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Discussion and Research on Ecological Waterway

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Abstract

Ecological waterway construction requires coordination and unity with natural ecology in the process of waterway construction, realize green development, and form a benign interactive construction and development model, which is in line with the concept of ecological society construction in the new period of our country. This paper makes an in-depth study of the background, research status, related methods and key technologies of the ecological waterway, and puts forward several questions according to the current situation, hoping to provide help for the relevant personnel and attract attention.

Keywords

Ecological Waterway; Methods; Key Technologies; Problems.

1. Introduction

Jin Wenzheng[1] once roughly summarized the management of inland waterways in the United States. Although European and American countries have not proposed a clear concept of ecological waterways, they have long applied ecological concepts to river management[2]. In the early 1970s, due to excessive development, the ecology of the Rhine River was severely damaged and was once considered a "sewer" in Europe [3,4]. Its natural riverbed and bank slopes were extensively hardened and covered, resulting in a decrease in the permeability of the river and even causing two major floods [5]. In the 1980s, German scientists proposed the concept of "Near Natural Torrent Control" [6], advocating for reducing the application of concrete in river water conservancy and shipping development. The Japanese government followed the Rhine River governance model and proposed the "Project for Creation of Rich in Nature" [7], developing various ecological revetment structures mainly composed of stone and wood. In the 1990s, American scholar Dale Miller [8] proposed the technology of biological revetment engineering, which uses biodegradable bio fiber woven bags to fill soil matrix for slope protection, and then plants vegetation on the surface. This structure can still perform well in revetment after experiencing Hurricane Floyd in 1999.

The construction of ecological waterways in the United States mainly involves taking many positive and effective environmental measures during the development of the Mississippi River, achieving good ecological results. The construction of its waterway has gone through five stages: primitive, navigation assistance, standard, high-level, and intelligent waterway [9,10]. Since the development and construction of shipping infrastructure, measures have been taken such as environmental protection, ecological construction, and shipping management, maintaining a beautiful and ecologically friendly environment to date.

2. Related Methods

2.1. Ecological Utilization of Dredged Soil and Reef Clearing Materials

In previous waterway regulation projects, dam construction, dredging, and reef cleaning were commonly used to achieve the planned waterway scale. Dredged soil and debris from reef cleaning are mostly treated by nearby deep trench dumping, which has a significant impact on aquatic organisms, aquatic ecology, and benthic organisms. In recent years, the method of

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stacking on shore has also been adopted for treatment, and there are also significant ecological and environmental impacts.

To achieve this, we need a design approach of ecological dredging of soil and reef clearing materials. We can start from the following aspects: firstly, using dredging soil to backfill the previously damaged beach body, combined with the remediation project to quickly restore the guiding and controlling effect of the beach body on water flow, and also promote the restoration of the original habitat. When choosing to backfill and reinforce the beach area, not only should the slope stability and river regime control be met, but also the construction conditions should be considered to ensure the smooth implementation of the project; Secondly, utilizing reef clearing materials to construct shallow and deep channel habitats in suitable water areas, enhancing water flow diversity and creating a suitable flow environment for fish; Thirdly, construct an ecological conservation area in the shiliang or dam cover area, using clear reef stones as the foundation, and placing ecological fish nest bricks on it to create a complex aquatic environment favored by aquatic organisms, and cultivate and build three fish farms.

Fan Pengpeng and Chen Xi [11] once proposed an ecological design plan for dredging soil and reef clearing materials in the regulation of the Lianshitan waterway. It is proposed to use dredged soil and reef clearing materials to construct backfill and ecological conservation areas. The ecological effects are not yet known, and it is necessary to conduct follow-up monitoring, analyze the effects, summarize experiences and lessons, and systematically establish the construction concept and methods of backfill and ecological conservation areas. In addition, clear reef stones are also used to construct shallow and deep channel habitats favored by aquatic organisms based on actual terrain. However, there is no systematic study on how high the stones should be filled to be most suitable for the survival of aquatic organisms. Therefore, it is necessary to conduct research on the adaptability of rare and unique fish living environments in the upper reaches of the Yangtze River to provide a basis for constructing ecological channels.

