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Water Pollution Prevention and Control Project
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Engineering Method of Water Pollution Prevention and Control in Waterworks Integrated with Biological Therapy

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Abstract: Water pollution is easy to cause social concern and panic because of its harm to human body. As an important place for water treatment, the water pollution problem generated by the waterworks is a major issue of public concern. The water pollution prevention and control project has naturally become a topic of close attention by the public, and the biological treatment method has brought a reference path to water pollution prevention and control. Based on this, this paper uses the biological treatment method to manage the water pollution prevention project of the waterworks, and designs a method to improve it. This paper first introduces the causes of water pollution, then analyzes the problems in the process of water pollution prevention and control, and then puts forward the water pollution prevention and control measures for the waterworks. In this paper, the effect of water pollution prevention and control project in waterworks is analyzed by using biological therapy. Finally, it is found that biological therapy can greatly improve the effect of water pollution prevention and control in waterworks. Biotherapy has a relatively effective application in the water plant pollution prevention and control project, so as to achieve the prevention and control of water pollution.

1. Introduction

Water pollution incidents occur from time to time, and often lead to different hazards. As the base of water treatment and application, the water pollution problem generated by the water plant has become the top priority of public attention. Prevention and control of water pollution can improve the quality of water used by the public and improve the public's confidence in the waterworks. Therefore, it is necessary to prevent and control the water pollution of the waterworks.

Water pollution is a public concern, and some scholars have conducted in-depth research in this area. Shukla, BishnuKant studied the groundwater quality parameters around the Punjab area and determined the pollution degree of these groundwater [1]. Sahu, Subhankar use the potential of biometric elements to monitor water pollution [2]. Ahmed, Shahid investigated the awareness level of Delhi youth on water pollution, its causes, health effects and solutions, and used the original data collected through the schedule of Delhi University/College students [3]. Lomova, L. A analyzed the ecological and economic consequences of water pollution [4]. Li, Xiang's use of metal-organic framework to eliminate water pollutants and its industrial application [5]. Sarker and Bijoyee try to fundamentally discuss the causes and impacts of urbanization and industrialization on surface water and groundwater pollution, and solve the control problems and challenges in South Asia at the same time [6]. Sheffield, J discussed the potential of recently launched, upcoming and proposed tasks, which may further strengthen and change the assessment and monitoring of water resources [7]. Although many scholars have conducted analysis and research on water pollution, there are few studies on water pollution prevention and control measures of waterworks.

In order to improve the water pollution situation of the waterworks, this paper proposes the biological treatment method to manage the water pollution prevention and control project of the waterworks, and designs the water pollution prevention and control measures to prevent and control the water pollution. The analytic hierarchy process was used for evaluation, and it was concluded that the water pollution control effect of the waterworks had been greatly improved after the biological treatment method was adopted. Compared with the experimental results of others, this paper applies biotherapy to the water pollution control project of the waterworks for the first time.

2. Reasons for Water Pollution

In many forms of water pollution, industrial pollution plays an important role [8-9]. It is caused by a large amount of wastewater from industrial production without proper treatment. With the development of industry and the growth of urban population, industrial wastewater pollution has become more and more serious [10]. First of all, the main problem of wastewater treatment is the overcrowding of wastewater treatment plants. Some enterprises deliberately do not equip enough wastewater treatment plants to reduce the investment in wastewater treatment. Many wastewater treatment plants are still operating after their service life, resulting in poor wastewater treatment effect. Second, the wastewater treatment technology is not perfect. With the increase of urban sewage discharge, the requirements for urban sewage treatment system are also higher and higher, especially for the treatment of sewage containing a large amount of organic substances. At present, no wastewater treatment technology can meet all requirements. In addition, there is still a gap in policy. Without strong institutional guarantee, it is difficult to implement water resources protection and wastewater treatment. At present, there are still some gaps in the legislation of wastewater prevention and control, resulting in unclear responsibilities for wastewater treatment and stagnation of work. At the same time, there is also a lack of legislation on the requirements of wastewater treatment plants and wastewater treatment technology, which affects the effect of industrial wastewater treatment. The causes of water pollution are summarized in Figure 1:

