

REVIEW ARTICLE

Industrial wastewater treatment strategies from the perspective of ecological civilization

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The development of Chinese industry has indeed had a serious impact on the environment to a certain extent, especially in terms of water resource utilization and water pollution control. A large amount of water resources has been consumed in the industrial production process, and the wastewater, if not effectively purified and treated, is directly discharged into the environment, which will cause serious damage to the surrounding water bodies and ecological environment, thereby affecting the livestock and agricultural production in the surrounding areas. Therefore, strictly controlling the process of purifying wastewater and discharging it by enterprises is an urgent task in China's current environmental protection work. This paper analyzed the industrial wastewater treatment technology and current situation and found that industrial wastewater pollution control could be strengthened by improving the level and form of industrial wastewater treatment, strengthening the direction of sewage disposal, increasing investment in sewage treatment funds, improving sewage treatment technology, and rationally using big data technology in the future. The results could help to better understand the current situation and challenges of industrial sewage treatment and provide reference for future work.

Keywords: industrial wastewater; ecological civilization; wastewater treatment.

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Introduction

Current situation of industrial wastewater discharge

Industrial wastewater refers to the wastewater discharged into the environment through the industrial system, which contains various pollutants such as organic matter, inorganic matter, heavy metals, and radioactive substances. Depending on the different characteristics of the main pollutants in the wastewater, it can be classified into various types including organic wastewater, inorganic wastewater, heavy metal wastewater, and

radioactive wastewater. In addition, according to the different fields of industrial production, industrial wastewater can be further subdivided into wastewater from industries such as chemical, metallurgical, energy, papermaking, pesticides, mineral processing, and food. The large-scale discharge of industrial wastewater not only directly affects the water quality and ecological environment but also leads to serious damage to the ecosystem [1, 2], especially the heavy metals, chemical oxygen demand (COD), chromium (Cr), and other substances with great risks to human health [3]. Long term exposure or ingestion may cause various diseases and even

endanger life safety. In recent years, the acceleration of urbanization has driven the rapid development of industrial activities, which has led to a huge demand for water resources. Related studies have shown that, from 2000 to 2004, the total amount of water used in China's industrial sector reached an astonishing 198.99 billion cubic meters, accounting for about 20% of the country's total water use and increasing at a rate of about 1% annually, which means that the rapid growth of industrial water consumption is leading to a sustained increase in demand for water resources. Meanwhile, China's industrial wastewater discharge has exceeded that of many major industrial countries such as the United States and India. From 2007 to 2012, the total amount of wastewater discharge directly increased by 13 billion cubic meters with an average annual growth rate of 4.24%, which indicates that the rapid growth of industrial wastewater discharge has become one of the important reasons for environmental pollution. The 2022 - 2028 Market Dynamics and Competitive Strategy Analysis Report of China's Wastewater Treatment Industry reveals the severity of China's industrial wastewater discharge problem, especially the high level of industrial wastewater discharge compared to other countries. Although the country has been increasing its efforts in industrial wastewater treatment and monitoring, there are still challenges such as low technological level and insufficient investment, which limit the improvement of industrial wastewater treatment level. Therefore, it is urgent to take effective measures to improve this situation, enhance the level of industrial wastewater treatment, protect the water environment, and maintain public health.

The significance of industrial wastewater treatment

The discharge of industrial wastewater not only puts great pressure on water resources but also has a serious pollution impact on the water environment. The water quality of rivers, groundwater, and lakes has been severely damaged with frequent occurrences of

eutrophication, excessive heavy metals, and abnormal pH values. These pollution phenomena directly threaten the survival and reproduction of aquatic organisms [1, 4], and affect people's daily water safety. Industrial wastewater treatment is an important task facing today's society, which directly relates to the quality of people's living environment and the possibility of sustainable development in the future [5].

(1) Improving the level of urbanization

With the continuous acceleration of China's urbanization process, significant development has been made in social, economic, cultural, and educational aspects in various regions, and the quality of life of the people continues to improve. In urban construction, improving sewage treatment in municipal engineering is particularly important, which is one of the important infrastructures to ensure the urban ecological environment and promote sustainable economic and social development. Currently, the development goal of urbanization in China has shifted towards establishing a smart city system, which includes the recycling and reuse of resources such as sewage and rainwater to solve the water shortage problem faced by urban development. The importance of sewage treatment engineering is self-evident [6]. The development of cities cannot be separated from a clean and healthy ecological environment, and the construction of sewage treatment projects directly affects the quality of the urban environment. By improving and perfecting various sewage treatment measures, the urban sewage can be effectively purified, and the quality of water resources can be protected. Further, the efficient utilization of water resources can be achieved, providing solid guarantees for the sustainable development of cities [7].

