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Natural Ecological and Environmental Protection Strategies Based on Biotechnology Analysis

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Abstract: Due to the rapid development of industry in the market economy, a series of pollution problems have been brought accordingly. Among them, industrial sewage, domestic sewage treatment and other problems have seriously damaged the ecological environment and become one of the most critical issues to be solved for environmental protection nowadays. Therefore, this paper adopts biotechnology to treat domestic wastewater and explores the removal rate of COD, ammonia nitrogen, TP and TN in wastewater by displaced biochemical tank wastewater treatment process, and compares the treatment effect of displaced ball packing and combined packing with ordinary combined packing as reference. The results showed that the removal rate of each pollutant increased with the increase of water retention time of the displaced biochemical tank and the increase of the amount of filler in the biochemical tank, and the removal effect of the displaced ball filler on pollutants was significantly better compared with the combined filler.

1. Introduction

In recent years, the provincial governments have proposed many solutions to the sewage problem and increased the management of the sewage system, and a large amount of money and equipment has been invested in the parks containing industrial manufacturing plants in the cities and towns of the provincial areas, mainly for the construction of sewage treatment, with the fundamental purpose of improving the quality of life of people, thereby improving the control index of sewage treatment and constantly promoting the city's healthier development [1].

Research on the use of biotechnology for wastewater treatment has progressed relatively well. For example, some scholars have used a hybrid model based on material conservation to study the control strategy of the anaerobic reaction process of wastewater treatment. The data collected on the microbial mass growth rate are subjected to neural network analysis to clarify the control state of the anaerobic reaction process. The microbial mass in the water is made to meet the treatment requirements of the anaerobic reaction process by establishing a corresponding hybrid-type model

[2]. The main feature of existing wastewater treatment methods such as SBR method is the intermittent operation of each treatment unit in a certain time sequence during operation, and the operating parameters of each reaction stage can be flexibly regulated according to the actual influent water quality, which not only can effectively reduce the volume of aeration tank to save energy and reduce costs, but also improve the effluent quality compared to the continuous activated sludge method [3, 4]. In conclusion, there are many other biological technologies for wastewater treatment, and all of them have achieved good research results.

This paper firstly introduces the process of sewage treatment and the evaluation method of sewage treatment effect, then analyzes the influence of the hydraulic retention time of the displaced biochemical pond, the amount of filler, and the type of filler on the treatment effect of sewage pollutants, and finally puts forward the environmental protection strategy for sewage treatment from three aspects, such as improving sewage treatment technology, sound rule of law supervision, and strengthening environmental protection education.

2. Basic Overview

2.1. Analysis of Sewage Treatment Process

Sewage treatment process is composed of different kinds of process design units, and these process design units can be operated independently as well as uniformly, and each process design unit has correlation. Therefore, the process design is different for different wastewater treatment processes [5]. Municipal wastewater is a mixture of multiple water qualities, which may contain industrial wastewater, domestic sewage, etc. The current severe shortage of water resources makes the process flow of municipal wastewater treatment particularly important [6]. Wastewater treatment generally requires five processing and treatment components, of which there are four main basic processing and treatment processes, as shown in Figure 1.

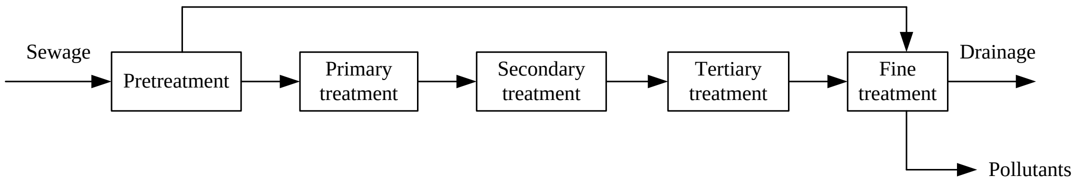

Figure 1. Basic flow of wastewater treatment

(1) The pretreatment process generally sets up grates and sand settling ponds to intercept large suspended pollutants to prevent these pollutants from affecting the fluidity of other wastewater treatment links and to reduce the workload for the subsequent stages of wastewater treatment [7].