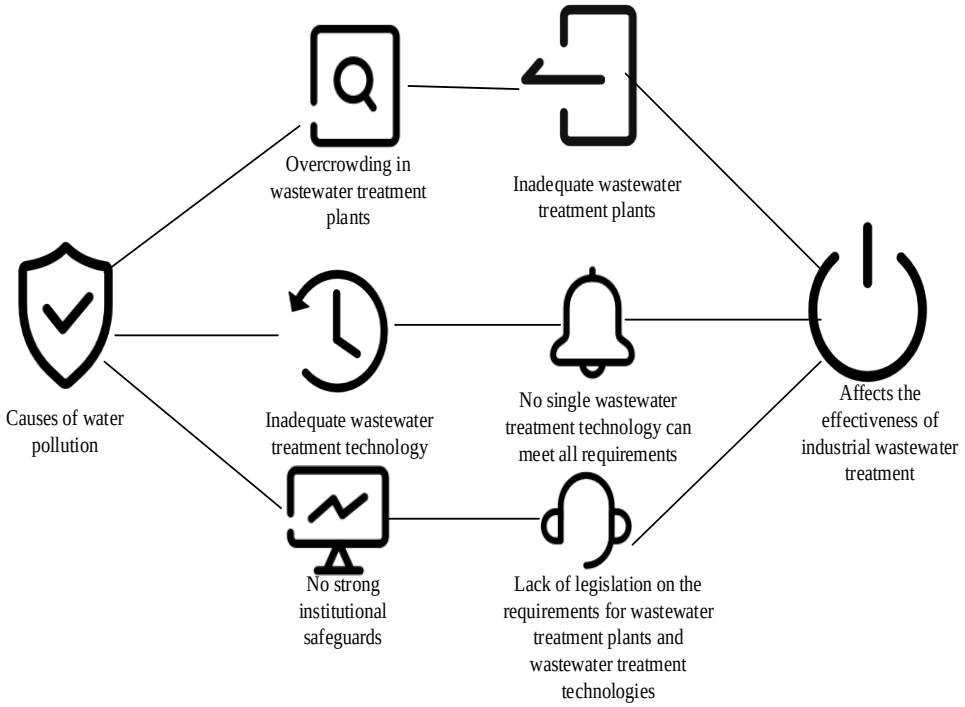


Figure 1. Causes of water pollution

3. Problems in Water Pollution Prevention and Control

In the process of water pollution prevention and control, there are often problems such as inadequate sewage treatment facilities, lax supervision by relevant departments, severe water pollution treatment situation, and complex pollution sources, as shown in Figure 2:

