

Mechanical Performance Test of Rubber-Powder Modified Concrete

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Abstract: A number of rubber cement concrete specimens that rubber powder dosage different were obtained using same cement, water and fine aggregates, by adjusting the dosage of rubber powder. Then it was used to research the influence of rubber powder dosage on performance of cement concrete by measuring its liquidity, strength and toughness. The results show that: when water-cement ratio was equal and rubber powder replacing the same volume sand, the fluidity of cement concrete almost linear increased with rubber powder dosage increasing. With dosage of rubber powder increasing, compressive strength and flexural strength reduced, but toughness linear growth trend when dosage of rubber powder less 30%.

1 Introduction

Waste rubber powder was a renewable resource. It was widely used in road construction technology at home and abroad, not only improved road performance but also significantly reduced noise, prolong its life [1]- [3].

Therefore, scholars in domestic and foreign do more research on rubber powder cement concrete or concrete [4]-[7]. Most of researchers replaced rubber particles with coarse aggregate, and then researched the properties of rubber concrete [5]-[18]. So, study on rubber powder cement concrete that replaced rubber powder with fine aggregate was less. This paper obtained a number of

rubber cement dosage specimens that rubber powder dosage different to study effect of rubber powder ash on cement concrete fluidity, strength and toughness.

2 Raw Material

2.1. Cement

Lafarge P.O42.5 cement made in Beijing was used in the testing. The physical and mechanical properties of cement were shown in Table 1.

Table 1 Performance index of cement

Fineness / (m ² /kg)	Setting time/min		Compressive strength/MPa		Flexural strength/MPa	
	Initial setting	Final setting	3d	28d	3d	28d
350	180	275	5.6	49.8	6.1	8.9

2.2 Fine Aggregate

Fine aggregate was river sand choosing from Qinhuangdao. It belonged to zone II. The fineness modulus was 2.8, and apparent density was 2.6 g/cm³. The fineness modulus of ultra-fine sand was 0.8. The

grading of ultra-fine sand and ordinary sand was fine.

2.3 Coarse Aggregate

Coarse aggregate was choosed from Beijing. The apparent density was 2.7 g/cm³.

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2.4 Rubber Powder

80 mesh rubber powder was used in this testing. The density was 1.2 g/cm³ and its bulk density was 0.3 g/cm³.

3 Testing Methods

Single factor method was used in the testing to determine the effect of rubber powder dosage on liquidity, compressive strength, flexible strength and toughness by adjusting the dosage of rubber powder. Meanwhile the other raw material was same.

Workability, strength test referenced to the guide that "cement and concrete testing procedures for highway" (JTG E30-2005). Rubber concrete toughness was determined by flexural load-deformation curve and trabecular specimen testing. Specimen size and loading position was equal to flexural strength testing. The curve that flexural load-deformation of rubber concrete trabecular was measured using MTS-810 at the rate of 0.5mm/min.

When workability was measured, select three kinds of rubber powder dosage replace sand with equal volume rates were as follows: 10%, 20%, and 30%. The basis amount of cement was 600g, sand was 1500g, aggregate was 3100g, and water-cement ratio was 0.5.

When strength was measured, select ten kinds of rubber powder dosage replace sand with equal volume rates were as follows: 1%, 3%, 5%, 7%, 9%, 10%, 15%, 20%, 25% and 30%. The basis amount of cement was 600g, aggregate was 3100g, sand was 1500g, and water-cement ratio was 0.5.

When toughness was measured, select three kinds of rubber powder dosage replace sand with equal volume rates were as follows: 10%, 20% and 30%. The basis amount of cement was 600g, sand was 1500g, and water-cement ratio was 0.5. The basis specimen was marked 3-0, and the other was 3-1, 3.2, and 3-3.

4 Testing Results and Analysis

By test method described above, the influence of rubber powder dosage on performance of cement concrete by measuring its liquidity, strength and toughness was shown as follows.

4.1 Effect of rubber powder dosage on workability

The workability and liquidity testing results of cement concrete mixed with different rubber powder dosage was shown in Figure 1 and Figure 2.