(2) The primary treatment is mainly used by physical methods. Set up sedimentation ponds to separate muddy water, and for pollutants such as BOD, COD, and suspended solids, the physical sedimentation method can usually be used. However, for most of the pollutants that are not easily removed, there will be some residues that cannot meet the sewage discharge index. General domestic wastewater will contain a variety of impurities, only a simple primary treatment is unable to meet the requirements of sewage discharge, so it is also necessary to follow up the primary treatment of sewage [8, 9].

(3) Secondary treatment mainly uses biological methods. High-efficiency sedimentation tanks and other treatment equipment are generally set up, which can remove organic particles present in the sewage, or dissolvable organic matter, etc. In the process of wastewater treatment, secondary treatment is the core treatment link, with the most complex treatment process, usually using the

activated sludge method for process design. However, the wastewater after this treatment still has some bacteria, which cannot meet the reuse of water resources, for which a more thorough processing is needed [10, 11].

(4) Tertiary treatment using chemical method. Since there are some other impurities and bacteria that are difficult to remove in addition to some pollutants in the sewage, it is also necessary to further process and disinfect the sewage after secondary treatment to ensure that the water quality has a good discharge index and the residents of cities and towns can have a good living environment [12].

2.2. Wastewater Treatment Effect Evaluation

In evaluating the effect of sewage treatment is, first of all, we have to collect sewage samples. After pumping the decomposition solution from the sewage samples, centrifuging the decomposition solution, and sampling the samples of the pumping solution to measure the concentration of pollutants [13]. Then the amount of hydrate generation and the amount of filtrate are weighed and recorded to calculate the water yield; the effect of sewage treatment is evaluated by the removal efficiency R_e of pollutants, enrichment factor E_f and water yield W_y, calculated as follows.

$$R_e = \frac{C_o - C_f}{C_o} \tag{1}$$

$$E_f = \frac{C_{ef}}{C_o} \tag{2}$$

$$W_y = \frac{V_d}{V_o} \tag{3}$$

Where C_o denotes the concentration of pollutants in the initial sample, C_f denotes the concentration of pollutants in the decomposed water, C_{ef} denotes the concentration of pollutants in the extraction solution, V_d denotes the volume of decomposed water, and V_o denotes the volume of water in the initial sample.

3. Environmental Treatment of Wastewater Based on Biotechnology Analysis

3.1. Displacement Ball Packing Sludge Reduction Mechanism

The investigation controls the hydraulic retention time of the displaced biochemical pond for 8h, the hydraulic retention time of the anaerobic pond for 10h, dissolved oxygen 3mg/L, filling degree 3mg/L. Under this condition, the displaced ball filler of the displaced biochemical pond which has been successfully cultivated with biofilm and operated stably for 1 month is taken, and the bacteria film on the surface of the displaced ball shell and the surface of the internal volcanic rock particles are scraped off a little and transferred to the anaerobic medium for cultivation for a period of time. After a period of incubation, the microorganism survival in the medium was observed by microscopic examination; the total length of the displaced biochemical pond was about 50 cm, and a number of displaced ball fillers were taken every 10 cm from the inlet, totaling 5 sections, and the microorganism species in different flow sections of the displaced biochemical pond were analyzed by microscopic examination, so as to understand the operation mechanism of the displaced ball fillers in reducing sludge volume in the wastewater treatment process [14, 15].

