

## Original Paper

# Research on in-Situ Covering and Remediation Technology for Polluted Sediment in Village and Town Ponds

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### **Abstract**

*With the rapid development of the social economy and the continuous acceleration of urbanization, the development gap between urban and rural areas has become increasingly large. The infrastructure construction of villages and towns has seriously lagged behind urban development, resulting in a large amount of household waste and industrial wastewater being discharged into village ponds and rivers in daily life and development. This has led to an increasing amount of sludge at the bottom of village ponds, as well as the accumulation of heavy metal pollutants, oxygen consuming substances, and other substances, which can easily cause serious ecological environment pollution. By attaching great importance to this and adopting in-situ covering and restoration technology of sediment, we can effectively control the pollution of sediment in village ponds and protect the environment of villages and towns.*

### **Keywords**

*Village and town ponds, Polluted sediment, In situ coverage repair technology*

## **1. Introduction**

There are two main techniques for sediment remediation: in-situ remediation and ex situ remediation. Among them, ex situ remediation requires excavating the contaminated sludge at the bottom of village ponds, finding suitable sites to stack and treat it, in order to achieve good remediation results. However, it is relatively expensive and requires a large amount of work, which can easily cause secondary pollution and affect the overall ecological environment of villages and towns. Therefore, it is necessary to focus on in-situ coverage restoration technology for the polluted sediment at the bottom of village and town ponds, in order to strengthen the effective application of in-situ coverage restoration

technology and ensure the effective treatment of polluted sediment in village and town ponds without affecting the overall ecological environment.

## **2. In Situ Coverage Repair Technology**

### *2.1 Overview of In-Situ Coverage Repair Technology*

In situ covering and restoration technology refers to the use of a suitable covering material without the need to move the contaminated sludge at the bottom of village and town ponds, which can isolate the polluted sediment from the upper water body, prevent pollutants and harmful substances from spreading to the water body, and achieve effective treatment effects while causing pollution to the water body. The covering materials mainly include dust, sand, and artificial compounds, which are suitable for water bodies with low fluidity. They help prevent pollutants such as persistent organic pollutants, oxygen consuming substances, and heavy metal pollutants from sediment from entering the water body, avoiding water pollution and ultimately achieving the goal of improving water quality and remediation. However, village and town ponds have strong non fluidity characteristics, which are suitable for the application of in-situ covering and restoration technology to restore the water body of the ponds, while also helping to improve the village and town environment.

### *2.2 Advantages of In-Situ Coverage Repair Technology*

In the actual application process of in-situ coverage restoration technology, only one or more layers of clean covering material need to be laid on the surface of polluted sediment in village and town ponds, so that it can isolate the polluted sediment from the upper water body, thereby preventing pollutants in the sediment from migrating to the bottom of the water. Its main functions are mainly reflected in the following three points. Firstly, the isolation function is to isolate the polluted sediment and the upper water body through the covering layer. Secondly, consolidate the effect, stabilize the polluted sediment, and avoid the suspension or movement of the polluted sediment. Thirdly, adsorption effect. The covering material is usually composed of organic particles, among which the organic particles have strong adsorption effect, which can effectively adsorb polluted sediment and reduce the pollutants in the polluted sediment entering the upper water body. In addition to the technical advantages reflected in its main functions, it also has the most powerful application advantages in the application process, such as low repair costs, which can obtain significant social and environmental benefits with lower costs, enabling it to improve the water body of rural ponds and optimize the environment of rural ponds. For example, the technical process is relatively simple, easy to implement, and can achieve the most significant repair effect.

### *2.3 Disadvantages of In-Situ Coverage Repair Technology*

Although the in-situ coverage restoration technology is relatively simple and the construction cost is relatively low, there are still certain shortcomings, which lead to certain limitations in the practical application process and cannot fully leverage the effective advantages of in-situ coverage restoration technology to achieve effective governance and restore the water environment. The disadvantage of

technology in the application of polluted sediment in rural ponds is mainly reflected in its own principles and properties. The main application principle of in-situ coverage restoration technology is to cover the original polluted body with a layer of isolation layer, so that it can isolate the polluted sediment and water body. This technical principle leads to the application of in-situ coverage restoration technology, which increases the volume of sediment in lakes and ponds, reduces the depth of water, and changes the slope of the pond bottom. So there is a certain frequency limit for the actual use of technology in the polluted sediment of rural ponds.

