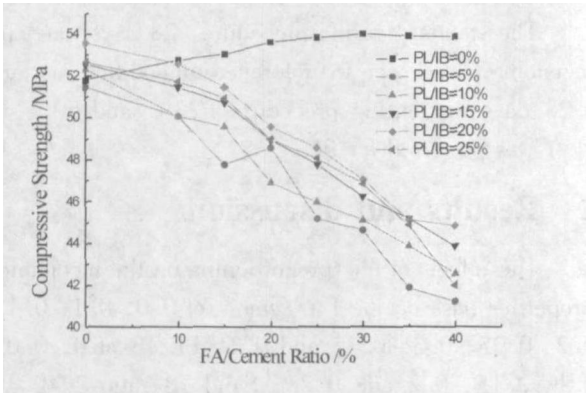

Fig. 2 Effects of FA on compressive Strength

2.3 Adhesion strength

Fig. 3 exhibits the adhesion strength of the mortars increasing with aggrandizement of FA and PL content. The reason for this may be due to the adhesional bond strength between the functional group—COOH of PL and the production of alumina or calcium oxide hydration, such as —COOC$_n$S, —COOCH, and —COOC$_n$A etc.

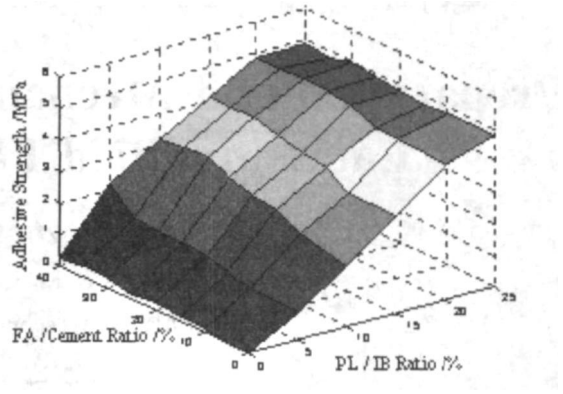

Fig. 3 Effects of FA on adhesive strength

3 Conclusions

(1) FA can be used as inorganic binder material partially replacing Portland cement in polymer modified mortar systems.

(2) The flexural and adhesion strengths of the mortars tend to increase with increasing FA/cement ratio and PL/IB ratio, and to attain maximums at FA/cement ratios of 30% and PL/IB ratios of 25%, respectively.

(3) The compressive strength decreases with increasing of FA and PL content.

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聚丙烯酸酯乳液改性粉煤灰/水泥砂浆的制备与性能研究

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摘 要: 以纯丙乳液为有机添加剂, 制备了粉煤灰/水泥砂浆, 研究了不同粉煤灰和纯丙乳液用量对砂浆抗压、抗折及粘结强度的影响。砂浆的抗折及粘结强度得以改善, 但抗压强度有所降低。

关键词: 纯丙乳液; 粉煤灰; 水泥; 聚合物改性砂浆

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