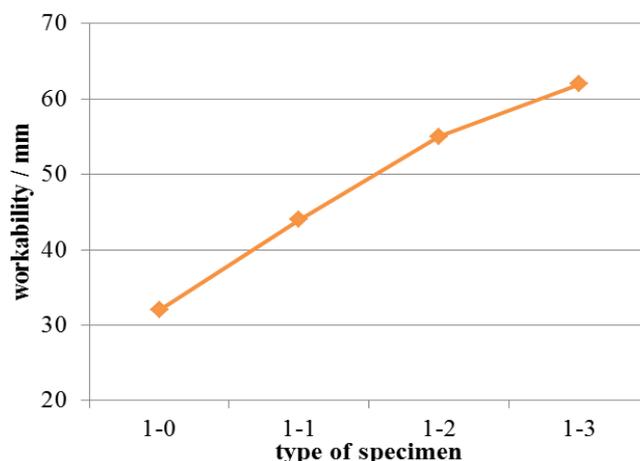


Figure 1 Rubber powder dosage and workability

As can be seen from the Figures, when cement ratio was same, workability of the cement concrete linearly increased with rubber powder dosage increased. Crumb replaced by fine sand dosage volume ratio, due to less dense rubber powder was loose state, resulting in lesser quality rubber powder instead of the larger mass of fine sand, in the water-cement ratio under the same conditions, with the significantly crumb content increased, the

corresponding amount of water absorption of the cement concrete has been reduced, an increase in free water. While the reduction of fine sand, causing concrete cement particles and aggregate particles sliding frictional resistance reduction. Therefore, the workability of the cement concrete increased with increasing of rubber powder dosage.

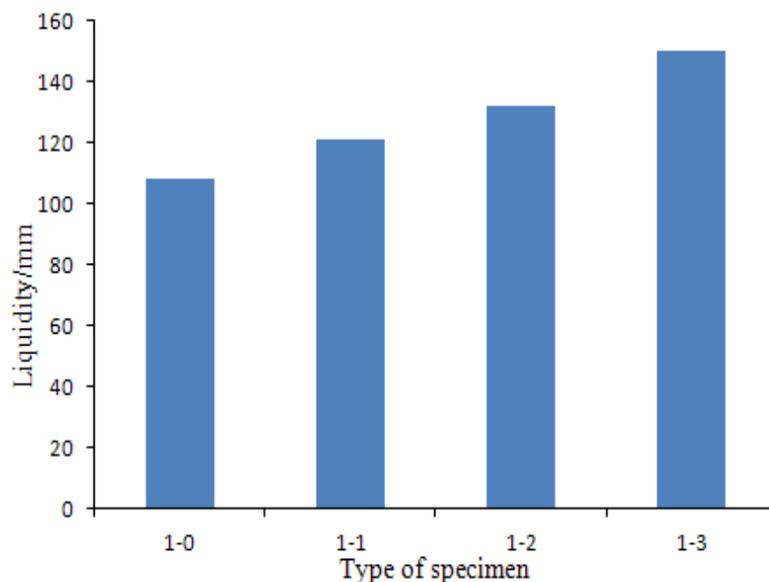


Figure 2 Rubber powder dosage and liquidity

4.2 Effect of rubber powder dosage on cement concrete strength

The compress strength and flexible strength testing results of cement concrete mixed with different rubber powder dosage was shown in Figure 3.

