Research Progress on the Law of Nitrogen Transfer and Transformation in Sediment

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Abstract. The eutrophication of closed and semi-closed landscape water bodies such as lakes and rivers is one of the typical environmental problems in cities. The bottom sludge formed under long-term eutrophic water is prone to re-release of nitrogen and phosphorus elements and cause secondary pollution. While effectively intercepting and controlling external pollution, attention should be paid to the secondary release of internal pollutants. Analyzing the nitrogen exchange of eutrophic sediments in sediments-overlying water-plants and the release of internal nitrogen in sediments is conducive to the wider application and promotion of plant ecological restoration technology in sewage treatment projects.

Keywords: eutrophication, nitrogen, migration and transformation.

1. Introduction
The continuous eutrophication of enclosed and semi-enclosed landscape water bodies in urban wetlands such as lakes and rivers is one of the typical ecological environmental problems in current cities. This directly affects citizens' quality of life, physical health and the improvement of the living environment. The main reason for the eutrophication of closed landscape water is that pollutants such as nitrogen and phosphorus in the water exceed the standard. When such enclosed and semi-enclosed landscape water bodies are seriously polluted, the nitrogen and phosphorus nutrients in the water bodies can accumulate in the bottom mud through physical methods such as sedimentation or particle adsorption. And it may release a large amount of nitrogen and phosphorus nutrients to the overlying water body again through the effect of suspension [1-3]. Therefore, even if the external pollution source can be effectively...
controlled in time for the black and smelly water body that has already undergone eutrophication; the concentration of various pollutants in the water still exhibits an extremely high phenomenon for a long time. An important reason is the bottom mud. Bottom mud is an important storage reservoir for pollutants in lakes, rivers and ponds. It is also a place for decomposition and digestion, material circulation, and energy flow and exchange in the water ecosystem. A large amount of nitrogen, phosphorus, nutrients, organic matter, etc. are deposited in the silt at the bottom of the river through various physical effects. The decomposition and differentiation of substances will consume a large amount of dissolved oxygen. As a result, the water body and the bottom mud are in a hypoxic or anaerobic environment. As a result, a large amount of toxic, harmful and irritating gases are produced, including ammonia nitrogen, hydrogen sulfide, methane and so on. Especially in a long-term anaerobic environment, the deposited sludge is overloaded with oxygen consumption, forming secondary endogenous pollution that will be released to the water body for the second time. At the same time, these regenerated secondary pollutants will enhance the resorption of exogenous nitrogen, phosphorus and heavy metal elements, forming a vicious circle [4-5].

2. Research progress at home and abroad

At present, many experts and scholars have shown through a large number of studies that the migration and transformation of nitrogen and phosphorus between the sediment and the overlying water is affected by many factors. It mainly includes the influence of environmental conditions such as water temperature, pH, and dissolved oxygen [6-8] and the physical conditions of water fluctuations. There have been significant studies on the distribution of phosphorus in shallow lakes in Denmark [9], the loading of phosphorus in sediments of Lake Pontchartrain in the United States [10], and the information on nitrogen and phosphorus in Yinfu Reservoir in China. China’s Yinfu Reservoir, regarding the release of nitrogen and phosphorus [11], the problem of nitrogen and phosphorus flux in the water body and sediment in Dianchi Lake [12], etc., have all appeared in the sediments of the re-release of excess pollutants, causing secondary pollution. Some aquatic plants themselves have a large demand for nutrients. Nitrogen and phosphorus can be absorbed and utilized through roots, stems and leaves. In particular, the well-developed root system of plants can take root in the bottom mud, which can effectively absorb nutrients and effectively prevent the bottom mud from floating up. It is beneficial to control the release of nutrients in the bottom mud. Reduce the probability of secondary pollution in the water body. And this control technology has been widely used in engineering practice [13-15]. The absorption and enrichment of nitrogen and phosphorus nutrients by aquatic plants is an effective way to repair, regulate and control the eutrophication of water bodies [16-19]. Different plant species have huge differences in the removal effect of nitrogen and phosphorus. The removal rate of nitrogen and phosphorus in the studied plant species ranges from 20% to 98%. In the water body restoration method, plant ecological restoration is an efficient, simple, economical and sustainable restoration method. It has been widely used in the restoration and treatment of various eutrophic water bodies [20-21]. Some scholars have studied the restoration effects of the aquatic plant Eichhornia crassipes on water bodies with different levels of eutrophication. It was found that this plant can efficiently remove excess N and P elements from water bodies [17]. The research of Liu Pan et al. [22] showed that: the floating water plant Hydrangea japonicus can significantly reduce its concentration by absorbing and utilizing nitrogen and phosphorus in eutrophic water. Wu Juan et al. [23] found through research that the submerged plant Hydilla verticillata can absorb a large amount of nitrogen and phosphorus through rapid growth. This effectively reduces the nitrogen and phosphorus content in water bodies and sediments. Zhu Huabing et al. [24] compared the effects of Eichhornia crassipes and cattails on the removal of nitrogen and phosphorus in eutrophic water bodies. It was found that nutrients such as nitrogen and phosphorus in the water body declined rapidly.

To achieve the goal of restoring cleanliness of eutrophic water bodies is mainly to reduce the concentration of the main nutrients nitrogen and phosphorus that cause eutrophication of water bodies. The effect of different aquatic plants on the absorption of nitrogen and phosphorus in water bodies and sediments has become an important indicator for judging the purification ability of aquatic plants. Most
of the existing research focuses on the efficient purification of eutrophic water bodies by different aquatic plant species, while there are relatively few studies on the purification of nitrogen in sediments formed by water bodies with different eutrophication levels and the law of nitrogen migration and transformation. Nitrogen and phosphorus are the most important limiting factors for the occurrence of eutrophication in water bodies. The research on the release boundary and amount of nitrogen in sediments formed by water bodies with different eutrophication levels is useful for preventing water sediments in practical engineering applications. It is very necessary to cause secondary pollution. The research on the nitrogen release rule of the bottom mud of the closed landscape water can be applied to the control of the internal pollution of the landscape water and provide favorable conditions for ecological restoration to improve the self-purification ability of the water body.

