Research on the preparation and application of polymer anti-segregation agent

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Abstract. Concrete is the largest material used by human beings, and it is often easy to cause segregation of concrete in the process of application due to the deterioration of raw materials and human errors, resulting in accidents such as plugging of pumps, exposure of reinforcing bars, and substantial reduction of concrete strength, which cause huge risk factors and economic losses. In this paper, a new type of polymer anti-separation agent is synthesized with acrylamide as the main raw material. The effect of different causes of concrete segregation on the dosage and effectiveness of concrete anti-segregation agents was investigated.

Keywords: Polymer anti-separation agent; Water secretion; Sand rate; Concrete segregation

1 Introduction

With the development of the construction industry, concrete is still the largest material used by human beings [1-2]. During the actual production and application of concrete, deterioration of concrete raw materials and human errors often easily cause segregation of concrete[3], resulting in accidents such as blocked pumps, exposed reinforcement, and substantial reduction in concrete strength, causing huge risks and economic losses [4].

For ready-mixed concrete, because of admixture overmixing, wrong measurement of sand moisture content caused by sand rate reduction and increase in water consumption is the most common cause of segregation of concrete[5], the use of concrete anti-segregation agent can effectively improve the state of segregation of concrete to ensure that its workability is not affected and can be used normally[6].

Domestic researchers have tried to add ultrafine mineral admixture, mixtures of polyvinyl alcohol and anhydrous sodium sulphate[7], polyacrylamide and other means to reduce the segregation of fluid concrete[8-9], and have also achieved some results. Foreign researchers, on the other hand, have used materials such as gel polysaccharides and alkaline materials and natural polysaccharide ethers to prepare segregation-resistant concrete[10].

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In this paper, for the above several types of concrete segregation, a polymer anti-segregation agent was prepared with acrylamide, 2-acrylamido-2-methylpropane sulfonic acid (AMPS), ammonium persulfate, sodium hypophosphite, mercaptoethanol, and sodium hydroxide (NaOH), etc., and the application of the anti-segregation agent for concrete was discussed.

2 Experiment parts

2.1 Raw materials

Raw materials for synthesis.

Acrylamide, 2-acrylamido-2-methylpropane sulfonic acid (AMPS), ammonium persulfate, sodium hypophosphite, mercaptoethanol, sodium hydroxide (NaOH). All of the above materials are of industrial grade.

Raw materials for performance testing.

Cement: P-O42.5 ordinary silicate cement produced by Conch Cement Plant, density 3. 12 g / cm3, standard consistency water consumption 25%, physical performance index of cement is shown in Table 1, chemical composition and mineral composition of cement clinker is shown in Table 2; Sand: Mechanized sand, fineness modulus 3.2, MB = 0.9; crushed stone, particle size 5-25mm; polycarboxylic acid water reducing agent, Point-400S water reducing agent produced by Kezhijie Group Co. Point-400S water reducing agent produced by KZJ Group Co.

Table 1. Physical properties of cement

solidification time /min		flexural strength /MPa		compressive strength /MPa	
condensation	congeal	3d	28d	3d	28d
240	360	5.4	8.6	30.1	54.2

Table 2. Chemical composition and mineral composition of cement clinker

SiO_2	Fe_2O_3	Al_2O_3	SO_3	MgO	CaO	Na_2O	f-CaO	Cl^-	C_3S	C_2S	C_4AF	C_3A
21.54	2.77	4.48	3.19	2.31	62.84	0.60	0.78	0.006	46.02	27.08	8.46	7.05

2.2 Preparation of anti-segregation agent

Acrylamide, AMPS and water were accurately weighed into a four-necked flask, nitrogen was introduced and stirring was started. When they were completely dissolved, the peristaltic constant-flow pump was turned on and ammonium persulfate solution and sodium hypophosphite solution were added dropwise for 2 to 3 hours. At 1 hour, add mercaptoethanol solution dropwise. After dropwise addition, keep warm for 20-40min, add sodium hydroxide solution to prepare polymer concrete anti-separation agent KK.

2.3 Performance test methods

In this paper, the concrete performance test methods including slump extension and compressive strength of concrete are all based on GB 8076-2008.The proportioning of concrete are shown in Table 3.

Table 3. C30 proportioning of concrete

proportioning of concrete kg/m^3			
Clinker	Mechanical sand	Crushed or broken rock	Water
360	830	1010	175

3 Results and discussion

3.1 Influence of water reducing agent dosage on the effect of anti-segregation agent

This part simulates the water secretion of concrete due to overmixing of water reducing agent, the results of concrete test are shown in Table 4, and the compressive strength is shown in Fig. 1.