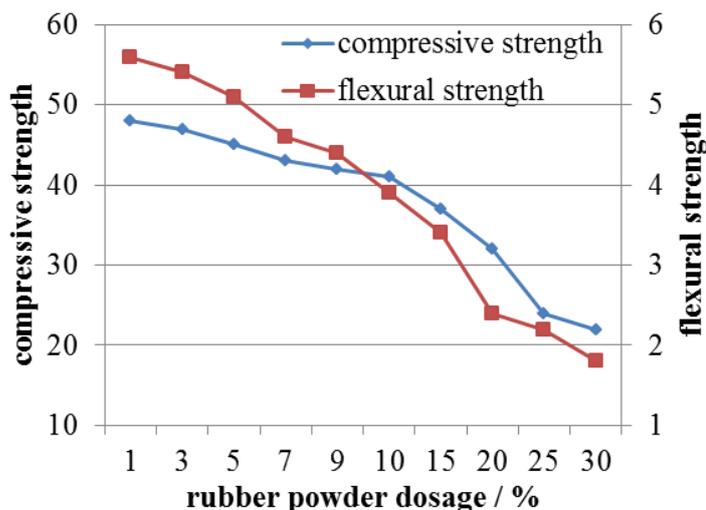


Figure 3 Rubber powder dosage and strength

It can be get following conclusions from Figure 2: ① With the dosage of rubber powder increasing, 28 days compressive strength and flexural strength of rubber powder significantly decreased. Compress strength decreased by 43%, while flexural strength dropped 32%. The decreasing amplitude of flexural strength less than compress strength. ② The ratio of flexural strength and compress strength increases gradually with rubber powder dosage increasing.

4.3 Effect of rubber powder dosage on toughness

The toughness testing results of cement concrete mixed with different rubber powder dosage was shown in

Figure 4.

Toughness increased with rubber powder dosage increasing. It was relevant with that rubber powder was low modulus and elastic material, the elastic modulus of the cement concrete material greatly concerned. Incorporated into rubber powder in the cement concrete, the deformation small capacity concrete material was rubber powder instead of the deformation capacity. So, when load was equal, the greater dosage of the rubber powder, the greater the deformation capacity of the material. Stress-strain curves belonged to specimen that rubber powder dosage was different was close to a straight line. Rubber powder improved the elasticity of cement concrete material, even larger strain, the material remains at elastic state.

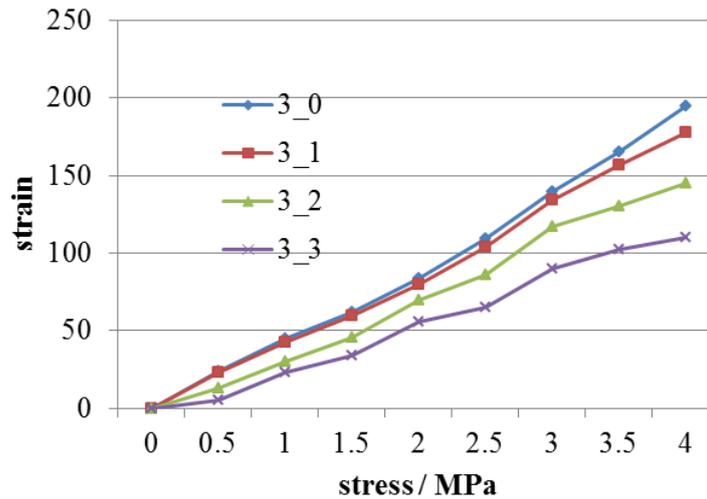


Figure 4 Rubber powder dosage and stress-strain curve

5 Conclusion

A number of rubber cement concrete specimens that rubber powder dosage different were obtained using same cement, water and fine aggregates, by adjusting the dosage of rubber powder. Then it was used to research the influence of rubber powder dosage on performance of cement concrete by measuring its liquidity, strength and toughness.

The result shows that: 1, When water-cement ratio was equal, and rubber powder replaced sand by equivalent volume amount, the workability of cement concrete linearly increased with rubber powder dosage increasing. 2, Compress strength and flexural strength of cement concrete gradually reduced with dosage of rubber powder increased. When dosage was greater than 10%, strength decreased sharply with dosage increasing. Meanwhile, the ratio of flexible strength and compress strength increased. 3, When water-cement ratio was equal, rubber powder replaced sand by equivalent volume amount, and rubber powder dosage was less than 30%, toughness of cement concrete increased with dosage of rubber powder increasing. 4, Rubber powder improved brittleness of cement concrete. It maintained concrete keeping flexible at a large strain range.

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