(2) Highlighting the value of urban construction

By efficiently treating wastewater, the utilization efficiency of water resources can be maximized, ensuring effective utilization of resources in the process of urbanization, and achieving a win-win situation for both economic and ecological

benefits. Wastewater treatment can not only purify the urban environment and solve serious water shortage problems but also promote the healthy development of China's urbanization process [8]. The effectiveness of urban sewage treatment reflects the level of urban development and an important guarantee for the quality of urban ecological environment and the quality of life of residents. Therefore, accelerating the promotion of urban sewage treatment projects and promoting coordinated and sustainable urban development has become an important issue in current urban construction [9].

(3) Beneficial for optimizing the ecological environment and strengthening water resource management

With the acceleration of urbanization, the continuous growth of population, and the continuous advancement of industrialization and urbanization, the demand for water resources is also increasing. However, with the enormous pressure brought by urban development, water pollution has become increasingly prominent, and urban sewage has become one of the serious environmental problems. If effective governance measures are not taken, the direct discharge of urban sewage will seriously damage the water environment, affect the quality of life of urban residents, and even have a great impact on the water use of the entire city [10]. The generation of urban sewage mainly originates from industrial production and people's daily activities including industrial wastewater, domestic sewage, and rainwater discharge. These wastewaters contain many harmful substances such as organic matter, heavy metals, chemicals, and microorganisms. If discharged directly into the water, it will seriously pollute the water environment and endanger people's health. For example, discharge containing a large amount of wastewater can lead to eutrophication of water bodies, causing the proliferation of algae and affecting water quality. The discharge of heavy metals and chemicals can cause toxicity to aquatic ecosystems and affect the safe utilization of water resources. Urban sewage environmental

treatment is an important measure to protect the water environment, ensure people's health, and achieve sustainable development. Only by strengthening urban sewage treatment and improving sewage treatment efficiency can we effectively improve water environment quality [11], ensure water resource security and promote the sustainable development of cities. Therefore, governments at all levels and all sectors of society should attach great importance to the treatment of urban sewage environment, increase investment, take effective measures, and jointly protect common water environment [12].

Common treatment methods for industrial wastewater

With the rapid development of Chinese industry, the quantity and complexity of industrial wastewater are also constantly increasing. Industrial wastewater produced by different industries and processes has different components and characteristics. For different types of wastewaters, corresponding wastewater treatment methods need to be adopted for processing. At present, the methods for treating industrial wastewater in China include physical treatment such as mechanical filtration, chemical treatment like chemical precipitation, and biological treatment [13, 14]. For different sewage characteristics, a single treatment technology can be used, or multiple technologies can be combined for comprehensive treatment. For industrial wastewater with high organic content, biological treatment technology can be used to degrade organic matter through microorganisms, while for industrial wastewater with high heavy metal content, methods such as chemical precipitation or adsorption can be used to remove heavy metal ions. The physical treatment method mainly removes impurities and pollutants from wastewater through physical processes using filters, sedimentation tanks, screens, and other equipment for interception, sedimentation, and screening. These methods are usually suitable for removing large particle impurities and suspended solids in wastewater with poor effectiveness and difficulty to remove

pollutants such as dissolved organic matter. Adsorption treatment is a common and effective method for industrial wastewater treatment, which mainly utilizes solid substances or materials with super strong adsorption capacity such as activated carbon to adsorb and coagulate impurities in water. This method is suitable for removing various pollutants from water including, but not limited to, irritating odors, color changes caused by special dyes, COD, and other organic compounds [15]. Membrane separation technology is an efficient physical method widely used in the field of wastewater treatment, which includes operations such as ultrafiltration, microfiltration, and reverse osmosis. These methods utilize special membrane materials to separate microorganisms, organic matter, and other pollutants from wastewater through differences in molecular size and shape, thereby improving purification efficiency and enhancing water quality stability [16-19]. The chemical treatment method is to use chemical reactions to change the properties of pollutants in wastewater, transforming them into harmless or easily treatable substances. Common chemical treatment methods include oxidation, extraction, and neutralization. The oxidation method involves adding oxidants such as ozone or hydrogen peroxide to wastewater to oxidize pollutants and convert them into compounds that are easier to treat or remove. The extraction rule is to use organic solvents to extract pollutants from water to achieve separation and removal. The neutralization law is to neutralize the acidic or alkaline substances in wastewater into neutral substances by adding acidic or alkaline chemicals to achieve the goal of purification. The biological treatment principle is to use microorganisms or other organisms to degrade and transform organic matter in wastewater [20-22]. Biological treatment methods usually include anaerobic treatment and aerobic treatment. In anaerobic treatment, microorganisms degrade under anaerobic or anaerobic conditions, producing decomposition products of gases such as methane and organic matter. In aerobic treatment, microorganisms

