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# Study on Injection Performance of Injection Ecological Concrete

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**Abstract:** The work of slope treatment is often high energy consumption, heavy pollution treatment mode [1]. For the construction technical measures taken in the slope treatment, the anchor and shotcrete support is the most widely used, and often the local rock mass is broken. We will expand the treatment area in the construction process [2] This leads to the destruction of the original ecological concrete in the urban slope protection has been successful cases [3], So the ecological concrete to the northwest slope management work, will promote the slope ecological environment improvement will play a promoting role, so the need to study the performance of ecological concrete jet, in the northwest jet type ecological concrete slope governance applied successfully, for the future slope governance ecological provide reliable theoretical basis.

**Keywords:** Cological concrete, slope, spray performance.

## 1. Study on the Injection Performance of Injection Ecological Concrete

During shotcrete construction, due to the influence of injection distance, injection pressure, injection material ratio and the operation proficiency of shotcrete hand[4], Will cause the injection of shotcrete to the spray surface can not be completely attached to the spray surface is called the return ratio of shotcrete, the mass ratio of the amount of ejection is called the return rate, the return rate is an important index to measure the injection performance of shotcrete[5]Therefore, this section will focus on the rebound rate of injection ecological concrete, and the calculation formula of the rebound rate is shown in equation 1.1.

$$W = m \alpha M 100\% \text{ (equation 1.1)}$$

Where: the rebound rate of W-injection type ecological concrete;

M-The rebound quality of injection type ecological concrete;

M-Total quality of ecological concrete of the injection model;

α -Mass adjustment coefficient, considering the internal injection material adhesion of the jet machine, take 1.1;

During the injection test, m is measured by measuring the concrete mass on the color strip placed under the injection surface, while the mass of M is the total injection amount is weighed directly weighed in advance.

## 2. The Injection Type of Ecological Concrete Injection Test

Specific injection test process: three sets of mix ratios obtained from the extreme analysis of orthogonal test results: (design porosity 26%, The coarse aggregate particle size is 9-12mm, Water-gel ratio of 0.40, The incorporation of the polyacrylonitrile fiber is 1%) is recorded as PH 1, (Design porosity of 30%, The coarse aggregate particle size is 14-16mm, Water-adhesive ratio of 0.38, The mixture of the polyacrylonitrile fiber is 1%) is denoted as PH2, (Design porosity of 30%, The coarse aggregate particle size is 14-16mm, Water-adhesive ratio of 0.42, The mixture of the polyacrylonitrile fiber is 1%) is denoted as PH3, The ejection tests were performed in turn, Comparative analysis of the differences between the mix groups, Explore the relationship between different fit ratios and rebound rates, Finally, select the mix ratio with the lowest rebound rate for the secondary injection test, Analyze the jet surface material, The influence of the injection pressure and the injection distance on the return rate, , The selected equipment and the test injection process are shown in the 2.1-2.2 drawings.

**Figure 2.1.** Trial Spray Process 1

**Figure 2.2.** Test injection process 2

# 3. Analysis of the Injection Test Results

## 3.1. Mix ratio composition and the relationship between injection surface material and return rate

According to the pre-designed mix ratio prepared materials in the mixer for mixing, keep the control injection pressure and spray distance unchanged, and test the mix materials made of three mix ratios in turn. See Figure 3.1 to 3.2 and record the change of rebound rate, as shown in Table 3.1 for details.

**Figure 3.1.** Sprjection of concrete block surface

**Figure 3.2.** Slope injection

**Table 3.1.** Results of Rebound Rate Test

| test number | injection pressure /MPa | Jet distance /m | rebound degree /% | |
|---|---|---|---|---|
| | | | Concrete block surface | Soil slope surface |
| PH1 | 0.5 | 1 | 27 | 25 |
| PH2 | 0.5 | 1 | 31 | 26 |
| PH3 | 0.5 | 1 | 32 | 29 |

