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Study on Seawater Corrosion Resistance of Concrete Mixed with Slag Powder and Basalt Fiber

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Abstract

It has become an important subject to use slag powder, basalt fiber and other admixtures and superplasticizer to dispose high durability concrete in hydraulic environment. Because basalt fiber can improve the shrinkage and crack resistance of concrete, this test uses slag powder and superplasticizer to configure concrete. On the basis of satisfying strength, basalt fiber is added to carry out comparative tests. It is concluded that the durability and strength of basalt fiber concrete with slag powder of about 700 m2/kg are better than that of ordinary concrete and slag powder with specific surface area of about 700 m2/kg and 1.5 kg/m3 basalt. Rock fiber has the best cost and performance effect on concrete. Its water-binder ratio is low, strength is high and durability is good. It can realize the universal application of high performance concrete.

Keywords

Water slag fine powder; Basalt fiber; Seawater corrosion resistance; Concrete.

1. Introduction

Some offshore concrete hydraulic structures suffer from the effects of the marine environment to varying degrees and shorten their lifespan. The main reasons are chloride ion penetration erosion, alternating dry and wet, freeze-thaw cycles, and carbonization. In recent decades, the world has caused huge economic losses due to the erosion of concrete structures. As a result, people have further studied the safety and durability of concrete [4,6].

Researches by domestic and foreign scholars have shown that: 1) Concrete configured with slag powder can increase the compactness between aggregate and cement and the outer surface of the concrete, thereby effectively preventing seawater erosion. At the same time, adding a large amount of slag powder can greatly improve the strength of concrete. [2]; 2) Basalt fiber (BFRC) is a continuous inorganic non-metallic fiber, with its superior properties (material naturalness, comprehensive performance, compatibility with cement mortar, etc., cost objectivity, etc.) as a new type of cement Matrix composite building materials have considerable application prospects in the engineering field [3].

This paper analyzes the compressive strength, water seepage height, and chloride ion erosion of slag powder with the same gradient specific surface area (600m2/kg, 700 m2/kg, 800 m2/kg) when the equivalent amount of replacement concrete reaches 60%. Research; under the same reference conditions, basalt fiber with a length of 9mm and a diameter of 15μm was incorporated, and the dosage was 1.5kg/m3, and the corresponding results were combined with only slag powder or at the same time with the same specific surface area. The concrete test blocks of basalt fiber are compared to obtain a reasonable ratio of the concrete with a large amount of water slag powder and the basalt fiber.

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2. Experiment Material

The raw materials used in this test are Du Brand P.O42.5 Portland cement produced by Anshan Gangdu Micropowder Co., Ltd., polycarboxylic acid high-performance water reducing agent, slag powder, basalt fiber, coarse aggregate (selected to meet the requirements of "General Anshan crushed stone specified in the Standards for Concrete Sand and Stone Quality and Inspection Methods), fine aggregates (select Haicheng river sand that meets the standards of "Sand for Construction").HHH

3. Experiment Method

The impermeability of concrete is closely related to durability [2]. Generally speaking, concrete with good impermeability effect has high compactness and low internal porosity, so it has high resistance to material erosion in the medium in which it is located. In addition, substances that penetrate into the concrete may precipitate hydration products such as calcium hydroxide, causing a vicious circle of concrete corrosion. Therefore, impermeability is an important indicator for testing the durability of concrete. This test determines its impermeability by measuring the shrinkage rate and water loss rate of the concrete test block.

4. Results and Analysis

According to The slump, 28-day compressive strength, and water seepage height of coagulation test blocks mixed with the same gradient and different specific surface area slag powder were tested. Four sets of test blocks were selected for comparison. The test results are shown in Table 1. 2.3

Table 1. Impermeability results of test blocks with a specific surface area of 600 m2/kg slag powder

Grouping	Slump/ Diffusion	Standard 28d compressive strength/Mpa	Water seepage pressure 4.0Mpa Water seepage height/mm
Benchmark	22/49	56.2	35.0
1	26/55	55.5	19.6
2	24/52	58.1	23.2
3	26/55	57.4	14.4