degrade under oxygenation conditions, producing harmless products such as carbon dioxide and water. Anaerobic-anoxic-oxic (A2O) process is a method that combines anaerobic and aerobic treatment, which can efficiently degrade organic pollutants in industrial wastewater and achieve the goal of purifying water quality [23].

Problems in industrial wastewater treatment

One of the biggest challenges brought by industrial production and development is the issue of wastewater treatment. In environmental policy, industrial wastewater management is considered a scientifically rigorous undertaking. It not only improves the efficiency of sewage treatment but also enables scientific and effective management of sewage treatment facilities, thereby improving the quality of sewage treatment facilities [24]. However, there are many problems in the process of industrial wastewater management that need to be addressed and improved.

The effectiveness of sewage treatment is not high, and the technology needs to be innovated and optimized

The wastewater generated by industrial production causes serious pollution to the environment. Therefore, it is necessary to comprehensively and efficiently utilize wastewater treatment technology to improve treatment efficiency. However, the general treatment effect of industrial wastewater is not satisfactory at present, the application of sewage treatment technology is not sufficient, and there are incomplete situations. Although specialized sewage treatment plants have been established in industrial areas or areas with concentrated wastewater discharge, the overall treatment efficiency is still relatively low [25]. Wastewater treatment is a technology intensive and complex project, and advanced wastewater treatment technologies must be fully utilized in the process to improve and optimize wastewater treatment efficiency. The wastewater generated from industrial production contains various organic

compounds, heavy metals, and chemical substances. If discharged directly without effective treatment, it will cause serious damage to the water environment. Therefore, the treatment of industrial wastewater is crucial. However, there are currently some issues that affect treatment efficiency and quality, which include that the existing sewage treatment facility technology has not been fully applied, and some enterprises may still be using traditional treatment methods without adopting more advanced technologies. In addition, some equipment in sewage treatment plants may experience aging and low efficiency, leading to poor treatment efficiency. Further, some enterprises may have insufficient investment and poor management in wastewater treatment, which affects the quality and efficiency of wastewater treatment.

The discharge of industrial wastewater is large, and the investment in wastewater treatment is small

In the field of environmental engineering, the scientific treatment of industrial wastewater is of great significance for sustainable social development. Effective wastewater treatment can not only reduce the pollution caused by wastewater discharge to the environment but also protect the safety and health of the ecological environment. Therefore, it is necessary to continuously improve sewage treatment work in practice, increase investment, and ensure the orderly and comprehensive development of the sewage treatment industry [26]. However, at the current stage, industrial wastewater treatment still faces many challenges and problems. Firstly, the backwardness of industrial development models directly affects the discharge rate of industrial wastewater. With the acceleration of industrialization, the amount of wastewater discharge continues to increase, and the types of wastewaters are also becoming increasingly diverse, which brings huge challenges to sewage treatment technology. Traditional sewage treatment technologies may not be able to effectively treat certain types of wastewaters and require continuous

technological innovation and upgrading. Secondly, the complexity of industrial wastewater treatment systems is also a prominent issue. The wastewater treatment system requires a large amount of funding, technology, and professional equipment support, but currently in actual production, some enterprises may use outdated or even expired equipment for a long time to save costs, which affects the efficiency of wastewater treatment and increases safety hazards. Once the equipment malfunctions, it may lead to serious safety accidents, threatening people's lives and property safety. In addition, the significant lack of funding in the current sewage treatment process is also an urgent issue that needs to be addressed. Although both the government and enterprises are aware of the importance of wastewater treatment, in practical operation, many newly built sewage treatment plants cannot operate normally due to insufficient funds, which affects the efficiency and quality of wastewater treatment and may also lead to further deterioration of environmental pollution problems.