Analysis, Table 3.1 and Figure 3.7, Controlling the injection pressure and jet distance are constant, The rebound rate of the concrete block surface and slope is 20% -30%, The backfill rate is the lowest for PH 1, Compared to the complex ratio of PH 1, The reasons for the increase in PH2 and PH3 are mainly due to the following two aspects, First, the coarse aggregate size of PH2 and PH3 increases, The increase of aggregate particle size will directly increase the internal pores of concrete and the mobility of concrete, Thus that the internal pores cannot be filled, Eventually leads to an increase in the rebound rate; Second: the water-cement ratio of the mixture ratio of PH3 increases, Leading to an increased liquidity, shotcrete is difficult to condense on the jet surface, Eventually leading to an increase in the rebound rate.

Analysis of three kinds of coordination than the concrete block surface and soil surface rebound rate, it can be seen that the surface of concrete block rebound rate is higher than the slope surface of the rebound rate, the main cause of this phenomenon is that the concrete block surface is smooth, so the friction of concrete block surface is less than the slope surface friction, jet material is difficult in the meeting surface forming, moreover soil surface absorption jet to moisture become soft, under a certain pressure can be embedded in the soil surface, so the falling rebound will be less, leading to the decline of the rebound rate.

## 3.2. Relationship between injection pressure and injection distance and rebound rate

According to the above injection test, it is found that the injection ratio PH 1 has the lowest backfill rate on both injection surfaces, so the mixture ratio PH 1 is selected to conduct the injection test again on the soil surface. The test results of the relationship between the injection pressure and the rebound rate are shown in Table 3.2.

**Table 3.2**. Test results of the relationship between injection pressure and rebound rate

| mix proportion | Pit surface material | Injection distance / m | injection pressure /MPa | rebound degree /% |
|---|---|---|---|---|
| PH1 | Soil slope surface | 1 | 0.5 | 25 |
| | | 1 | 0.6 | 23 |
| | | 1 | 0.7 | 20 |
| | | 1 | 0.8 | 26 |

Analysis Table 3.2 test data, in the case of fixed injection distance between 0.5-0.7MPa rebound rate decreased with the increase of the injection pressure, but when the injection pressure is greater than 0.8MPa, rebound phenomenon, thus the rebound rate is not inversely related to the injection pressure, through the injection pressure to reduce the rebound rate within a certain critical range, the test results can be seen that the injection ecological concrete in the injection pressure of 0.7MPa, the lowest rebound rate of 20%.

To further explore the relationship between injection distance and rebound rate, this test will combine the relationship between injection pressure and rebound rate. The test results are shown in Table 3.3

**Table 3.3.** Test results of the relationship between injection distance and rebound rate

| mix proportion | Pit surface material | Injection distance / m | injection pressure /MPa | rebound degree /% |
|---|---|---|---|---|
| PH1 | Soil slope surface | 0.8 | 0.7 | 24 |
| | | 1 | 0.7 | 20 |
| | | 1.2 | 0.7 | 32 |
| | | 1.4 | 0.7 | 30 |

Analysis table 3.3 can be seen that the jet distance is too large or too small will cause the change of the rebound rate, not pure linear relationship, the injection distance in 0.8-1m, with the increase of the jet distance, the rebound rate dropped 1%, but the jet distance in 1-1.4m, with the increase of the jet

distance, the rebound rate has shown a trend of increasing, at 1.2m backfill rate reached the maximum value of 32%. When the injection distance is 0.8-1m and 1.2-1.4m, the rebound rate has a downward trend, while the downward trend of the former is significantly greater than that of the latter, and the rebound rate of the former is lower than that of the latter. Therefore, in this test, the injection distance is controlled to be the optimal injection distance of 0.8m-1.2m when the injection pressure remains constant.

# 4. Conclusion

The three groups of mixture ratios determined by orthogonal test are made of jet injection on different spray surfaces, and the rebound rate is compared, and the compound ratio with small rebound rate is finally determined: the design porosity is 26%, the coarse aggregate particle size is 9-12mm, the water cement ratio is 0.38, and the mixing amount of polyacrylonitrile fiber is 1%.

# Reference Documentation


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