

Study on Several Kinds of Polymer Emulsion Modified Cement Mortar Performance

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Abstract. Cement mortar is typical of a brittle material, with high compressive strength, low tensile strength, flexural strength, and bonding strength. This paper introduces that several polymer emulsions modified cement mortar. By researching the water-reducing, impermeability and mechanical properties of cement mortar, the results shows SD623 (Styrene-butadiene rubber latex) is most obvious.

Introduction

Cement mortar is typical of a brittle material, with high compressive strength, low tensile strength, flexural strength, and bonding strength[1]. It is difficult to meet the engineering requirements of durability and construction efficiency, greatly limits its application in construction engineering[2].

Today, polymer emulsion modified cement mortar is very hot, and the factors of affecting the modified cement mortar properties and in addition to the kind and performance of cement mortar, the main types, dosage, curing methods of polymer mortar[3]. In this paper, several polymer modified cement mortar, so study its relative performance.

Raw Materials and Test Method

Raw materials

PO 42.5 cement using ordinary portland cement, meeting the relevant standards, Its chemical composition and physical properties are shown in table1, table2;

Shanghai styrene-butadiene latex (SD623) produced by BASF, Acronal styrene-acrylic emulsion(PS608), acrylic emulsion(S400), their Related properties are shown in table 3.

Table1 The chemical composition of cement

compositio (%)	MgO	Al ₂ O ₃	SiO ₂	SO ₃	CaO	Fe ₂ O ₃	Loss
content	2.87	6.23	22.86	1.95	58.43	3.36	4.30

Table2 The physical properties of cement											
perform ance density (g/cm ³)	finene ss(%)	norma l consi stency (%)	setting time (min)		sta bili ty Co nfo rmi ty	breaking strengt h (MPa)			compressive strength (M Pa)		
			initial set	final set		3d	7d	28d	3d	7d	28d
3.10	1.25	27.4	130	195		6.5	8.2	10.4	26.8	41.7	54.3

Table 3 Polymer emulsion physical properties				
The emulsion type	main chemical compositions		solid content (%)	PH value
SD623	styrene, PSB		51	7.8-10
PS608	crylic acid, styrol copolymer		50	8.0-9.0
S400	styrene, acrylics copolymer		57	7.0-8.5

Test Method

Determination of the strength of cement mortar on the basis of national standards of GB/T17671-1999; Testing cement mortar fluidity is reference to national standard of GB-T2419 [4];

Permeability resistance is the basic guarantee of cement concrete has excellent durability. Due to the high testing precision, simple operation and time-consuming short (6 h), chloride ion permeability resistance index can be used as the main index of cement concrete durability test. So for PS608, SD623, S400, the three kinds of emulsion performance of the cement mortar, adopting the rapid determination of chloride ion diffusion coefficient method (RCM method) test, cement mortar impermeability is reference to national standards of JGJ 70-90 test[5].

Experiments and Results

Polymer Emulsion on Cement water-reducing

The selected gray sand ratio is 1: 3, polymer - cement ratio controlled as follows: 5%, 10%, 15%, 20%, jump table fluidity of fresh mortar controlled as 150 ± 5 mm and the water-cement ratio is adjusted according to the fluidity.

The water-reducing effect of these three kinds of different content of the emulsion, as shown in Fig.1. It can be seen that different type and different amount of the polymer emulsion have different effect of water-reducing: ①At the same rate of polymer-cement, the order of water-reducing effect as follows: SD623>PS608>S400, the water-reducing of S400 is 13.1% when the polymer - cement ratio is 10%, whereas the water-reducing rate of SD623 is 28.3% which is 2.2 times the S400; ②With the increasing of the amount of polymer emulsion, water-reducing rate will increase, but when the polymer - cement ratio is higher than 15%, the increasing trend of water-reducing by the polymer is not significantly increased. As PS608: the water-reducing rate increases at 42.9% when the cement ratio changes from 10% to 15%, whereas the water-reducing rate increases at 6.7% when the cement ratio changes from 15% to 20%. It can be found that the effect of SD623 to reduce the water is best, whereas S400 is worst, and taking into account the cost-effective and polymer - cement ratio are no higher than 15 percent as much as possible.