### **3. The Available Covering Materials**

#### *3.1 Natural Covering Materials*

Natural covering materials refer to naturally formed sedimentary materials with clean properties, such as soil, sand, silt, gravel, etc. Currently, natural covering materials are mainly sand in the in-situ covering and remediation technology of polluted sediment in rural ponds. Normally, natural covering materials belong to the inert covering layer, which has no degradation function or effect on pollutants. Instead, under the influence of gravity in water, they form a covering isolation layer in the polluted sediment of rural ponds based on physical blocking, chemical adsorption, and other effects, slowing down the diffusion and migration of polluted sediment in water. And natural covering materials such as sand contain relatively low organic carbon content, and their adsorption effect is relatively small. Therefore, in practical applications, they can only achieve the effect of delaying pollution and repairing water bodies, but cannot effectively treat polluted sediment. But this type of material has strong practical and economic performance, is easy to find, convenient for transportation, and can fully meet the needs of village and town pond restoration. And it has no harmful attributes, suitable for any biological habitat, and helps to restore the biological community.

#### *3.2 Modified Clay Material*

Modified clay material is also one of the main covering and repairing materials used in in-situ covering and repairing technology. It refers to a covering material developed on the basis of natural covering materials that can promote the adsorption of various pollutants, so it is also known as modified clay material. Compared with natural covering materials, modified clay materials have strong stickiness and can effectively adsorb various pollutants and harmful substances in the polluted sediment of village and town ponds, achieving effective isolation of water bodies and polluted sediment while achieving good remediation effects and improving the water environment. The main application principle is that clay itself contains a large amount of exchangeable cationic hydrophilic inorganic minerals. Although the thin water film on its surface cannot effectively adsorb organic substances in hydrophobicity, modification can effectively increase the internal organic carbon content, making it have a double-layer structure of organic matter adsorption layer and ion adsorption layer to better adsorb organic pollutants. By applying it to polluted sediment in rural ponds, it can effectively achieve good remediation effects and improve the water environment.

### 3.3 Active Covering Material

Active cover materials have been proven to have strong ability and potential for repairing hydrophobic organic compounds in sediments. Their strong adsorption ability can effectively prevent the diffusion of polluted sediment from rural ponds to the upper water body. Moreover, the functional characteristics of their diversity, strong biological affinity, and environmental friendliness can effectively achieve the role of repairing and treating water polluted sediment. In general, active covering materials mainly refer to materials with zero valent iron, apatite, calcite and other properties. They can achieve good covering effects in practical applications, block polluted sediment and water, and degrade pollutants and harmful substances in polluted sediment. However, in practical applications, it may have a certain degree of impact on the benthic communities at the bottom of village ponds. Therefore, in the process of practical application, it is necessary to consider the characteristics of active covering materials and ensure the application effect of in-situ covering and restoration technology by using them reasonably.

### 3.4 Geomaterials

Geomaterials refer to the construction materials used in geotechnical engineering, which are mainly made of polymers. Geomaterials usually include the following four types: geotextiles, geotextiles, geotextiles, and geotextiles. By making reasonable use of them, they can achieve filtration, drainage, and separation effects. They can be applied to the remediation technology of untreated polluted sediment in rural ponds, effectively isolating polluted sediment and upper water bodies, producing good remediation effects, and improving the water environment of rural ponds. However, in practical applications, geosynthetics are rarely used alone, but rather as a combination of materials. Usually, geosynthetics are placed in the lower layer and compacted by other materials such as sand and gravel, which can achieve the repair effect of increasing adsorption and blocking effect. At the same time, it can also achieve fixation effect, avoid other loose materials floating up and affecting the overall coverage effect, and fundamentally prevent the migration and diffusion of bottom silt. And in the subsequent use process, only a simple replacement of the internal covering material is needed to complete the in-situ coverage and restoration of polluted sediment in village and town ponds.

## 4. Application Measures

### 4.1 Strengthen the Detection of Polluted Sediment in Ponds

Environmental survey is an important basic prerequisite for the effective application of in-situ coverage restoration technology in polluted sediment of village and town ponds. It can fundamentally determine the actual application effect of in-situ coverage restoration technology. Therefore, it is necessary to attach great importance to the preliminary environmental survey work. By actively carrying out environmental survey work, we aim to understand the actual situation of village and town ponds, as well as the actual treatment and restoration needs of polluted sediment in village and town ponds. Based on comprehensive survey data, we will reasonably select in-situ coverage restoration materials and develop corresponding in-situ coverage restoration construction plans. In this process, it is

necessary to establish a professional survey team to familiarize themselves with the application goals of in-situ coverage restoration technology in polluted sediment of village and town ponds. They should carry professional survey data to measure the width, depth, depth of polluted sediment, and specific composition of pollutants in the sediment of village and town ponds. Based on the data, they can infer the required types and quantities of covering materials. Secondly, it is necessary to investigate the relevant situation of villages and towns, understand their economic performance, personnel structure, etc., analyze the causes of pollution in the bottom sediment of village and town ponds, and develop effective construction plans based on comprehensive factors.