3.2. Data Analysis

(1) Effect of hydraulic retention time of the displaced biochemical tank on the removal rate of each pollutant

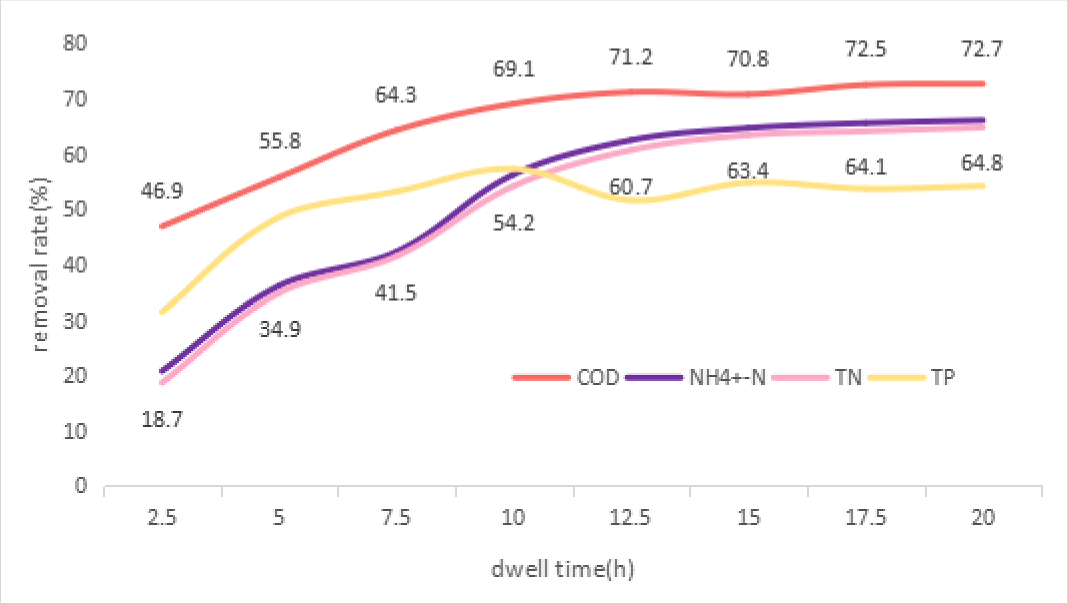

Figure 2. Effect of hydraulic retention time on the removal rate of each pollutant (%)

According to Figure 2, the removal rate of COD, ammonia nitrogen and TN increased with the increase of hydraulic retention time of the displaced biochemical tank. Before 10h, the COD removal rate increased faster during this time because the retention time was less and the organic pollutants were not degraded, and the physical retention effect of biofilm was weakened significantly. However, after reaching 12.5h, the growth of COD removal rate was found to be significantly reduced until 17.5h when it basically reached the plateau period, and the continued increase of residence time had no significant effect on improving COD removal rate.

In the 0-5h period, due to the short residence time, the microorganisms did not have sufficient time to carry out nitrification and denitrification reactions, and there was even the possibility that some microorganisms were washed away by the water flow due to the excessive flow rate, so the removal rate of ammonia nitrogen and TN was less than 40%. After that, as the retention time increased, the removal rate of ammonia and TN also increased, but after 15h, the removal rate did not increase much.

The TP removal rate increased with the increase of hydraulic retention time, but the overall improvement was not significant compared with ammonia nitrogen and TN, and the TP removal rate started to slow down as early as 7.5h, probably because the TP content in domestic wastewater was not high enough to meet the phosphorus absorption needs of polyphosphorus bacteria at a lower retention time.

(2) Influence of the amount of filler in the displaced biochemical tank on the removal rate of each pollutant

Table 1. Influence of filler quantity on the removal rate of each pollutant

Filling degree of filler	20	40	60	80	100
COD	62.3	65.4	68.7	69.3	70.5
NH_4^+-N	43.6	45.8	49.2	56.1	63.4
TN	39.5	44.2	47.3	53.6	61.8
TP	53.8	57.2	61.4	60.2	58.9

