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The Effect of Mechanical Performance on PP Fiber to Polymer Mortar

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Abstract: It introduces the purpose of of adding Polypropylene fiber. The paper The production process and test method of epoxy resin mortar with PP fiber are developed. The influence of PP fiber on mechanical properties of polymer mortar was studied in this paper, including the influence of PP fiber content on flexural strength, the ratio of flexural and compressive strength and so on. The experimental results are compared and analyzed. The reason is found, the conclusion of research is acquired.

1. Introduction
Polymer epoxy resin concrete has a very obvious advantage, it has high strength, good toughness, impact strength and good resistance to chemical corrosion, wear-strength, water and antifreeze performance. Polymer epoxy resin concrete can make up for the shortcomings of ordinary concrete such as low tensile strength, poor crack resistance and poor brittleness. After curing the epoxy resin concrete to the atmosphere, moisture and chemical media has a very strong corrosion resistance. The material, having a wonderful application prospect, has became one of the fastest growing building materials in the field of research and application and it is applied frequently on project of water conservancy and hydropower and industrial and civil construction at home and abroad.

2. The content of research

2.1. The purpose of adding PP fiber and the production process of epoxy resin mortar
PP fibers are added to improve the brittleness of Polymer concrete (Polymer concrete, hereinafter referred to as PC) by physical methods. The performance parameters of PP fiber are shown in Tab.1.

In the epoxy resin, added the diluent, toughening agent, PP fiber, curing agent, etc. to form epoxy glue, and then added cement to form epoxy cement, and then the medium sand is added to form epoxy mortar. The production process is shown in Fig.1.

| Species            | PP fiber |
|-------------------|----------|
| Diametre, μm      | 48       |
| Specific gravity, g/cm\(^3\) | 0.91   |
| Tensile strength, MPa | 276     |
| Elongation (%)     | 15～18   |

Tab.1 PP fiber performance 1.
2.2. Test method and The effect of fiber on polymer mortar’s mechanical properties

As the current state has not yet issued relevant standards on polymer concrete, the mold making and test methods adopted in this experiment are identical to the ordinary concrete. The standard test mold size of epoxy resin mortar is $40 \times 40 \times 160$ mm. Mixed the mortar evenly, poured into the mold, and removed the mold after 1 day under the indoor natural conditions, and then maintain for 6 days under the standard curing humidity. The flexural strength and compressive strength of the 7-day standard test block were measured. For the acid and alkali resistance test of PC, put the cured specimens into sulfuric acid solution and sodium hydroxide solution respectively, and soak for more than 48 hours. After taking out, the mass loss percentage of the test block was measured and calculated, and the flexural strength and compressive strength of the test block after immersion were measured, and the strength change was observed. The mixing ratio of epoxy resin mortar in the test is: epoxy resin: ethylenediamine: isobutyl alcohol: dibutyl ester: medium sand = 1: 0.08: 0.15: 0.1: 5.

This test is mainly considered the influence of PP fiber’s quantity on polymer mortar’s mechanical properties. The mixture ratio of epoxy resin mortar is: ethylenediamine; isobutanol; dibutyl; medium sand; thiokol; cement is 1: 0.08: 0.15: 0.1: 5. 01: 15. PP fiber’s quantity is calculated as a percentage of epoxy resin is 0%, 0.4%, 0.8%, 1.2%, 1.6%. Due to the rapid hardening of PC this test take flexural strength, compressive strength and pressure ratio of the 7d indoor natural curing as the standard is shown in Tab.2.

| The content of pp fiber/% | 0   | 0.4 | 0.8 | 1.2 | 1.6 |
|--------------------------|-----|-----|-----|-----|-----|
| Flexural strength/MPa    | 19.7| 23.6| 24.6| 23.2| 22.9|
| Compressive strength/MPa | 66.9| 68.8| 69.4| 66.3| 63.8|
| The ratio of flexural and compressive strength | 0.29 | 0.34 | 0.35 | 0.35 | 0.36 |

Figure.1 Production process of epoxy resin mortar.

| Modulus of elasticity/MPa | 3793 |
|---------------------------|------|
| Acid and alkali resistance| Extreme high |
| Length/mm                 | 12   |
In addition, the quality percentage of PP fiber content is drawn as the curve of the relationship between the PC's flexural strength, compressive strength and the ratio of flexural and compressive strength are shown in Fig. 2-4.

![Figure. 2 The effect of PP fiber’s quantity on flexural strength of PC](image1)

![Figure. 3 The effect of PP fiber’s quantity on compressive strength of PC](image2)

![Figure. 4 The effect of PP fiber’s quantity on the ratio on flexural and compressive strength](image3)

It can be seen from Fig. 2 to Fig. 4: as the PP fiber content increases, the flexural strength of block is stable, the compressive strength is increased first and then decreased, the ratio of flexural and compressive strength is stable. Obviously, the variation range of compressive strength of test block is larger. When the content of PP fiber is 0.8%, the compressive strength and the flexural strength of PC reaching maximum, compared with the PC without the PP fiber, the compressive strength increased by 24%, the compressive strength increased about 4%, and the fluctuation of each point was obvious. Analytical findings:

First: After adding PP fiber to the PC mix, a deranged three-dimensional network is formed. The formation of this kind of structure can prevent the generation of the original crack in the plastic deformation stage effectively, so as to increase the strength of PC. Moreover, the adhesion of epoxy resin and PP fiber is good, which can hinder the occurrence and development of cracks, thus improving the strength of PC.

Second: Because the addition of PP fiber influences the dispersion effect of cement base material, the density of concrete has decreased, which leads to the decrease of compressive strength of concrete. Third: When the PP fiber content is 0.5%, because of the better dispersion effect of the fiber, the compactness of polymer concrete has less influence, It can play a certain role in preventing the original crack. The optimum content of PP fiber in polymer concrete is 0.5% of epoxy resin.

3. Conclusion
The research of mechanical performance on PP fiber to polymer mortar with the following conclusions:

First: Polymer concrete with high strength, good toughness, impact strength, good resistance to chemical corrosion, wear-resistance, water and antifreeze properties. The materials has better tensile strength and crack resistance than ordinary concrete. Second: The different dosage of PP fiber has different influence on the three crucial indexes of mechanical properties, and the impact of flexural strength and the ratio of flexural and compressive strength is relatively stable, while the influence of
non compressive strength fluctuates greatly.
When the content of PP fiber is 0.8%, the flexural strength value and the compressive strength value of PC reach the highest; compared with PP fiber, the flexural strength of concrete block can be increased by about 24%, the optimum amount of PP fiber is 0.5% of epoxy resin.
The above results show that the adding of PP fiber has certain impacted on epoxy resin mortar, but the optimum mixing amount is needed.

4. Acknowledgements
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