#### *4.2 Reasonably Develop Technical Implementation Plans*

The reasonable formulation of the technical implementation plan helps to ensure the orderly application of in-situ coverage and restoration technology in the polluted sediment of village and town ponds, and avoids the overall construction effect being affected by unexpected events during the actual construction process. Therefore, before the actual construction of in-situ coverage repair technology, it is necessary to conduct a comprehensive analysis based on the relevant data surveyed, develop an effective construction plan based on the actual situation, and make sufficient construction preparations based on the plan. Firstly, it is necessary to purchase sufficient covering materials based on the actual situation of rural ponds. While ensuring that the basic performance of the materials meets the construction standards, it is also necessary to follow the principle of comparing goods to ensure the economic performance of the materials. And in the process of preparing materials, a comprehensive inspection of the material quality is carried out. After passing the inspection, it is stored reasonably to protect the material performance from external environmental influences. Secondly, prepare the necessary construction equipment and inspect it to ensure its normal operation. Finally, do a good job of technical disclosure to ensure that construction personnel are familiar with and understand the in-situ coverage repair technology process, clarify the actual construction process of in-situ coverage repair technology, and carry out standardized construction according to the requirements of the plan and the actual construction process to ensure construction quality.

#### *4.3 Optimize Coverage Technology Construction Methods*

In the practical application process of in-situ coverage repair technology, the construction method used can to some extent determine the overall construction cost and the overall repair effect after coverage implementation. Therefore, it is necessary to reasonably choose the construction method of in-situ coverage restoration technology based on the actual treatment and restoration needs of polluted sediment in rural ponds. In general, the actual construction methods of in-situ coverage repair technology are mainly divided into the following three types: first, the surface dumping method of mechanical equipment. It refers to the use of truck starters and other related mechanical equipment to directly pour the covering material into the village pond, so that it can use the gravity of the covering material to naturally settle on the polluted sediment and achieve effective coverage. This method is relatively simple to operate, and its overall village and town environment may also be well suited for

the passage of trucks and other equipment, but it is relatively prone to uneven coverage. Secondly, the surface spreading method of mobile barges. This method mainly utilizes the movement characteristics of mobile ships to evenly spread on the surface of village ponds. However, in the actual application process, it is easy to be limited by the conditions of village and town ponds, resulting in slow dispersion. However, the overall coverage effect is good, and the economic performance is relatively low. Thirdly, hydraulic spraying surface covering method refers to the use of high-pressure equipment to spray the covering material stored at the edge of the pond into the pond to achieve a good covering effect. Fourthly, the underwater covering method for barge pipelines involves injecting the covering material into the lower layer of the water using the pipes on the vessel. By utilizing the buoyancy of the water itself, the covering material can be evenly dispersed and covered on the polluted sediment. This method can directly use underwater covering, with relatively less disturbance to the sediment and no burial of benthic organisms. However, the overall construction process is relatively complex and the overall cost is relatively high. It is necessary to adopt appropriate construction methods based on the actual situation of villages and towns to ensure the practical application effect of in-situ coverage repair technology.

#### *4.4 Strengthen Monitoring of Water Quality in Ponds*

After the application of in-situ coverage repair technology is completed, it is necessary to conduct a comprehensive inspection of the water body of the covered pond, and investigate whether there is uneven coverage in the water body of the covered pond. If there is, appropriate adjustments can be made to ensure the actual application effect of in-situ coverage repair technology, so that it can achieve good improvement effect. If there is surface uncovered during the monitoring process, targeted adjustments can be made based on the relevant information monitored to effectively ensure the comprehensiveness of coverage. At the same time, it is necessary to actively carry out education on pond environmental protection during the monitoring process, emphasizing that village and town residents should take good care of the pond environment. Only by actively protecting the pond environment and not discharging household waste into the pond can industrial waste extend the restoration cycle, form good restoration effects, create a harmonious ecological environment, and ensure the green development of villages and towns. In addition, it is necessary to regularly monitor the actual development of the pond water and the growth of benthic communities based on a certain monitoring period. If necessary, certain intervention measures can be taken to assist the growth of benthic communities.

Summary: In summary, the restoration and treatment of polluted sediment in village and town ponds is crucial, as it can fundamentally determine the overall ecological environment of village and town ponds. By conducting a thorough analysis based on the actual characteristics of polluted sediment in village and town ponds, and taking effective treatment measures according to the actual restoration and treatment needs of polluted sediment in village and town ponds, the reasonable application of in-situ coverage restoration technology of polluted sediment in village and town ponds can be achieved to

achieve effective restoration effects and ensure the ecological environment. Therefore, it is necessary to attach great importance to in-situ coverage restoration technology and actively explore effective application strategies of in-situ coverage restoration technology in polluted sediment of rural ponds.

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