2.2. Ecological Revetment

The traditional revetment structure is mainly made of hard materials, with the advantages of stable and safe structure. However, it also has significant negative impacts on the environment, specifically as follows:

1) The application of hard materials makes the morphology of rivers and waterways rigid, lacking vitality, and with poor landscape quality;

2) During waterway management and bank protection construction, it is necessary to cut corners and straighten them, resulting in the destruction of many floodplains, affecting the survival of surrounding animals and plants, and breaking the regional ecological balance;

3) After the completion of the construction of the hard bank slope, it blocks the natural exchange between the waterway water body and the bank slope, directly affecting the survival of microorganisms in the water that need to be supplied with nutrients on land, which is not conducive to the purification of water quality;

4) During the peak rainfall period, the hard bank slope cannot achieve timely removal of surface water, resulting in the inundation of plants in the nearshore zone. During dry periods, the waterway water body is also unable to provide timely water supply for the bank slope plants. Once a large number of plants die, it directly leads to a decrease in the soil fixation capacity of the bank slope, leading to problems such as soil erosion.

Under the current concept of green environmental protection, this model can no longer adapt to the pace of ecological sustainable development, so ecological bank protection is imperative.

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3. Key Technologies

3.1. Reasonable Selection of Materials and Strengthening of Ecological Slope Protection Construction

We should attach importance to the construction of slope protection, utilize the ecological concept to enhance the environmental protection of the construction, and achieve the benign and sustainable application of slope protection. Make full use of environmentally friendly materials and construction models to enhance the environmental protection effect of slope protection construction. For example, actively selecting steel wire mesh protective mats for paving can reduce the application of reinforced concrete materials to a certain extent, maintain the original state near the slope protection, and minimize the ecological damage problem in the water land transition area. The ecological structure of steel wire mesh gabions can also be utilized to make reasonable use of natural materials, Continuously improving the aesthetics of slope protection and achieving coordination and consistency with the ecological environment [12].

3.2. Adapting Measures to Local Conditions and Strengthening the Ecological Construction of Natural Riverbanks

When optimizing riverbank construction, continuously improve the recoverability and ecological type of the riverbank, enhance its landscape characteristics, and take into account the characteristics of the waterway to enhance the hydrophilicity of the riverbank structure. Actively utilize the terrain and characteristics of the surrounding waterways to carry out construction work according to local conditions. In order to improve the landscape of the waterway and break the single visual effect, multiple primary and secondary structures can be actively applied, For example, the first level revetment adopts a combination of concrete and metal wire mesh box structures, gravity and balance weight structures, with priority given to permeable box structures. In the gravity type, landscape greening is reasonably applied, and old embankments and docks are reasonably applied. Through effective transformation, the aesthetics of the waterway are improved, becoming a part of the natural ecology, effectively breaking the sense of conflict, and achieving coordination and consistency [13].

3.3. Optimizing the Structure to Enhance the Effectiveness of Water Flow Prevention and Control

In the actual operation process, it is inevitable that the waterway will generate large water currents, which will impact the revetment and corrode the revetment bit by bit over a long period of time. In order to effectively solve this problem, the structure can be further optimized and the wave prevention and control effect can be continuously improved. In order to effectively reduce the impact of water currents, effectively reduce the erosion of the revetment and the impact on ships, It can be considered to apply a water permeable wave dissipation structure in some sections to enhance the deceleration function of water flow [14].

4. Conclusion

The construction of an ecological waterway system is an inevitable requirement to meet the combination of economic and ecological development needs. The process is not global ecological, but only partial development based on the minimum impact on the natural environment. The construction of ecological waterways should not only take into account the waterway itself, but also fully consider the ecological environment around the waterway. In the process of waterway construction, comprehensive planning should be made, energy-saving and environmentally friendly materials and construction methods should be reasonably utilized, and the coordination and unity between waterway construction and ecological environment

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protection should be continuously improved, thereby enhancing the environmental protection of waterway construction.

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