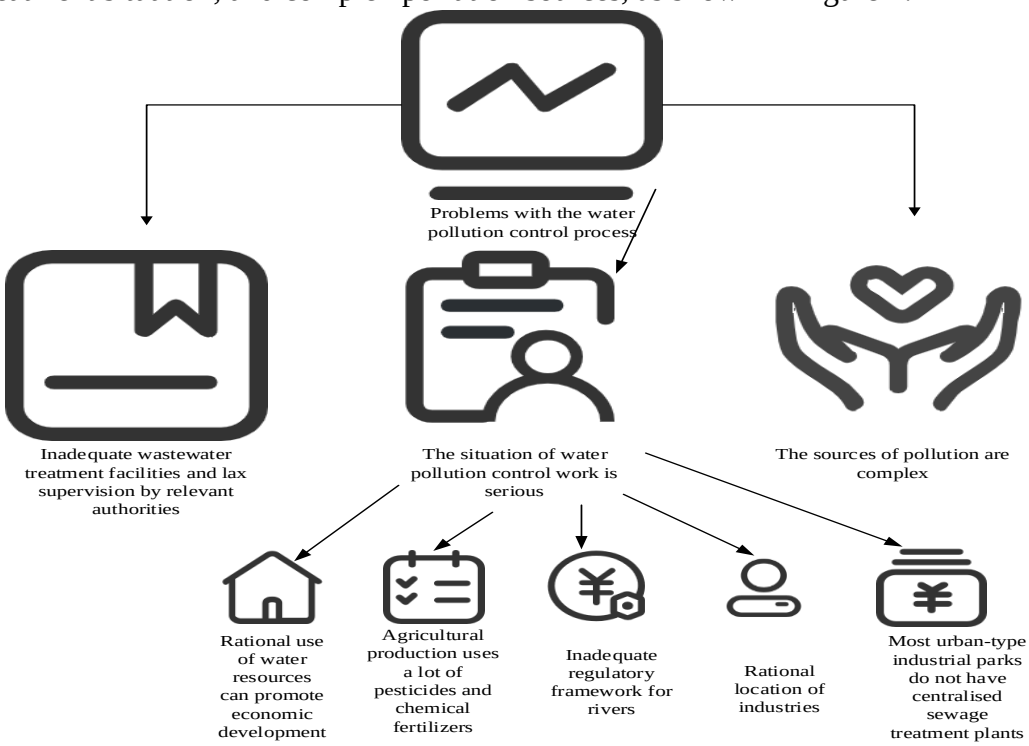


Figure 2. Problems in the process of water pollution prevention and control

3.1. Insufficient Sewage Treatment Facilities and Lax Supervision by Relevant Departments

Most enterprises face many problems when discharging industrial wastewater [11]. For example, the low efficiency of wastewater treatment plants affects the final result of wastewater treatment. In addition, the wastewater treatment facilities of some companies are still imperfect. Some companies required to stop production continue to produce without the permission of the competent department. At the same time, the law enforcement agencies rarely enforce the law and did not take legal action against the illegal enterprises, resulting in increasingly serious water pollution.

3.2. Situation of Water Pollution Control Is Severe

First of all, rational use of water resources can promote economic development, but when people use water resources for economic benefits, they neglect water-saving and effective wastewater treatment [12-13]. In many areas, water resources are not fully utilized, which undermines water security. Secondly, agricultural production uses a large amount of pesticides and fertilizers, aquaculture is increasing, livestock and poultry breeding has not been effectively treated, resulting in serious water pollution. Third, the river regulatory framework is not perfect, the ecosystem, river function and river structure are not comprehensively planned, the governance technology and standards are relatively unified, and the impact of governance cannot be effectively considered. Fourth, the industrial location is unreasonable, and structural pollution still exists. Some industries (such as plastic waste recycling industry) have no environmental protection measures, relatively backward technology, small production scale, original pollution control equipment, and its production and processing process is easy to cause water pollution. In addition, most urban industrial parks do not have centralized sewage treatment plants, while industrial parks with plants are "built without use", which makes it difficult to install sewage treatment plants.

3.3. Pollution Source is Relatively Complex

The mixed sewage of various enterprises is treated in the industrial park in a centralized manner, but the classification and quality treatment are not implemented, resulting in more and more serious pollution. The water bodies of the waterworks have limited natural purification capacity for some substances entering them [14-15]. However, if the pollutants continue to enter the water body, their content exceeds the self-purification ability of the human body, and the human body cannot remove them in time, water pollution would occur. Water pollution poses a direct threat to human health, industry, agriculture and fishery, and has a huge negative impact on social life. Metal pollutants can easily be transferred from water to sediment (through sedimentation or adsorption). The concentration of heavy metals in water is usually at a low and apparently uncontaminated level, but the level of heavy metals adsorbed and deposited in sediment may be much higher than the normal level of the whole water body. Water bodies may be more polluted. The migration of heavy metals from water to sediment seems to be the "self-purification" of water body, but from the perspective of the whole water body, the heavy metals deposited in sediment would slowly release into the water, becoming the secondary source of long-term pollution of water body, which is difficult to deal with. The contaminated area may continue to expand due to the slow migration of sediment with water.

