Performance Test of Rubber Powder-modefied High Strength Concrete

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Abstract: The performance of high strength concrete (HSC) modified by recycled rubber powder was tested and analyzed. Effects of rubber contents and size on density, slump, compressive strength, splitting-tensile strength and flexural strength of high strength concrete were investigated. Test results showed that the increase of rubber content would reduce the density, slump and strength. The size of the rubber particles had little effect on compressive strength and flexural strength, while it had much more effect on splitting-tensile strength.

Key words: rubber powder modified; high strength concrete; density; slump; compressive strength; splitting-tensile strength
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1 Introduction

It was reported that the annual waste tire in China had already exceeded 100 million. This increasingly deteriorating "black pollution" had made our weak environment worst. The common disposal method of the solid waste was not suitable for this kind of waste rubber. It would offer us a new method of waste tire disposal if we made building material with waste tire[1-3].

At present, the research on rubber powder concrete in China was still in the start stage. Furthermore, the research work was mostly focused on the normal concrete, and had little reference to the varipus performance of high strength concrete modified by rubber powder. The density, slump, compressive strength, splitting-tensile strength, and flexural strength of high strength concrete modified by rubber powder were tested and analyzed in this paper.

2 Material

In this experiment, the PII, 52.5R Portland cement, slag and rubber powder were used. The waste rubber had 1.02 g/cm^3 unit weight and three sizes, they were No.15, No.40 and No.60 sieve.

The fine aggregate was replaced by rubber powder. The weight ratio of rubber powder used in concrete was 1%, 2% and 3% respectively. The serial number of the test cubes was RPC-m-n, and m represented the size of rubber powder, that was No.15, No.40 and No.60 sieve; n represented the contents of rubber powder, that was 1%, 2% and 3% respectively.

3 Test result and analysis

3.1 Density

Test results showed that the increase of rubber content would reduce the density of high strength concrete modified by rubber powder, and the size of the rubber particles had little effects on the density. The density of rubber powder was far less than that of the sand and stone, so the density of the concrete would decrease. In addition, due to the coarseness and non-polarity of the rubber powder surface, the gas content would increase, and consequently the density of the concrete would decline[4].

3.2 Slump

The research showed that the slump of high strength concrete modified by rubber powder was 230 mm with the addition of 1%. It was because the surface coarseness of the rubber granule enwrapping some gas which formed air bubble during the mixing process. This air bubble acted as ball bearing in the mixture of the concrete, thus the friction among the aggregate was lessened and the lubrication was increased[5]. The slump began to decline with the in-

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crease of rubber powder. It decreased to 215, 200 and 205 mm with 3% addition of the sieve No. 15, No. 40 and No. 60, respectively.

3.3 Cubic compressive strength

The compressive strength of the specimen decreased considerably with the increasing amount of rubber powder at the end of 28 day. The compressive strength of the control concrete was 112.3 MPa. The strength of RPC-15 had dropped greatly to 86 MPa which had declined 23% with the 3% addition. The trend of strength change of RPC-40 and RPC-60 was the same as that of RPC-15. It reduced to 95.8 MPa and 86.7 MPa with the 3% addition respectively. Test results showed that the size of the rubber particles had little effects on the compressive strength.

3.4 Splitting-tensile strength

The splitting-tensile strength of high strength concrete modified with rubber powder decreased with the increasing amount of rubber powder at the end of 28 day. The splitting-tensile strength of the control concrete was 5.4 MPa. The strength of RPC-15 had dropped most greatly to 4.3 MPa with the 3% addition. The trend of strength change of RPC-40 and RPC-60 was the same as that of RPC-15. It reduced to 4.7 MPa and 4.9 MPa with the 3% addition respectively. The size of the rubber particles had effects on the splitting-tensile strength. The larger size of the rubber particle, the more decline of the splitting-tensile strength.

3.5 Flexural strength

The test results showed that the flexural strength of the high strength concrete modified with rubber powder decreased with the increasing amount of rubber powder. The flexural strength of the control concrete was 9.2 MPa, while it decreased 22%, 14% and 19% with the 3% addition of sieve No. 15, No. 40 and No. 60 rubber powder, respectively.

4 Conclusions

The test results indicated that the compressive strength, splitting-tensile strength and flexural strength of the HSC modified with rubber powder decreased with the increasing amount of rubber powder. The size of the rubber particles had little effects on the compressive and flexural strength, while it did have effects on the splitting-tensile strength.

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再生橡胶改性高强混凝土性能试验研究

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摘　要：以废轮胎橡胶粉作为改性材料，研究了橡胶粉含量和细度对高强混凝土密度、坍落度、抗压强度、劈裂抗拉强度和抗折强度的影响。研究表明：随着橡胶粉掺量的增加，橡胶粉高强混凝土材料的密度、坍落度、强度会下降。橡胶粉的粒径对高强混凝土的抗压强度、抗折强度影响不明显，但劈裂抗拉强度就随着橡胶粉粒径的增大而下降。

关键词：橡胶粉改性；高强混凝土；密度；坍落度；抗压强度；劈裂抗拉强度

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