3. The transfer and transformation process of nitrogen from bottom mud to overlying water
The main form of nitrogen exchange between sediment and overlying water is ammonia nitrogen, and the main way for nitrogen exchange between sediment and overlying water is through the adsorption and desorption of ammonia nitrogen [25]. Studies have shown that changes in the concentration of ammonia nitrogen in the overlying water of the sediment can effectively reflect the adsorption-desorption process of ammonia nitrogen in the sediment [26]. When the concentration of ammonia nitrogen in the overlying water is low and high, the adsorption and desorption dynamics of ammonia nitrogen in the bottom sludge show the opposite state, but the lack of change is consistent after a certain fluctuation and tends to a stable state. At the same time, the concentration of ammonia nitrogen in the bottom sludge is inversely proportional to the adsorption efficiency of the bottom sludge. On the contrary, the concentration of ammonia nitrogen in the overlying water is directly proportional to the adsorption efficiency of the bottom sludge. It is precisely because of this adsorption-desorption dynamic change process existing in the sediment and the overlying water that after controlling the entry of exogenous pollutants, the stability of the sediment or water body can be changed to eliminate endogenous pollution. Improve the quality of water bodies.

4. The method of nitrogen migration and transformation in sediments

4.1. The environmental conditions of the overlying water promote the release of nitrogen from the sediment
The nutrients in the bottom mud appear as "sinks" or "sources" in closed and semi-enclosed landscape water bodies such as ponds, lakes, and reservoirs, which are mainly affected by the physical conditions and chemical composition of the overlying water. When the water body is seriously polluted, a large amount of excessive nitrogen and phosphorus nutrients in the water body will accumulate in the bottom mud through physical effects including sedimentation, particle adsorption, etc., and under certain conditions, the nitrogen and phosphorus nutrients will be back-released in the water body, causing Secondary pollution [13, 15]. The main factors that affect the release of nitrogen and phosphorus nutrients from the bottom mud to the overlying water include pH, temperature, dissolved oxygen, and water flow.

4.2. Alternate dry and wet conditions promote nitrogen release from sediments
When the bottom sludge is in a "wet" state, the first is mineralization. At this time, a large number of ammoniated microorganisms will produce a large amount of ammonia nitrogen through their own metabolism. When the accumulation reaches the peak, the microbial enzymatic reaction will produce Inhibition results in a sharp drop in the number of ammoniated microorganisms. Other types of microorganisms multiply by using the ammonia nitrogen in the bottom sludge as an energy source, so that the amount of ammonia nitrogen is rapidly reduced. Conversely, when the bottom mud is in a "dry" state, a large amount of oxygen will accumulate on the surface of the bottom mud, which is conducive to the growth and metabolism of nitrogen-fixing microorganisms. At the same time, the evaporation of water drives the soluble nitrogen to move to the surface, resulting in total nitrogen. The phenomenon
content is increasing. Studies have shown that adding sand particles to the bottom mud with alternating wet and dry conditions can cause the sediment to become sandy, which is beneficial to reduce the activated nitrogen content in the bottom mud [27]. Yang Bin et al. [26] found through research that in the overlying water layer of the sediment, the proportions of various types of nitrogen in descending order are: nitrate nitrogen, ammonia nitrogen, and nitrous nitrogen. The nitrogen in the sediment is mainly organic nitrogen, and the proportion of various nitrogen is ammonia nitrogen, nitrate nitrogen, and nitro nitrogen.

4.3. Methods of controlling the release of sediment
The re-release of nutrient elements in bottom mud has become an important source of water pollution. Therefore, in the process of water pollution control, not only the external source pollution must be controlled, but the second release of the internal source requires more research and attention. Effectively controlling the secondary release of nutrient elements in the bottom sludge is of great significance to the treatment of water pollution. At present, the main methods for controlling the release of sediment are: in-situ remediation method and ex-situ remediation method.

4.4. Study on plant species that absorb nitrogen in bottom mud
In the process of sediment restoration, phytoremediation is a long-term, environmentally-friendly and sustainable restoration method. Especially the pollution of bottom sludge was caused by landscape water bodies. Phytobioremediation can not only continuously and effectively remove excess nitrogen and phosphorus in sediments and water bodies, but also play an aesthetic role in landscape design. At present, a large number of studies have discovered various types of aquatic plants that can efficiently absorb nitrogen and phosphorus, including submerged plants, floating plants and emergent plants. The main principles of phytoremediation technology include: the plant itself needs to absorb directly; the plant root system releases special secretions and enzymes; the plant and the root zone microbes work together.

5. Outlook
Excess nitrogen and phosphorus are important substances that cause eutrophication of water bodies to form sediment pollution. However, the accumulated nitrogen and phosphorus elements in the bottom sludge have the potential to be released again, which will cause serious secondary pollution to the water body. Therefore, the research on the transfer and transformation law of nitrogen and phosphorus in sediments and the control of the release of nitrogen and phosphorus in sediments are very important. In future research, more research will be conducted to explore the internal principles of the migration and transformation of nitrogen and phosphorus, and new technologies, methods and new materials will be developed to control the release of nitrogen and phosphorus in sediments, and provide a more scientific approach to water pollution control. Effective and low-cost governance methods.

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