Study on the Effect of Soil and Water Conservation of New Ecological Vegetation Blanket Slope Protection Technology

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Abstract: Through the study of the protection mechanism of vegetation blanket, this paper discusses the role of vegetation blanket in slope protection. The role of vegetation carpet in soil is studied from the aspects of soil erosion resistance, vegetation coverage, root density and surface runoff by means of experimental exploration. The test shows that the soil water conservation effect of the vegetation blanket on the slope is significantly better than that of the vegetation blanket on the slope, and its effectiveness is better.

1. Introduction

Owing to the rapid progress of society and economy in China, the problem of soil erosion in China has become increasingly prominent. Plant cover can reduce the impact of rain on the earth, improve the friction of the earth, and diffuse the force of water and air, thus achieving the purpose of slope protection and water and soil conservation. Currently, a new, safe, economic and sustainable ecological meadow is adopted in the prevention and control of floods and droughts in China. The plant cover can reduce the impact of precipitation on the ground, and because it improves the surface roughness, it reduces the speed of water flow. The actuating force of air or water flow is distributed between the covers, and the covers all bear the original force[1].

2. Protection Principle of Vegetation Blanket

The vegetation blanket is composed of plant fiber layer, water retaining agent, nutrient soil, etc. Among these materials, one can lock the seeds, fertilizer and water-retaining agent to help the rapid growth of the plant, See fig1. Between the plant root and the soil, a protection mechanism can be established to improve the shear and tensile strength of the plant. The composition of the fiber layer is mainly composed of binder, wood fiber, organic mineral catalyst, etc. In the process of its biodegradation, its output can be increased to a certain degree, so as to achieve a good ecological environment. Combining plant felt with ground nails and firmly nailing them on the slope can not only reduce the impact of precipitation on the surface, but also prevent the seeds from being eroded by rain. After the vegetation is mature, its strong roots can form a solid composite with vegetation blankets, slopes, etc., thus preventing water and soil loss[2].

Fig.1 Ecological Vegetation Blanket Used for Slope Protection

3. Application Advantages of Vegetation Blanket in Slope Protection

Due to the particularity of the materials it collects, the vegetation blanket has obvious advantages in the field of soil erosion prevention and control, and has broad development space in practical projects.

3.1 Turn Waste into Treasure

As an agricultural country, China produces many crops of rice straw every year. At present, the burning method is widely used for disposal, but the burning process will have a certain impact on the atmosphere. The vegetation blanket is composed of straw, coconut shred and other raw materials, which can convert a large amount of agricultural waste into resources. After a series of treatment, the vegetation blanket can be produced for water and soil conservation, which can not only increase the income of farmers, but also effectively improve soil erosion [3].

3.2 Reduce Construction Time

Compared with other projects, the application of vegetation blanket in this project has significantly reduced the construction time. This is because after the completion of slope brushing, it is only necessary to lay vegetation blanket on the slope surface, open 20 cm anchor ditch at the top and bottom of the slope, bury and compact the vegetation blanket around, and then fasten it with U-shaped nails at the outside[4].

3.3 Lower Cost

Vegetation blanket has the advantages of wide source of raw materials, great difficulty in production, low cost and investment. In Shropshire, UK, in the 2017 annual test, the input of coconut carpet per square meter was between 5.6 and 13.6 yuan, while the input of straw was between 3.4 and 6.8 yuan; In China, the cost of grass felt used in the slope treatment project of 108 Provincial Highway in 2018 is only 28 yuan/m^2, while the cost of three-dimensional grass felt is only 21 yuan/m^2, while the cost of grass felt used in the new canal in Beijing is only 18 yuan/m^2.

3.4 Save Water Consumption for Future Maintenance

After the layout of the plant blanket is completed, it can fully store water and retain moisture, effectively reduce the evaporation of water in the soil by the atmosphere, thus reducing the amount and frequency of watering. When the climate is dry, appropriate watering is carried out to ensure its normal germination [5].

4. Analysis of Soil and Water Conservation Effect of Vegetation Blanket Slope Protection

At present, there are a variety of plant blankets. In order to analyze the relationship between the soil and the soil of each planting blanket, this paper takes each planting blanket as the research object, and selects the best vegetation blanket type from the analysis of soil erosion resistance, vegetation coverage, effective root density, surface runoff and other factors.

4.1 Experimental Materials

The project takes the slope of a provincial high-speed railway as the test site, with a total length of 200 m and a maximum filling height of 5.5 m, and adopts a grade 2 slope with a gradient of 1:1 and a gradient of 1:0.8, which is mainly composed of silty clay and has strong permeability. The region is a warm and mild land monsoon with an average annual precipitation of 327.5 mm. The rainy season is mainly from July to August. In this experiment, three planting blankets of pure wheat straw type, pure coconut shred type and coconut shred- wheat straw mixed type are used, and their sizes are 2.5 m × 30 m, with a density of 300 g/m^2, their seeds are tall fescue, ryegrass and alfalfa, and their germination efficiency is above 85%.

4.2 Experimental Method

Use the above three kinds of vegetation blankets, and lay them in sections in this building section.