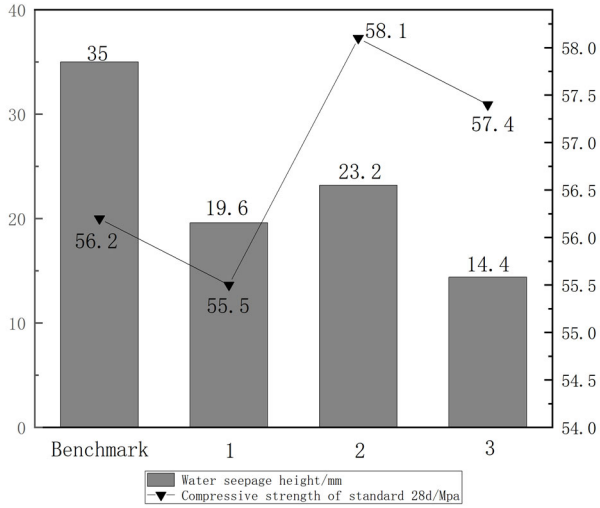

Figure 1. Water seepage height of test block mixed with specific surface area of 600 m2/kg slag powder

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From the above data, it is easy to obtain: the water seepage height of the concrete sample (No. 1) mixed with a specific surface area of 600 m2/kg slag powder has a greater downward trend than the reference concrete seepage height, which is reduced by 15.4mm at 28 days; mixed with basalt fiber Later (No. 2), the water seepage height of the reference concrete block is also greatly reduced; at the same time, the concrete test block (No. 3) with a specific surface area of 600 m2/kg slag powder and 1.5kg/m3 basalt fiber is added at 28 days. The water seepage height is reduced to a minimum of 14.4mm, with a decrease of 20.6mm. With the incorporation of basalt fiber, the strength of concrete increases. The No. 3 group has excellent strength and impermeability for the comprehensive performance of concrete. It can also be seen that the compressive strength of concrete is not the only criterion for judging the impermeability, and there is no direct relationship between the two. There is more than one way to improve the strength, and the working performance of different admixtures is not the same when the main principles are the same.

Table 2. Impermeability results of test blocks with a specific surface area of 700 m2/kg slag powder

Grouping	Slump/ Diffusion	Standard 28d compressive strength/Mpa	Water seepage pressure 4.0Mpa Water seepage height/mm
Benchmark	22/49	56.2	35.0
1	26/55	62.4	16.4
2	24/52	58.1	23.2
3	26/55	64.6	13.1

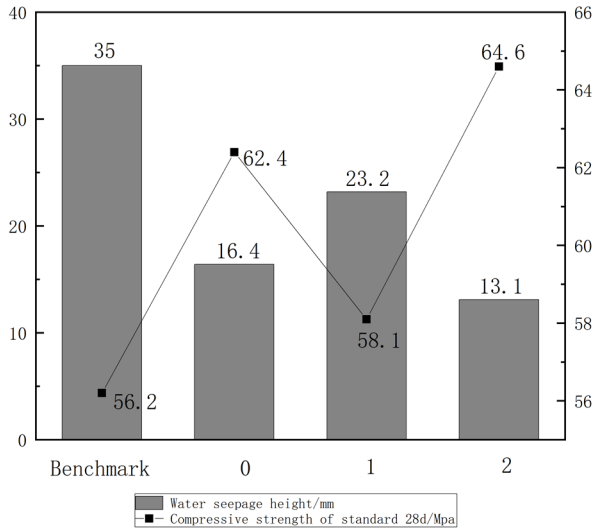

Figure 1. Water seepage height of test block mixed with specific surface area of 700 m2/kg slag powder

From the above data, it is easy to obtain: the water seepage height of the concrete sample (No. 1) mixed with a specific surface area of 700 m2/kg slag powder has a greater downward trend than the reference concrete seepage height, which is reduced by 18.6mm at 28 days; mixed with basalt fiber Later (No. 2), the water seepage height of the reference concrete block is also greatly reduced; at the same time, the concrete test block (No. 3) with a specific surface area of 700 m2/kg slag powder and 1.5kg/m3 basalt fiber is added at 28 days. The water seepage height is reduced to a minimum of 13.1mm, with a decrease of 21.9mm. With the combined action of 700m2/kg of slag powder and basalt fiber, the strength of concrete increases. The No.