Table 4. A1-A5 Concrete test results

Number	Point-400S dosage /g	KK dosage /g	Concrete extensibility /mm
A1	15	0	550
A2	18	2.0	565
A3	21	3.7	555
A4	24	5.5	545
A5	27	8.1	555

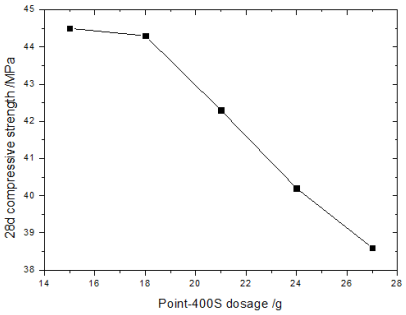

Fig. 1. A1-A5 28d compressive strength

No. A1 is the fresh concrete with appropriate amount of water reducing agent, the concrete is in good condition without obvious water seepage. No. A2-A5 are the fresh concrete with different water reducing agents and then anti-separation agent. After upgrading the water reducing agent dosage, the concrete mix has obvious stone accumulation

phenomenon and water secretion phenomenon. On this basis, by adding appropriate amount of KK, the water secretion state of concrete mix disappeared, and the state of concrete mix improved with good working performance. The fresh concrete before and after the addition of anti-separation agent is shown in Fig. 2.

Fig. 2. Fresh concrete before (left) and after (right) adding anti-separation agent

From the experimental data, KK can effectively solve the concrete segregation caused by the excessive amount of water reducing agent, but with the increase of the amount of admixture, its compressive strength decreases.

3.2 Influence of water consumption on the effect of anti-segregation agent.

This part simulates the water secretion of concrete due to excessive water consumption, the results of concrete test are shown in Table 5 and the compressive strength is shown in Fig. 3.

Table 5. B1-B5 Concrete test results

Number	Water consumption/g	KK dosage /g	Concrete extensibility /mm
B1	175	0	560
B2	190	1.4	560
B3	205	2.4	555
B4	220	3.9	550
B5	235	5.9	565

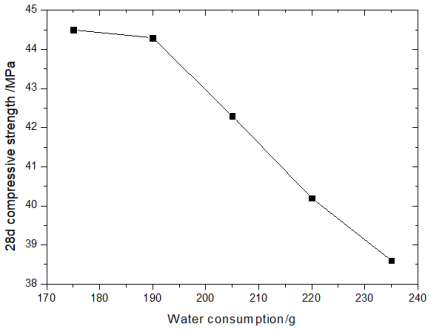

Fig. 3. B1-B5 28d compressive strength

In the table, No. B1 is the fresh concrete with appropriate amount of water reducing agent, and B2-B5 are the fresh concrete with different water consumption and then adding anti-separation agent. The compressive strength decreases with the increase of water consumption. Relative to the tests of A2-A5, B2-B5 used less amount of KK.

3.3 Influence of sand rate on the effect of anti-segregation agent

This part simulates the concrete water secretion caused by the decrease of sand rate, the concrete test results are shown in Table 6, and the compressive strength is shown in Fig. 4.

Table 6. C1-C4 Concrete test results

Number	sand rate /%	KK dosage /g	Concrete extensibility /mm
C1	45	0	550
C2	43	4.0	545
C3	41	6.2	545
C4	39	9.6	560

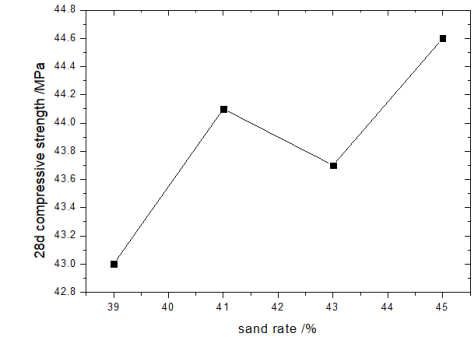

Fig. 4. C1-C4 28d compressive strength

In the table, No. C1 is the fresh concrete with appropriate amount of water reducing agent, and C2-C4 are the fresh concrete with different sand rates and then with anti-separation agent. With the decrease of sand rate, the fluidity of the concrete mix is also decreased, the amount of KK is also increased, and the compressive strength of the concrete does not see obvious changes.

4 Conclusions

1)In this paper, a new type of polymer anti-separation agent KK is synthesized with acrylamide as the main raw material, which can effectively solve the concrete segregation caused by excessive water reducing agent dosage, excessive water consumption and low sand rate.

2)Excessive enhancement of water consumption and admixture dosage will greatly reduce the performance of anti-separation agent and increase the dosage of anti-separation agent.

3) Anti-segregation agent has the most obvious effect on the segregation of concrete caused by excessive water consumption, and it has the best effect in resisting the decrease of strength caused by the decrease of sand rate.

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