

Rubber Powder-modified High Strength Concrete Before and After Fire Test

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Abstract: The characteristics of high strength concrete (HSC) modified with rubber powder was investigated by test method. The rubber powder which was produced from recycled waste tires has three types of granularity of 40 meshes ($420\text{ }\mu\text{m}$), 60 meshes ($250\text{ }\mu\text{m}$) and 80 meshes ($178\text{ }\mu\text{m}$), respectively. A series of mechanical destructive and nondestructive tests were accomplished in order to obtain the optimum quality and the best granularity of waste rubber powder in the composition, taking into account the compressive strength of the material before and after fire test. The research results showed that a relatively low addition of rubber powder (10.8 kg/m^3) would not reduce significantly the compressive strength at normal temperature, while the low dosage of 40 meshes rubber powder reduced the risk of explosive spalling of HSC at high temperature, and the residual compressive strength of HSC modified with rubber powder was slightly improved after fire test.

Key words: high strength concrete; rubber powder; compressive strength; fire test; spalling
CLC number: TU528.31 **Document code:** A **Article ID:** 0529-6579 (2007) S1-0169-02

1 Introduction

The research on rubber powder concrete had obtained encouraging results. The research showed that the concrete with rubber powder was provided with some unique merits such as light weight, elastic shock absorption, sound insulation, air and water permeability, and had good ductility^[1-6].

This investigation is based on the C80 high strength concrete. We added three types of rubber powder into the concrete, which was 40 meshes, 60 meshes and 80 meshes, and had successfully made the rubber powder concrete (RPC). We had made an elementary research on the performance of rubber-modified HSC before and after fire test.

2 Experimental program

2.1 High strength concrete

The base high strength concrete used in this work was C80 (mixture shows in Table 1).

2.2 Fine rubber powder

The fine rubber powder used in the experiment had three sizes that was 40 meshes ($420\text{ }\mu\text{m}$), 60 meshes ($250\text{ }\mu\text{m}$) and 80 meshes ($178\text{ }\mu\text{m}$). Density

Tab 1 C80 HSC mixture kg/m^3

Cement	Mine	stone	Sand	Water	Super plasticizer
310	235	1020	760	120	22

of the rubber powder was 1.02 kg/m^3 .

2.3 Design of experiment

The gross dosage of high strength concrete remained stable while varying three types of fine rubber powder addition of 0, 5.4, 10.8, 16.2 and 21.6 kg/m^3 .

2.4 Test specimens preparation

The concrete with each mixture was cast into the $100\text{ mm}\times 100\text{ mm}\times 100\text{ mm}$ concrete model and cured in a controlled humidity room until the day of testing.

2.5 Heating rule

Heating curve was referred to the ISO 834 standard heating curve, and when the temperature reached the designed temperature of 500°C , made it invariable for 1 hour.

①收稿日期: 2007-01-10
基金项目: 广东省教育厅自然科学重点项目 (05Z09), 广东省科技计划攻关项目 (2006B14401004), 广州市科技局科技项目 (2005Z-D0201)
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3 Results and discussion

3.1 Compressive strength

The change rule of compressive strength of the rubber powder concrete was almost the same with different size and uniform dosage. When the dosage was less than 10.8 kg/m^3 , the loss of the strength was below 10%. But the compressive strength declined rapidly with the increase of rubber powder.

3.2 The appearance of the specimens after heating

Spalling failure occurs in the case of plain concrete after heating. The former three groups of specimens of the RPC40 could retain the integrated appearance. And each group specimens of RPC60 and RPC80 had spalling to different extent.

3.3 Residual compressive strength

The residual compressive strength of HSC without rubber powder after 500°C high temperature test descended less than 5% when the specimen didn't spalling and retain the intact appearance. Whereas, the compression strength of the rubber powder modified concrete rose about 4% ~ 15%. But in the case of concrete which was spalling, the compressive strength decreased rapidly with the maximum loss more than 25% and even loss the capacity to support load.

4 Conclusions

The decrease of compressive strength of high

strength could be controlled within the 10% when the dosage of rubber was no more than 10.8 kg/m^3 . When the dosage of mesh 40 was less than 16.2 kg/m^3 , the specimen could retain its intact appearance after 500°C high temperature test. The specimens which had no spalling after heating had got an 4% ~ 15% increase in compressive strength. The buildup mechanism should be investigated further.

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橡胶粉改性高强混凝土高温前后性能研究

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摘要: 通过实验研究橡胶改性高强混凝土高温处理前后的性能。橡胶粉来源于废旧橡胶轮胎, 有 40 目 ($420 \mu\text{m}$)、60 目 ($250 \mu\text{m}$) 和 80 目 ($178 \mu\text{m}$) 三个不同粒径的精细橡胶粉, 研究废旧橡胶粉对高强混凝土材料的抗压强度的影响。并对研配成功的试件进行了高温实验, 利用外表面观察法、残余强度方法, 对比研究了高强混凝土与橡胶粉改性高强混凝土高温作用后的性能变化。研究表明, 常温下高强混凝土抗压强度随着橡胶粉掺量的增加而下降, 当橡胶粉外掺量小于 10.8 kg/m^3 时, 其抗压强度损失低于 10%; 高温时低用量的 40 目橡胶粉能抑制高强混凝土的爆裂行为; 高温作用后橡胶粉混凝土的强度有一定的增长。

关键词: 高强混凝土; 橡胶粉; 抗压强度; 高温; 爆裂

中图分类号: TU528.31