4. Water Pollution Prevention and Control Measures of Water Works

The technological upgrading of the water treatment system of the waterworks includes the following contents: transforming the filtration technology into a two-layer basin with carbon and

sand filtration media; Light filter media with larger particle size (carbon or glass filter media) and thicker and more uniform filter media layer can be considered. The use of a filter combined with gas and backwash water can improve the flushing efficiency, save flushing water and use filter aids. Adding a small amount of polymeric coagulant or tracer flocculant into the water of the filter tank, and then adding a small amount of polymeric coagulant or tracer flocculant, can significantly improve the water filtration efficiency, thus significantly improving the removal efficiency. This is a very important measure to improve the quality of filtered water. Adding filter aids can significantly reduce the inertia of wastewater, but would lead to a corresponding reduction in the duty cycle. If the duty cycle is still long, the filter bed can be kept unchanged by using the filter aid. Otherwise, the filter bed should be changed into a double-bed or homogeneous filter bed at the same time, and the surface flushing agent should be added to improve the flushing effect. Add activated carbon adsorption or biological activated carbon (combination of activated carbon and ozone) advanced treatment devices to further control the concentration of organic pollutants in plant water and reduce the production of halogens. If the conditions are not suitable for the installation of activated carbon filter, powdered activated carbon can be added before filtration, or the filter can be transformed into an activated carbon filter. Optimize the disinfection process, use disinfectants such as chloramine, chlorine dioxide and ozone, reduce disinfection by-products, and improve the health and safety of drinking water. Membrane technology can be used to replace the traditional advanced treatment process and remove some dissolved inorganic salts. The main function of the enhanced filter is to remove turbidity and bacteria through contact condensation between the filter medium and unstable particles. If the filter medium is not screened, sludge would accumulate on the surface of the filter medium, and pre-chlorination would inhibit the growth of organisms in the filter medium, so there is little or no biodegradation in the filter medium layer. If pre-chlorination is not carried out, biological action would occur in the filter medium layer, and the ammonium nitrogen in the filtered water would decrease, while the nitrite nitrogen would increase due to the presence of nitrite bacteria. The improved filtration should make the filter medium remove turbidity and decompose organic matter at the same time, thus decomposing ammonium nitrogen and nitrite nitrogen. In this way, a biofilm containing nitrite and nitrate bacteria should be grown in the filter medium to produce ammonium nitrogen and effectively remove nitrite nitrogen.

5. Method of Biotherapy

The biological treatment method is used to treat wastewater based on the ability of decomposing microorganisms to recover organic pollutants in wastewater. The treatment effect is obvious. It can convert organic substances in water into inorganic substances. It has a wide range of application, strong wastewater treatment capacity, and the most important is non-pollution, low operating cost, and wide application range. Microbial treatment plays an important role in industrial and municipal wastewater treatment. For example, the industrial wastewater of an ion exchange resin manufacturer contains high concentration of amide organic compounds. Adding specific microorganisms into the sewage would significantly improve the sewage condition and greatly reduce the organic content to meet the discharge requirements. At the same time, the microbial community would survive and reproduce normally and would not inadvertently pollute the water body.

5.1. Index System Construction

The validation and evaluation index system of biotherapy consists of two parts: test index and reference index.

Test indicators include water quality indicators, secondary pollution indicators, process performance indicators, economic and technical indicators and a series of secondary and tertiary

indicators, as shown in Figure 3:

