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Research on Sewage Purification Technology in Sponge Cities

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Abstract

Urban water system ecology has been severely damaged, urban waterlogging, water pollution, water resources shortage and other problems have become more serious, and it is urgent to repair and harness them. The concept of sponge city can effectively improve the state of urban water system. Therefore, this article aims to provide theoretical support for China's sponge city pollution water purification technology by analyzing the characteristics, hazards, and different sewage purification technologies of urban sewage.

Keywords

Sponge City; Sewage; Purify; River System.

1. Introduction

With the rapid development of urbanization, the water environment problems caused by urban rainfall runoff have become a key influencing factor for current urban development. As an important component of pollutants in daily life, treating rainwater runoff wastewater can effectively improve environmental quality and save water resources and environment. The construction of sponge cities is proposed in this context, based on the performance principles of sponges, which can automatically adjust and adapt to changes in the environment and natural disasters. Through the combination of natural and artificial methods, sewage is treated to the maximum extent, promoting the circular utilization of water resources, and is an important means of achieving sustainable urban development.

At present, domestic and foreign experts and scholars have conducted in-depth research on this topic and proposed many countermeasures, such as Low Impact Development (LID) in the United States, Sustainable Urban Drainage Systems (SUDS) in the UK, Water Sensitive Urban Design (WSUD) in Australia, etc[1].China mainly uses sewage interception and purification technology to apply in the sewage treatment process of sponge cities. The application of centralized infiltration facilities (sponge facilities) for rainwater runoff such as rainwater gardens and biological retention. The pollutants carried by rainfall runoff are naturally purified through physical, chemical, and biological processes such as packing adsorption, filtration, ion exchange, and microbial degradation, and then infiltrated to recharge groundwater or collected

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for reuse. This has a comprehensive function of alleviating urban waterlogging, purifying water quality, and conserving groundwater resources.

Therefore, this article takes urban sewage as the starting point, analyzes the characteristics, hazards, and different sewage purification technologies of urban sewage, aiming to provide theoretical support for China's sponge city pollution water purification technology.

2. Characteristics and Hazards of Urban Sewage

Urban domestic sewage mainly refers to various detergents, sewage, garbage, feces, etc. used in urban life, mostly non-toxic inorganic salts. Domestic sewage contains a lot of nitrogen, phosphorus, and sulfur, as well as many pathogenic bacteria, making it one of the main pollution sources of water bodies. So it is very important to treat domestic sewage. Discharging untreated domestic sewage not only causes pollution to the environment, but also poses many hazards.

2.1. Characteristics of Urban Sewage

2.1.1. Significant Changes in Water Quality and Quantity

The quality of urban sewage not only varies greatly due to different industrial structures, but also varies greatly among towns with the same industrial structure. Even the quality of sewage discharged from the same town can undergo significant changes in different seasons and times of the day. Due to the influence of the local population, especially in economically developed towns where there are a large number of migrant workers with strong mobility, the amount of sewage may vary significantly with seasons and holidays within a year, even on different periods of the same day.

2.1.2. Characteristics of Wastewater

At present, there are very few separate drainage systems established in existing towns both domestically and internationally. Urban sewage treatment plants are directly affected by urban discharge systems and rainfall, and wastewater may contain a large amount of oil, food residue, etc., with high suspended solids and high chromaticity. A large amount of residual food can cause wastewater to have a strong odor and be prone to odor. The concentration of organic matter in wastewater is relatively high, and the nitrogen and phosphorus sources are also high. Direct discharge can easily cause eutrophication of water bodies.

2.2. Hazards of Urban Sewage

2.2.1. Pathogen Contamination

Mainly from urban domestic sewage, garbage, and surface runoff. Pathogenic microorganisms have a large number, wide distribution, fast reproduction speed, and are prone to develop resistance, making them difficult to eliminate. Such pollutants actually enter the human body through various channels and survive in the body, causing human diseases.

2.2.2. Aerobic Organic Pollution

The common feature of organic matter is that after these substances enter the water body directly, they are decomposed into simple inorganic substances carbon dioxide and water through the biochemical action of microorganisms. In the process of decomposition, dissolved oxygen in the water needs to be consumed, and the pollutants will decay and decompose and deteriorate the water quality under anoxic conditions.