As can be seen from Table 1, the COD removal rate of the 100% filler group is 70.5%, the COD removal rate of the 80% filler group is 69.3%, and there is no significant difference between the two filler groups in terms of COD removal, which means that after the filler quantity reaches a certain level, the decomposition ability of the microorganisms in the biofilm attached to the filler has reached the limit for organic pollutants in the wastewater, and what limits the COD removal effect is not The COD removal rate of the 60% filling degree group was 68.7%, the COD removal rate of the 40% filling degree group was 65.4%, and the COD removal rate of the 20% filling degree group was 62.3%, which shows that the COD removal rate also showed a decreasing trend with the reduction of the filling quantity, indicating that the significant reduction of microbial quantity began to have an impact on the decomposition efficiency of organic pollutant decomposition efficiency, and the reduction of biofilm coverage area led to the weakening of membrane retention, which reduced the contact time between wastewater and microorganisms in disguise. As shown in Figure 2.4, the removal rates of ammonia nitrogen were 43.6%, 45.8%, 49.2%, 56.1%, and 63.4%, TN removal rates were 39.5%, 44.2%, 47.3%, 53.6%, and 61.8%, and TP removal rates were 53.8%, 57.2%, 61.4%, 60.2%, and 58.9% for the 20%-100% filler group. 58.9%, indicating that the increase in the amount of filler affected the removal rates of ammonia nitrogen, TN, and TP. The decrease in the amount of filler decreased the removal rate of ammonia nitrogen and TN, on the one hand, because the removal effect per unit time was affected by the large reduction of microorganisms, on the other hand, because the dissolved oxygen formed a certain penetration inside the filler in the process of decreasing the amount of filler, which destroyed the original anoxic environment inside the filler and caused the denitrification effect to be affected and finally led to the poor denitrification effect; the decrease in the removal rate of TP was also mainly due to the decrease in the amount of microorganisms. The reduction of TP removal rate is mainly due to the reduction of microorganisms, but because the phosphorus content of domestic wastewater is not high, the overall removal effect is not greatly affected compared with that of ammonia nitrogen and TN.

(3) Effect of different types of fillers on the removal rate of various pollutants and the amount of sludge produced

Table 2. Effect of different types of fillers on the removal rate of various pollutants

	Drifting ball packing	Combination packing
COD	75.3	61.2
NH_4^+-N	69.6	58.7
TN	68.1	56.6
TP	65.2	62.3