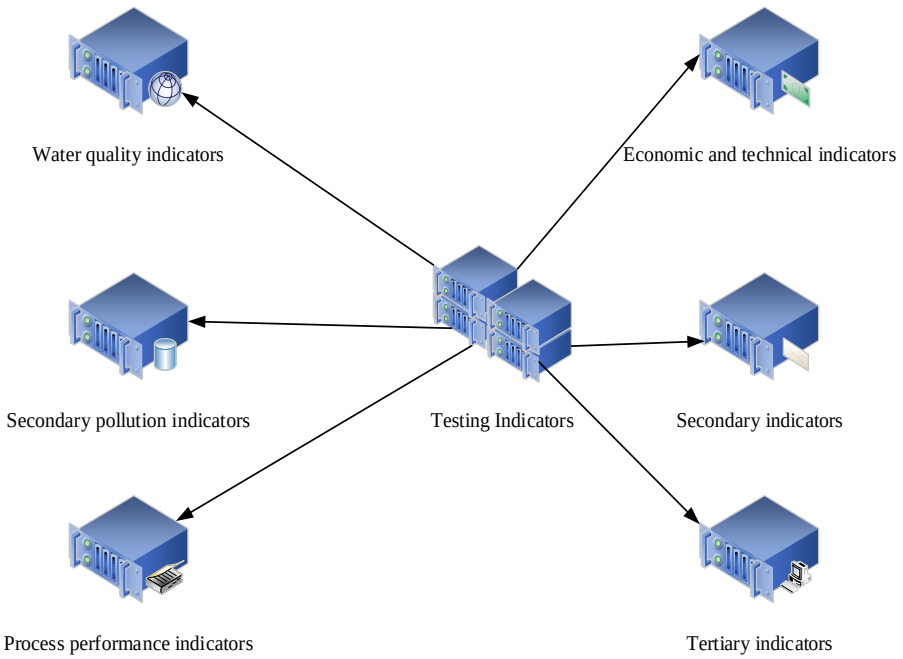


Figure 3. Content of test indicators

Water quality indicators mainly reflect the pollution removal efficiency of sewage treatment technology by detecting various physical, chemical and biological water quality indicators; The secondary pollution indicators mainly verify whether the technology has an impact on the environment and the extent of the impact during the application process, including noise, air, solid waste, etc; Process performance indicators mainly verify the effect of pollution reduction and the correlation between process performance parameters, including visible pollution effects. Economic and technical indicators include energy consumption indicators, chemical consumption indicators, material consumption indicators, water consumption indicators, resource and energy utilization rates, etc. General indicators are generally applicable and used for various biological treatment technology validation tests, including chemical oxygen demand, ammonia nitrogen, biochemical oxygen demand, pH, etc; Characteristic indicators are indicators that reflect a certain treatment effect or water pollution characteristics of the validation technology.

The weight of each index is calculated using the analytic hierarchy process.

(1) Determine objectives and evaluation factors

Evaluating indicator

$$z = \{z_1, z_2, \Lambda\ , z_n\} \tag{1}$$

(2) Construction of judgment matrix

When the importance of the factors to be compared with each other can be explained by a ratio with practical significance, the value of the corresponding element of the judgment matrix is taken as the ratio. The judgment matrix is obtained

$$P = (z_{ab})_{q \times q} \tag{2}$$

In order to check the consistency of the judgment matrix, it is necessary to calculate the consistency index

$$AD = \frac{\alpha_{\max} - m}{m - 1} \tag{3}$$

5.2. Verification Test Method

On the basis of the validation evaluation index system, according to the reliability and maturity of the existing validation testing technology, the main principle is to determine the quantitative analysis of evidence, supplemented by qualitative description and specific validation testing methods. Give priority to the evaluation indicators that can be quantitatively analyzed using national standard methods; For indicators that have no national standard methods or cannot be quantitatively analyzed at present, the methods recommended by the approved test procedures would be used for quantitative or qualitative evaluation. The validation of biological water treatment technology to reduce water pollution is divided into on-site validation research and laboratory validation research. The field validation test is to obtain empirical evidence by applying the field validation technology, especially for the field validation of industrial and domestic sewage, with the characteristics of rapid access to reliable data and low evaluation cost; The on-site verification is carried out in the laboratory where the environment, temperature and other conditions can be simulated and controlled. A large number of high-quality and repeatable verification data can be obtained in a short time, and the evaluation cost has advantages.