2.2.3. Eutrophication Pollution

The phenomenon of water pollution caused by excessive levels of plant nutrients such as nitrogen and phosphorus. The widespread use of detergents has led to the oxidation and

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decomposition of some organic compounds, resulting in high levels of nitrogen and phosphorus in water bodies.

2.2.4. Odor

Odor commonly occurs in polluted water bodies. Obstructing normal respiratory function and reducing digestive function; Working and living in a stinky environment for a long time will cause olfactory impairment and damage the excitation and regulation functions of the central nervous system and cerebral cortex; It can also generate toxic hazards such as hydrogen sulfide and formaldehyde.

3. Research on Urban Sewage Purification Technology

There are many hazards to urban domestic sewage, and it is very important to choose a suitable domestic sewage treatment plan to treat it. The correct sewage treatment plan can effectively treat urban domestic sewage, avoid sewage and pollutants directly flowing into the water, and is of great significance for improving the ecological environment, enhancing urban quality, and promoting economic development.

3.1. Sponge City Rainwater and Sewage Diversion Mode

3.1.1. The Significance of Rainwater and Sewage Diversion Transformation

Sponge city construction is an inevitable trend of green development and a new direction for urban rainwater and pollution management. Its core concept is to treat urban construction as a sponge. Sponge city construction is an inevitable trend of green development and a new direction for urban rainwater and pollution management. Its core concept is to treat urban construction as a sponge and still reduce the formation of waterlogging with strong elasticity, To achieve effective "suction, storage, infiltration, and purification", so that urban rainwater and sewage can be effectively diverted and still reduce the formation of waterlogging with strong elasticity, and to achieve effective "suction, storage, infiltration, and purification", so that urban rainwater and sewage can be effectively diverted and still reduce the formation of waterlogging with strong elasticity, To achieve effective "suction, storage, infiltration, and purification", so that urban rainwater and sewage can be effectively diverted and still reduce the formation of waterlogging with strong elasticity, and to achieve effective "suction, storage, infiltration, and purification", so that urban rainwater and sewage can be effectively diverted and still reduce the formation of waterlogging with strong elasticity, Realize effective "suction, storage, infiltration, and purification" to effectively divert urban rainwater and sewage, and still reduce the formation of waterlogging with strong elasticity. Realize effective "suction, storage, infiltration, and purification" to effectively divert and control urban rainwater and sewage, enhance the city's ability to withstand waterlogging disasters, and then treat sewage from the source [3].

3.1.2. Implementation Measures for Rainwater and Sewage Diversion

Firstly, rainwater runoff control is the key and foundation of rainwater and sewage diversion renovation. In terms of rainwater runoff control, it is necessary to strictly follow the standard requirements, follow the implementation standards of rainwater runoff control, reduce the width of impermeable road surfaces, and lay pavement materials with good permeability in parking lots, sidewalks, and other roads. Secondly, establish a flood prevention system. The sensing function of the drainage GIS system can be utilized to achieve effective drainage. For example, in rainstorm weather, the water pressure borne by the water pipe can be monitored in real time. When the water pressure is too large and other abnormal conditions occur, the GIS system will give an alarm, which is convenient for people to receive and deal with in time, and play a role in flood prevention. To further enhance the effectiveness of early warning,

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underground storage tanks can also be built in urban parks, roads, residential areas, etc., combined with GIS systems to enhance the effectiveness of water storage.

3.2. Research on the Application of Wastewater Interception and Purification Technology

3.2.1. Setting Grass Trenches

Grass planting ditches can better integrate with the surrounding scenery and serve as biological detention facilities. They are suitable for impermeable areas such as roads and light fields within buildings, as well as urban roads. Green areas and other areas have the advantages of low development and maintenance costs, but their use is limited due to their discomfort in areas with high groundwater levels. Due to its discomfort in areas with high diving water levels, its scope of use is limited [4].

