Study on purification of river sewage by aquatic plants

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Abstract

Aquatic plants are important elements in the treatment of river sewage. They not only have the effect of beautifying the environment, but also have the function of purifying water. They are the "purifiers" of ecological water environment. This paper introduces aquatic plants, the main causes of urban river pollution, and the mechanism of plant purification.

Keywords

Aquatic plants, river sewage, purification mechanism.

1. Introduction

Water pollution is a main factor causing shortage of water supply. Healthy water environment is the premise of harmonious coexistence between human and water, human and nature, and the foundation of sustainable urban development. In the process of urbanization, industrial enterprises are developing rapidly and the population is growing rapidly. The demand and dependence of urban development on water resources are constantly increasing. As a result, a large number of pollutants enter the urban rivers in large quantities, and the water environment pollution is intensifying.

With more and more attention being paid to ecological management, more ecological technologies have been applied to water purification, combining landscape design to create a beautiful ecological environment, and aquatic phytoremediation has been studied more, such as planting aquatic plants to absorb nitrogen and phosphorus nutrients, using allelopathy of aquatic plants to inhibit algae growth and improving river habitat conditions. Eutrophication of water is a key issue commonly faced by urban landscape rivers(Laurenson et al. 2013). Phytoremediation technology is an ecological remediation technology for polluted rivers. It has good effects, low investment and low secondary pollution, and is suitable for large-scale restoration of rivers.

2. Main cause of urban river pollution

2.1 Residents lack environmental awareness and the quality of life needs to be improved

Due to the influence of human activities, some rivers have become channels for the discharge of rainwater and sewage. Some urban enterprises, factories and residents have weak awareness of environmental protection. Uncivilized behaviors such as random construction, littering and random discharge of sewage, not only cause river silting, but also have a very adverse impact on water quality.

2.2 Urban non-point source pollution is becoming more and more serious

With the increase of urban population and lifestyle changes, urban non-point source pollution presents a complex and serious trend. The urban runoff pollution mainly refers to the runoff formed by the rainwater in the process of rainfall, flowing through the commercial areas and streets where the pollutants are concentrated, and carrying pollutants such as nitrogen and phosphorus into the water to form eutrophication of the water(Lee et al. 2000). Urban non-point source pollution is often an emergency, and once it is inevitable, it is mainly affected by rainwater runoff. Once the rainwater enters the urban drainage system, serious consequences will occur. The main pollutants are organic matter, SS, petroleum, nitrogen and phosphorus, etc(Konikow et al. 2005).

2.3 Water loses self-purification ability and dredging is not timely

The river water in urban areas has poor fluidity. Meanwhile, with the development of the city, the amount of sewage discharged into the river continues to increase, far exceeding the environmental capacity of the river, resulting in serious water pollution problems and the loss of self-purification capacity of the water. At the same time, due to the delay of dredging, the riverbed is increased, the drainage is not smooth, the sediment endogenous pollution is serious, and the water quality deteriorates.

3. Overview of aquatic plants

3.1 Aquatic plant concept

Aquatic plants are plants that have long been able to survive in water or in well-watered substrates. They are mainly composed of freshwater plants and marine plants and are important plant species within the plant kingdom. Aquatic plants are characterized by rapid growth, few diseases, many species, fierce reproduction and wide distribution. They are the most ecological, effective and economical way to remediate water environment. Their growth is affected by light, water, nutrients, matrix, oxygen and temperature. Influenced by other factors, it has high ecological value, landscape value and economic value.

3.2 Aquatic plant types

According to their life cycle characteristics, aquatic plants can be divided into annual aquatic plants and perennial aquatic plants. According to their natural habits, they can be divided into emergent plants, wet plants, floating leaves, floating plants and submerged plants. The emergent aquatic plant refers to plants that are rooted and fixed in the bottom of the mud, and the stems and leaves stand upright and rise out of the water, such as Phragmites australis, Nelumbo nucifera, Typha orientalis, Pontederia cordat and Sagittaria sagittifolia, etc. Wet plants are plants that grow in shallow water or on both sides of the river (submerged areas). They are highly resistant to water and land, such as Canna indica, Lythrum salicaria, Cyperus alternifolius and Juncus effusus, etc. Floating-leaf plants refer to plants whose rhizomes are fixed in the soil and whose leaves float on the water surface, such as Nymphae tetragon, Nymphoides peltatum, Trapa bispinosa and Nuphar pumilum, etc. Floating plants refer to plants whose roots are not fixed in the soil, and whose whole plants float on the surface of the water and float with water, such as Eichhornia crassipes, Hydrocharis dubia and Pistia stratiotes, etc. Submerged plants are plants in which the roots are fixed in the soil and the whole plant sinks in the water, such as Vallisneria natans, Myriophyllum aquaticum and Hydrillaverticillata, etc.