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3 group has excellent strength and impermeability for the comprehensive performance of concrete. It can also be seen that there is no direct relationship between concrete compressive strength and impermeability.

Table 3. Impermeability results of test blocks with a specific surface area of 800 m2/kg slag powder

Grouping	Slump/ Diffusion	Standard 28d compressive strength/Mpa	Water seepage pressure 4.0Mpa Water seepage height/mm
Benchmark	22/49	56.2	35.0
1	26/55	65.9	15.1
2	24/52	58.1	23.2
3	26/55	68.2	12.6

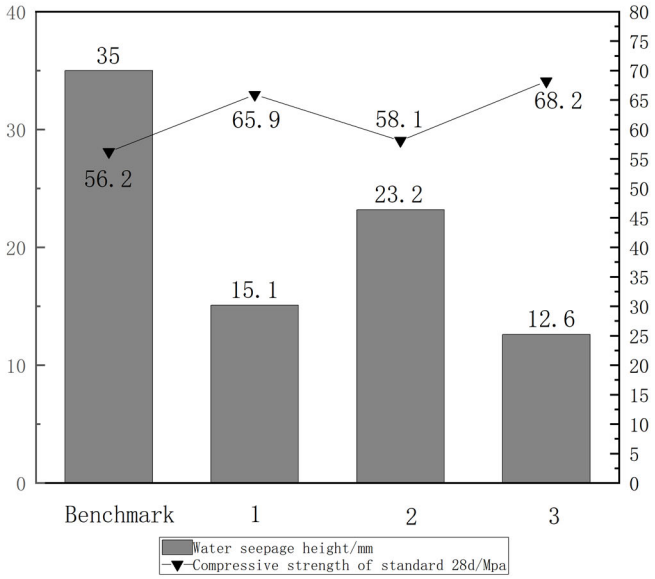

Figure 3. Water seepage height of test block mixed with specific surface area of 600 m2/kg slag powder

From the above data, it is easy to get: the water seepage height of concrete test block (No. 1) with a specific surface area of 800 m2/kg slag powder has a greater downward trend than the reference concrete seepage height, which is reduced by 19.9mm at 28 days; mixed with basalt fiber Later (No. 2), the water seepage height of the reference concrete block is also greatly reduced; at the same time, the concrete test block (No. 3) with a specific surface area of 800 m2/kg slag powder and 1.5kg/m3 basalt fiber is added at 28 days. The water seepage height is reduced to a minimum of 12.6mm, with a decrease of 22.4mm. With the combined action of 800m2/kg slag powder and basalt fiber, the strength of concrete increases. The No. 3 group has excellent strength and impermeability for the comprehensive performance of concrete. It can also be seen that there is no direct relationship between concrete compressive strength and impermeability.

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5. Summary and Suggestions

1) The larger the specific surface area of the mixed slag powder, the increase in the impermeability of concrete, but when the specific surface area is small (such as 600m2/kg), it is unfavorable to increase the compressive strength of concrete; when the specific surface area is larger, the impermeability is improved The rate has been reduced. The use of slag powder with a specific surface area of about 700m2/kg has the best effect on the performance and cost of concrete.

2) The concrete test block (No. 3) mixed with slag powder and 1.5kg/m3 basalt fiber at the same time has the lowest water seepage height at 28 days, the largest drop, the higher the concrete strength, and the best interaction between the two.

3) The compressive strength of concrete is not the only criterion for judging the impermeability, and there is no direct relationship between the two. The reasons for the increase in strength are different. In the case of improving the compactness as the main effect of the external admixture, the angle of action of different admixtures is not the same, which reflects the nature of different routes to the same goal in the general direction.

4) It is recommended to use slag powder with a specific surface area of about 700m2/kg and 1.5kg/m3 basalt fiber to configure high-performance concrete.

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