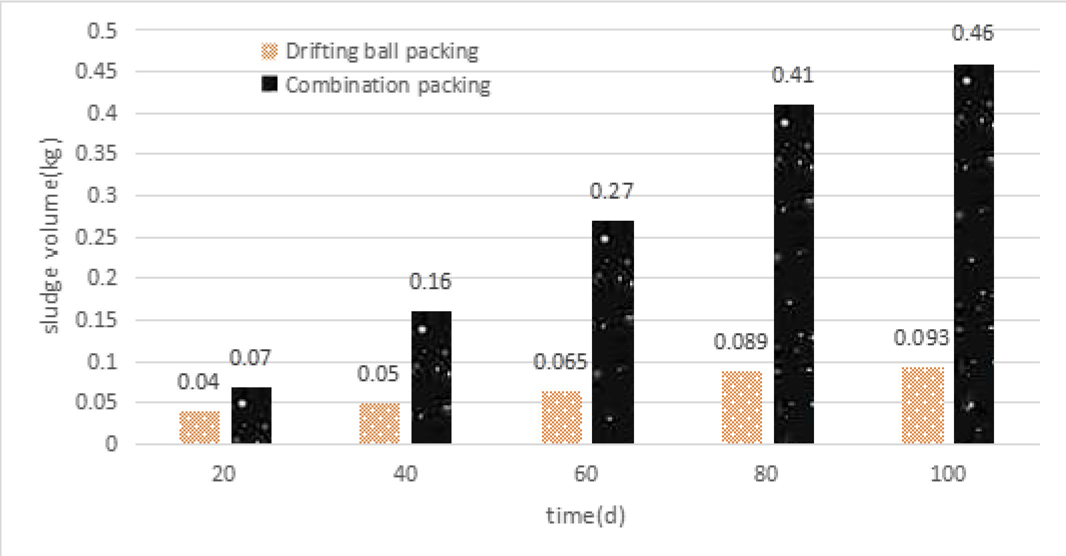

Figure 3. Comparison of sludge production of different types of fillers

As can be seen from Table 2 and Figure 3, under the same conditions of controlling the hydraulic retention time and dissolved oxygen content, the removal rates of COD, ammonia nitrogen, TN and TP by using displaced filler are 75.3%, 69.6%, 68.1% and 65.2% respectively, and the removal rates of them by using combined filler are 61.2%, 58.7%, 56.6% and 62.3% respectively, which shows that the removal effect of various types of pollutants in the sewage is significantly better than that of combined filler. The removal effect of various pollutants in the wastewater was significantly better than that of the combination filler; emptying the reactor wastewater for visual observation, it was found that there was almost no sludge precipitation in the displacement filler group, while a thick layer of black sludge had accumulated at the bottom of the reactor in the combination filler group, the sludge in the two reactors was collected, filtered, dried and weighed, and the sludge generated per 1kg of COD removal in the displacement filler group was higher than that in the combination filler group. This shows that the effect of the displaced filler on the removal of suspended particles is remarkable, and the application of the displacement principle plays a very great role in reducing the amount of sludge generated, effectively solving the problem of sludge treatment in the wastewater treatment process.

4. Ecological Environmental Protection Strategy for Wastewater Treatment

4.1. Improve Sewage Treatment Facilities and Technology

Under the premise that the funds are guaranteed, the resources of the sewage treatment project can be reasonably allocated and the facilities and technology of sewage treatment can be improved in accordance with the idea of sustainable development theory. In terms of facilities, in addition to being able to meet the requirements of national emission standards, they should also be adapted to the actual situation of current industrial production and urban development, and more importantly, to build sewage treatment technologies with low investment, low energy consumption, and simple and convenient operation and management, in order to facilitate the operation and maintenance of technical maintenance personnel at a later stage [16]. Avoid investing too much project funds and operating costs in the sewage treatment process and design parameters, but also effectively prevent the casual discharge of sewage, arbitrary cross-flow, only to solve the tricky problems in the sewage treatment link to truly improve our living environment.

4.2. Sound Rule of Law Regulation

Sound sewage law to pursue responsibility is also indispensable. First, strengthen the government's accountability mechanism for environmental responsibility, in accordance with the legal authority and procedures by the power organs, administrative organs, judicial organs to carry out supervision, and participate in the government's environmental responsibilities of the department and its managers of improper or illegal behavior to pursue legal responsibility. Second, enterprise credit incentive and disciplinary mechanism. Enterprise credit incentive and disciplinary mechanism refers to the credit of good environmental protection services enterprises to give encouragement and preferential, to the violation of the law of environmental protection services enterprises to be punished and restrained, is the organic combination of social legal supervision mechanism and reputation mechanism. Third, the expert consultant performance assessment mechanism. In view of the serious lack of sewage management professionals, the reality of the active formation of a team of experts to give technical guidance to the work of sewage management around the sub will be feasible, as far as possible to avoid guidance in the demonstration process for a variety of reasons caused by the "expert failure" problem [17, 18].

4.3. Strengthen Environmental Education

In view of the current situation of people's weak environmental protection concept, combined with the various types of water sources and environmental pollution events in economic development, strengthen the warning effect for the education of rural residents, increase the exposure of environmental violations, establish a scientific concept of environmental protection and the rule of law, and improve the sense of responsibility for environmental and ecological protection. Increase the publicity and coverage in the news and online media to promote advanced models and successful experiences in ecological construction and environmental protection, and mobilize self-confidence in environmental protection.

5. Conclusion

This paper mainly adopts biological technology to treat domestic wastewater in order to reduce the impact of wastewater discharge on the natural environment. The results show that the hydraulic retention time and filler degree have a significant effect on the effect of wastewater treatment in the displaced biochemical tank, and the removal rate of COD, ammonia nitrogen, TN and TP is higher with the displaced filler than the common combined filler, and the mud production is less than one-fifth of the latter, which has a very good sludge reduction effect, which is mainly due to the special structure of the displaced ball filler that can This is mainly due to the special structure of the displaced ball packing which can produce displacement in the fluid, making the inside of the packing appear anaerobic state and the outside of the packing appear aerobic state. Through the experiments in this paper, we hope to adopt more biological technology to treat wastewater in domestic wastewater treatment.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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