6. Effect of Water Pollution Prevention and Control Project in the Water Plant

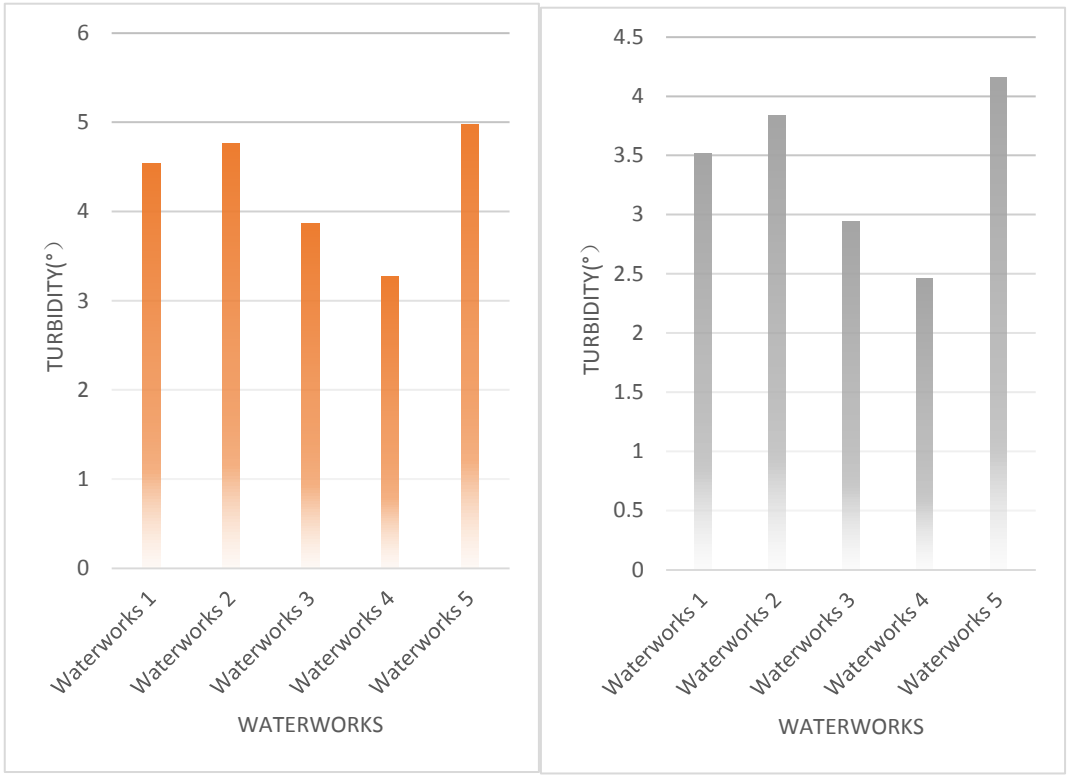
In this paper, five water plants were randomly selected as the subjects of investigation, and the water quality before and after biological treatment was investigated. The basic information of the five water plants selected in this paper was recorded in Table 1:

Table 1. Basic information of water plant

Waterworks	Pollution level
Waterworks 1	3
Waterworks 2	4
Waterworks 3	2
Waterworks 4	1
Waterworks 5	5

Among the five selected waterworks, the pollution level of waterworks 5 is the highest, followed by waterworks 2, waterworks 1, waterworks 3, and waterworks 4.

In this paper, the index of water pollution is turbidity. The turbidity survey results before and after the biological treatment in the water plant are recorded in Figure 4:



A. Results of water turbidity surveys at various water treatment plants before the introduction of biological treatment

B. Turbidity survey results for each water treatment plant after the introduction of biological treatment

Figure 4. Turbidity survey results for each water treatment plant before and after the use of biological treatment

In Figure 4, A represents the survey results of water turbidity in each waterworks before the biological treatment, and B represents the survey results of water turbidity in each waterworks after the biological treatment. Before the biological treatment, the water turbidity of water plant 1 was 4.54 °, that of water plant 2 was 4.76 °, that of water plant 3 was 3.86 °, that of water plant 4 was 3.27 °, and that of water plant 5 was 4.98 °; After the biological treatment, the water turbidity of water plant 1 is 3.52 °, that of water plant 2 is 3.84 °, that of water plant 3 is 2.94 °, that of water plant 4 is 2.46 °, and that of water plant 5 is 4.16 °. After the adoption of biological treatment, the turbidity of water quality in various waterworks has decreased significantly, indicating that the degree of water pollution has been greatly improved.

7. Conclusion

In order to improve the prevention and control effect of the water pollution prevention and control project in the waterworks, this paper adopts the biological treatment method to prevent and control the water pollution in the waterworks, and investigates the turbidity of the water quality in the waterworks before and after the use of the biological control method, and finally draws a feasible conclusion. After the adoption of biological treatment, the turbidity of water quality in each waterworks has decreased significantly, and the water pollution treatment effect is remarkable.

Biotherapy has a wide application space in water pollution control, and it can be applied to water pollution control in the future.

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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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