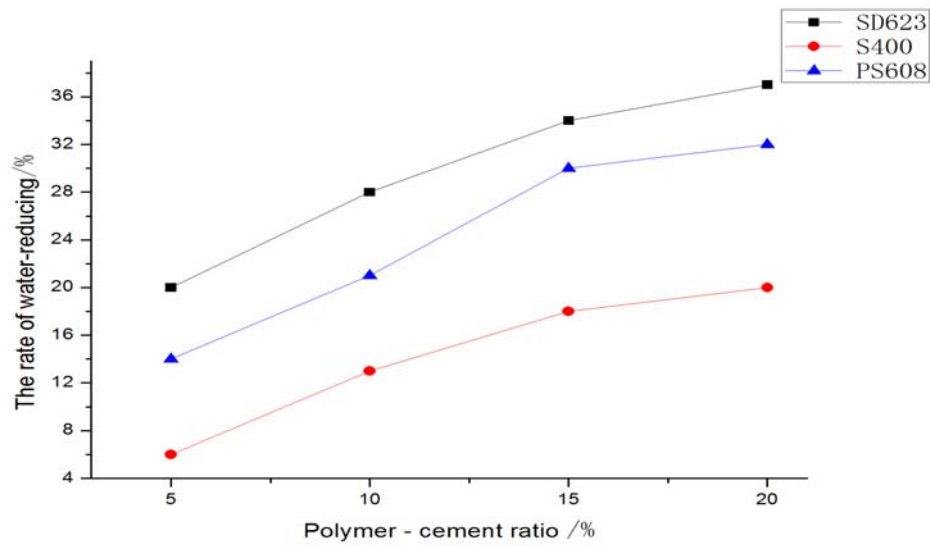


Fig.1 The effect of water-reducing of content among different types of polymer emulsion

Impermeability of polymer-modified cement mortar

The effect of PS608, SD623 and S400 on cement mortar impermeability is shown in Fig.2. It shows: Adding different types and different contents of polymer emulsion can reduce permeability coefficient of the cement mortar chloride, the orders of three kinds of latex modified mortar impermeability are $SD623 > PS608 > S400$. With the increasing of polymer - cement ratio, its impermeability increases. When the polymer - cement ratio is 20%, modified mortar Chlorine ion permeability coefficient of SD623, PS608 and S400 are $3.4 \times 10^{-13} \text{ m}^2/\text{s}$, $4.1 \times 10^{-13} \text{ m}^2/\text{s}$ and $5.2 \times 10^{-13} \text{ m}^2/\text{s}$, lower than the blank sample at 71.7%, 65.8%, 56.7%, respectively. It shows that polymer emulsion can better improve the barrier properties of cement mortar.

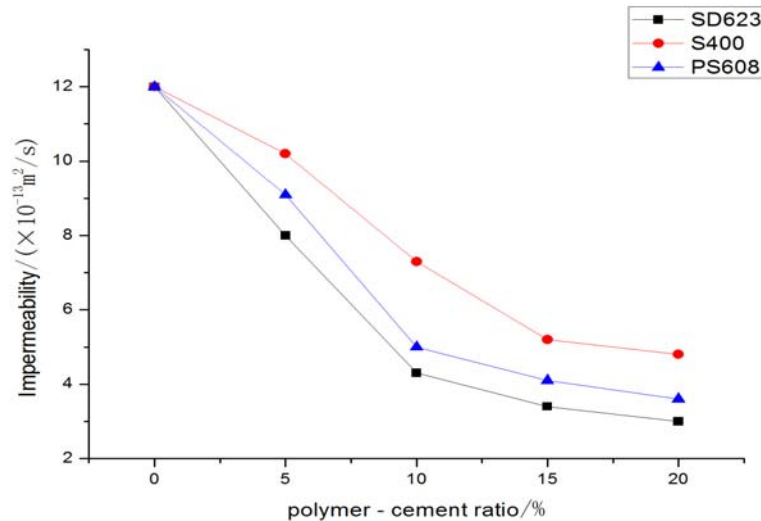


Fig.2 Effects of different types and content of the polymer emulsion on cement mortar impermeability

Study of properties of polymer emulsion modified cement mortar

The test results about how the type and amount of polymer emulsion affect the mechanical properties of mortar are shown in Table 1. It shows as follows:

Adding the polymer emulsion can better improve the ratio of bending-compressive strength, thereby increasing its flexibility, and the orders of the effect are: $SD623 > S400 > PS608$, in addition,

each mixing ratio of cement mortar 7d fold compression ratio is significantly higher than 28d fold compression ratios.

Table4 Influence of polymer emulsion type and dosage on the mechanical properties of mortar							
Types	P/C	3d			28d		
		Breaking strength (MPa)	Compressive strength (MPa)	Band-pr ess ratio	Breaking strength (MPa)	Compressive strength (MPa)	Band-p ress ratio
Blank sample	0	7.2	35.1	0.21	10.9	54.5	0.20
SD623	10	8.3	27.5	0.30	12.5	44.1	0.28
	20	9.1	25.2	0.36	14.2	40.2	0.35
PS608	10	7.9	28.3	0.28	11.1	47.5	0.23
	20	8.6	27.7	0.31	13.4	45.9	0.29
S400	10	4.7	15.8	0.30	7.1	29.4	0.24
	20	5.1	14.6	0.35	8.2	27.1	0.30

Conclusions

(1) The water-reducing effect of these three kinds of different content of the emulsion, as shown in Fig.3. It can be seen that different type and different amount of the polymer emulsion have different effect of water-reducing. It can be found that the effect of SD623 to reduce the water is best, whereas S400 is worst.

(2) It shows that polymer emulsion can better improve the barrier properties of cement mortar.

(3) Adding the polymer emulsion can better improve the ratio of bending-compressive strength, thereby increasing its flexibility, and the best of the effect are SD623.

In summary, through the research of how SD623, PS608 and S400 influence the relevant physical and chemical properties of cement-based materials, it can be found that SD623 can better improve the performance of the water-reducing and impermeability of cement.

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