3.3 Selection of aquatic plants

The selection of aquatic plants should first be based on their own growth habits. Aquatic plants with developed roots, large plant biomass and strong purification ability are preferred. Aquatic plants have thick stems and leaves and dense roots, which are good for absorbing more nutrients such as nitrogen, phosphorus and organic matter into their own substances, which is beneficial to the transportation of nutrients and the exchange of oxygen, which is conducive to the formation of a good microbial activity environment. At the same time, different aquatic plants have significant differences in growth, reproduction, pollutant absorption and purification, and oxygen production transformation in different water environments. Secondly, according to different water environment, landscape carrier, matrix type, water depth, fusion season and climatic conditions, aquatic plants are selected, and the varieties that are easy to flood and foreign species are used with caution, and the succession rules of aquatic plants are emphasized. In addition, it is necessary to follow the macro-level watershed ecosystem planning of the water environment, coordinate with the overall ecosystem, integrate surrounding environmental factors, and take into account economic benefits, and construct a three-dimensional, hierarchical aquatic plant community to demonstrate the aesthetic value of aquatic plant landscapes.

4. Plant purification mechanism

Purification of water quality by planting aquatic plants is a property that utilizes many aquatic plants to absorb nutrients in large quantities or to degrade and convert toxic and harmful substances into non-toxic substances. Planting a large number of aquatic plants with high pollution-resistance and purification in wastewater or contaminated natural water, so that the pollutants in the water can be decomposed or enriched into the body through the life activities of the white body, and then removed to restore the nutrient balance in the water. At the same time, through the photosynthesis of aquatic plants, oxygen is released to increase the dissolved oxygen content in the water, thereby improving water quality and reducing or eliminating water pollution.

4.1 Characters and Resistance of Plants

Because aquatic plants live in an environment of hypoxia and low light for a long time, their morphological anatomical structures form special traits; roots, stems and leaves form a complete aerated tissue to ensure the needs of organs and tissues for O2; the leaves are fleshy. For example, the surface of the cattail plant has a thick cuticle, a well-developed palisade structure, and closely arranged roots, stems, and epidermis cells at the pollution point, which can resist the decline of assimilation function and excessive transpiration of water due to pollution damage. The stain resistance and resistance of the cattail plant are enhanced.

4.2 Degradation of microorganisms

In sewage treatment systems, microorganisms play an important role in the degradation of various pollutants. Microorganisms, like aquatic plants, have the ability to absorb substances such as nitrogen and phosphorus, and can degrade and pollute elements through denitrification and nitrification. But microbes need to use the role of aquatic plants to degrade these pollutants, rather than relying on their own capabilities. Microbes and aquatic plants are closely linked, so microbial degradation of pollutants depends on aquatic plants for better results. The rhizosphere of aquatic plants provides the substrate and habitat for microbes. Aquatic plants transport O_2 from the photosynthesis and O_2 in the atmosphere directly to the roots through the gas transmission and release of plant shoots and roots, and diffuse into the water. On the one hand, the roots oxidize and decompose the sediment around the roots by releasing O_2. On the other hand, the bottom of the water and the matrix soil form many anaerobic and aerobic communities, creating conditions for microbial activity. Thus, plant metabolites and residues and dissolved organic carbon provide a source of food for colonies in the wetland. At the same time, a large number of microorganisms form a gray biofilm on the surface of the substrate, increasing the number of microorganisms and the area of catabolism. So the pollutants in the roots of the plant are decomposed by microorganisms or removed by bio-metabolic degradation.

4.3 Plant absorption and enrichment

The roots of aquatic plants are developed to facilitate the absorption of large amounts of nutrients such as nitrogen, phosphorus, carbon dioxide and organic matter in the water. After the plants absorb pollutants, especially heavy metals, pesticides and other synthetic organic matter, they are enriched and fixed in the body or in the soil, reducing the amount of pollutants in the water. When aquatic plants are harvested and transported out of the aquatic ecosystem, a large amount of nutrients are also exported from the water, thereby purifying the water. The type and quantity of pollutants absorbed by plants depends on the characteristics of the water, the type and amount of pollutants, and the characteristics of the plants.

4.4 Adsorption and sedimentation of plants

Aquatic plants can play a role in reducing the wind speed of the soil or the environment close to the water during the growth process. Aquatic plants can prolong the contact time between plants and water environment, create a stable water environment for the precipitation of solid suspended solids, ensure the stability of various elements in the water, and improve the brightness of low-quality water themselves. The aquatic plants with developed roots have an increased contact area with the water, thus forming a dense filtration layer. When the water flows, the insoluble colloids are adhered and

adsorbed by the roots, thereby sedimenting the suspended solids in the water. At the same time, the bacterial cells attached to the roots will coagulate after entering the endogenous growth stage, some of which are adsorbed by the roots, and another part of the agglutinated micelles will settle the suspended organic matter and metabolites.

5. Conclusion

Aquatic plants have a good purification effect on sewage, which is conducive to the reconstruction and restoration of aquatic ecosystems. Aquatic plants and microorganisms in the water play a role in purifying water, degrading pollutants contained in water, and forming a natural treatment system. Compared with the traditional water environment treatment method, the natural treatment system composed of aquatic plants has the characteristics of low energy consumption, low cost and recyclability. Therefore, the selection of aquatic plants with strong adaptability and aesthetics has certain theoretical and practical significance for reducing nitrogen, phosphorus and other substances in river sewage.

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