Each section is 20 m long. Select the above three kinds of seeds for plant culture. The length of each section is 20 m, and the density of the vegetation blanket is 300 g/m^2. In addition, plant culture is also carried out for the slope section that is not paved for comparative analysis. After more than 10 months of cultivation, all plants are mature, and the protective effect of each blanket can be tested.

4.2.1 Measure the Corrosion Resistance of Soil

Use the annular blade to dig 5 cm of the original soil layer in the standard ground, use the immersion method to measure the time required for the disintegration of the soil layer, measure after the plant growth is completed, repeat the measurement for 3 times, and calculate the average.

4.2.2 Measure the Vegetation Coverage

It includes vegetation coverage and leaf surface area index. The first aspect is to use the needle sample method. The size of the sample is 1m×1m. The ratio of the number of branches and leaves of the plant contacted by the drill rod when it is inserted vertically to the total number of needles is used. On top of the test material, a square wire frame with a side length of 20 cm is randomly placed to quickly seal all the blades in the frame, measure the total area with a measuring instrument, repeat the measurement for three times, and calculate the average value.

4.2.3 Measure the Effective Number of Roots

Vegetation uses roots with root diameter less than 1 mm to improve its corrosion resistance. On a soil profile of 100 m^2, its effective root density is the number of roots with a diameter of less than 1 mm. Randomly select the test site for this test, test the roots below 1mm in each soil in four different soils, obtain the number of roots in the soil, and calculate the average value of root coefficients in three soils.

4.2.4 Measure the Water Yield on the Ground

On the same slope, the edge of the slope is bounded by plastic sheet, 3m × 5m, and a water collector is placed at the bottom of the range to collect rainwater on the slope. Use weighing method to measure rainfall and runoff. The sediment in the collecting tank is measured to obtain the loss of sediment. After rainfall, the sediment is filtered from the settling tank and then completely discharged. Using the simple density method, the erosion amount per square meter can be obtained by weighing under completely dry conditions and repeating for 4-5 times.

4.3 Experimental Results

4.3.1 Impact on Soil Erosion

In the unit area, the soil erosion amount can more directly reflect the soil and water conservation effect of plants. The measurement shows that when the precipitation is 95.5 mm, the soil erosion amount of the pure wheat straw type plant blanket is 87.1 m3. hm-2, the soil erosion amount of the pure coconut type plant blanket is 85.9 m3. hm-2, the mixture of the two is 86.5 m3. hm-2, and the control group site is 125.0. When the precipitation is 40.8 mm, the water and soil loss caused by the pure wheat straw type plant blanket is 74.2 m3, the water and soil loss caused by the pure coconut fiber type plant blanket is 71.5 m^3, and the water and soil loss caused by the mixture of the two is 76.1 m^3, while the control point is 105.0. When the rainfall is 32.7 mm, the soil erosion amount of the pure straw type vegetation blanket is 65.2 m3. hm-2, the soil erosion amount of the pure coconut type vegetation blanket is 62.4 m3. hm-2, the mixture of the two is 62.8 m3. hm-2, and the control group is 92.5. The results show that the three kinds of turf could reduce soil and water loss by 30~39% compared with the ungrown turf.

4.3.2 Vegetation Coverage

After more than 10 months of artificial cultivation, the average canopy rate and average canopy rate of different types of herbs are 93.6% and 7.8 respectively. The LUE value of pure coconut shred type can reach 94.7% and 8.0. In the two complex ecosystems, the forest coverage and LUE

value reach 96.5% and 8.1 respectively. LUE and LUE in the control area are 82.4% and 5.8 respectively. It can be seen from the plant coverage that the coverage rate of the three planting blankets is more than 90%, but the difference is not significant, and 82.4% of the control test site is higher. The results show that the leaf coefficients of the three types of vegetation carpets are higher than that of the control, higher than 34.4~39.6%, and have significant precipitation interception effect.

4.3.3 Effective Root Density

There is a certain relationship between the soil erosion resistance and the number of soil roots, and the plant blanket can play a very good role in the establishment of plants, so that the coverage area of the ground can be improved, so that the root system on the ground becomes denser, thus enhancing the consolidation capacity of the land, thus impeding and reducing the impact of surface runoff on the soil. After measurement, the following conclusions are drawn. The time required for the disintegration of pure wheat straw is 266 min, and the effective root density is 54. The fracture of pure coconut shred takes 268 minutes, and its effective root number is 58. The disintegration period of the two mixed strains is 277 minutes, and the average number of effective strains is 62. In the control area, its disintegration duration is 185 minutes and its effective root number is 49. The results show that the disintegration period of the 3 planting blankets is significantly prolonged, and the distribution of their roots is also significantly higher than that of the control group, which can be used as a new type of vegetation blanket for slope restoration.

4.3.4 Surface Runoff on Slope

Compared with the slope not affected by rainfall, the interception effect of meadow is more significant. Under various rainfall conditions, the soil surface water yield in the control area is 20.5% - 54.1%, indicating the function and superiority of vegetation blanket in soil erosion.

5. Conclusion

In a word, in the new era, it is necessary to change the current ecological environment and enhance the prevention and control ability of soil erosion. Therefore, in the construction process of the project in the future, it is necessary to establish a good ecological concept, pay attention to the popularization and use of green carpets, and make full use of good green plants as slope protection materials, so as to effectively reduce soil erosion and maintain the local ecological environment.

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