3.2.2. Biodetention Facilities

Biological retention facilities treat rainwater through natural evaporation, soil infiltration, filtration, and other means to reduce the runoff of rainwater, achieving the goal of purifying rainwater and reducing sewage. According to different locations, biological detention facilities can be divided into rainwater gardens, high-level flower beds, and other contents. Rainwater gardens are usually built in low-lying areas within green spaces, while high-level flower ponds are built in conjunction with energy dissipation ponds or by adding efficient facilities such as gabions to receive rainwater from buildings, reducing the turbidity of the water area. Purified ecological tree ponds are used in areas with severe pollution, while simple ones are implemented in areas with relatively light sewage pollution such as parks and green spaces. Although the purification capacity is relatively weak, the cost is relatively low.

3.2.3. Ecological Revetment

Using stone or organic ecological materials, natural revetments are set up in the water bank space where the water flow is gentle and the water level drop is small. In or, river banks with turbulent water flow and high water levels can be protected by biodegradable materials such as tree stumps and branch cuttings, and fixed with more developed plants to form the bank. Alternatively, in combination with engineering materials, high-strength revetments can be constructed using dry stone masonry, water resistant wood, and concrete.

3.2.4. Rainwater Wetlands

The setting of rainwater wetlands can be divided into horizontal subsurface flow and vertical subsurface flow. Horizontal subsurface flow constructed wetlands, also known as infiltration wetlands or horizontal flow wetlands, allow sewage to flow evenly from one end of the wetland into the root zone of the filling layer plants through a water distribution system, achieving sewage purification. This type of wetland solves the problems existing in surface flow constructed wetlands, fully utilizing the biofilm and plant roots on the surface of the filling layer. The sewage treatment effect is good, and the sewage flows below without affecting the environment, A type of wetland that is less affected by climate and is currently widely used. Vertical subsurface flow artificial wetland, also known as vertical flow artificial wetland, combines the characteristics of free surface flow artificial wetland and horizontal subsurface flow artificial wetland. The sewage water is relatively high, but due to the incomplete removal of organic matter in the sewage and the relatively complex control, the infrastructure requirements are high and the treatment results are poor. Wastewater with high tidal undercurrent, but due to incomplete removal of organic matter in the wastewater and relatively complex control, requires high infrastructure requirements and poor treatment results. Tidal subsurface flow artificial wetland has only been studied and proposed in recent years. In this artificial wetland, the reed bed is alternately filled and drained according to time series. During the water injection process of the reed bed, air is discharged, and during the drainage process,

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fresh air is brought into the bed. Through this method, the interaction between water inflow and air movement can be achieved, which can improve the treatment effect of the reed bed on sewage. However, after a period of operation of this wetland, May cause biological blockage issues [5].

3.3. Research on Remediation Technology for Polluted Water Bodies

To ensure the stability of ecosystem functions, the first step is to do a good job in the restoration of polluted water bodies, mainly by adjusting water flow dynamics and repairing river bed materials. Generally speaking, if the dissolved oxygen content in a water body is sufficient to maintain decomposition, it can be considered that the purification capacity of the water body meets the standard. If the water body is polluted and causes serious pollution, it is necessary to regulate the flow dynamics and increase the content of dissolved oxygen. In the case of insufficient water, low flow rate and serious pollution to the water body require water flow dynamics regulation to increase the content of dissolved oxygen. In the case of insufficient water, the flow rate is low and the purification power is insufficient, which cannot effectively ensure the cleanliness of the water body. In this case, consideration can be given to designing a drop weir to increase the dissolved oxygen content in the water body. Under the condition of sufficient oxygen, aquatic plant can effectively absorb and transform methane and other harmful gases to ensure that the purity of the water body meets the standard. After being thrown into the water, pollutants will settle and undergo appropriate treatment to exert their purification effect. Common technologies include treatment and disposal techniques and sediment removal. Proper treatment is carried out to exert its purification effect, and common technologies include treatment and disposal technology and sediment dredging [6].

4. Conclusion

In summary, the ecological construction of urban water systems still faces many problems, such as the urgent need for restoration of water system ecological functions and water resource regulation and storage capacity, insufficient development and utilization of rainwater resources, etc., which pose significant challenges to the ecological restoration of water systems. The construction of sponge cities has proposed a systematic solution strategy for ecological restoration of water systems. By adopting methods such as source emission reduction, process control, and end treatment, pollution interception and purification technology is used to regulate the existing water system ecology of different water bodies in the city, and polluted water body restoration work is carried out to improve the efficiency of urban rainwater resource utilization, thereby creating more economic and environmental benefits.

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