Lack of supervision in industrial enterprise sewage treatment

Industrial wastewater treatment is an important task in the field of environmental protection, and as the main body of industrial production, enterprises bear key social responsibilities. However, most industrial enterprises currently face many challenges and problems in wastewater treatment, lacking sufficient environmental awareness and initiative, which directly affects the effectiveness and effectiveness of wastewater treatment work. Some business managers have a resistance towards investing in wastewater treatment. They believe that investing in wastewater treatment systems will increase the development costs of enterprises, thereby affecting their profitability. Therefore, they are often unwilling to actively invest in wastewater treatment and instead view it as a formal procedure, only used to cope with inspections by relevant regulatory authorities. This short-sighted behavior prevents effective

promotion and improvement of wastewater treatment work and leads to a continuous increase in wastewater discharge. Furthermore, some enterprises lack sufficient attention and maintenance of wastewater treatment systems. Due to the continuous maintenance and updating of wastewater treatment systems, some enterprises often overlook this. They may use outdated wastewater treatment equipment for a long time, resulting in low system operation efficiency and poor wastewater treatment effect. Lack of effective maintenance and updates makes the wastewater treatment system unable to keep up with the pace of technological development and meet increasingly strict environmental standards and requirements. In addition, the current lack of scientific monitoring systems for environmental industrial wastewater treatment is also a problem. Without an effective monitoring system, enterprises cannot accurately grasp real-time data and indicators of wastewater discharge and scientifically control and manage wastewater treatment systems and technologies, which brought unpredictable environmental and compliance risks to enterprises, as well as difficulties in the supervision work of regulatory authorities [27].

Measures and countermeasures for treating industrial wastewater

Improving the level of industrial wastewater treatment

The improvement of technology is crucial in solving the problem of industrial wastewater treatment [28]. Enterprises need to continuously upgrade their industrial wastewater treatment equipment, actively adopt advanced foreign treatment methods, and continuously strengthen research on industrial wastewater treatment technologies to improve their own treatment capabilities. By introducing and applying the currently mature concept of "circular economy", industrial wastewater can be effectively purified and reused to reduce its adverse impact on the environment and achieve the goal of conserving water resources. During

this process, advanced industrial wastewater treatment technologies such as activated sludge (AO) method, sequencing batch bioreactor (SBR) method, oxidation ditch method, A2O method, and biological contact oxidation (AB) method can be used to extract valuable substances from wastewater and produce useful products such as organic fertilizers. The introduction of the "circular economy" model is an innovative measure to solve the problem of industrial wastewater. Through this model, industrial wastewater can be purified and treated, removing harmful substances, and then reused for production or other purposes, achieving maximum utilization and recycling of resources. By using biological treatment and other methods, pollutants such as organic matter and heavy metals are removed from industrial wastewater, and then the treated water is reused in production or agricultural irrigation, thereby reducing the demand for freshwater resources, lowering production costs, and minimizing negative impacts on the environment. Meanwhile, the application of various advanced industrial wastewater treatment technologies is also an important means to improve wastewater treatment efficiency and water quality [29, 30]. The AO method can effectively remove organic matter and nutrients such as nitrogen and phosphorus from wastewater. The SBR method is suitable for treating fluctuating wastewater. The oxidation ditch method can be used for treating high concentration organic wastewater, while the A2O method can simultaneously remove nitrogen, phosphorus, and organic matter, and the AB method is suitable for treating high concentration organic wastewater. By selecting and combining these technologies reasonably, efficient treatment and resource recycling can be achieved for different types and characteristics of wastewater. In addition, corresponding treatment methods should be adopted for different types of industrial wastewater. For wastewater containing a large number of suspended solids, physical methods such as sedimentation or filtration can be used for treatment to remove solid particles from the wastewater [31]. For high-temperature

wastewater, cooling or heat exchange technology can be used for treatment to lower the wastewater temperature and reduce thermal pollution to the environment. Therefore, for wastewater with different characteristics, various treatment methods need to be comprehensively considered and selected and adjusted according to specific situations to ensure the effectiveness and sustainability of wastewater treatment.

Improving the form of industrial wastewater treatment

Industrial wastewater treatment is an important part of ensuring sustainable environmental development. In the face of increasingly severe environmental challenges, industrial enterprises must actively explore innovation, strengthen the control of sewage sources, continuously optimize sewage treatment technology, establish environmental protection concepts, and achieve green development goals. Source control is the key to industrial wastewater treatment. Industrial enterprises should strengthen internal management, establish sound sewage treatment systems, and ensure the minimization of wastewater generation during the production process, which includes adjustments to production processes, adoption of clean production technologies, and reduction of wastewater discharge. Meanwhile, employees should raise environmental awareness, actively participate in sewage treatment work, ensure standardized operation, and reduce the impact of human factors on the environment. Technological innovation is the only way to achieve sustainable development in sewage treatment. Industrial enterprises should continuously optimize existing sewage treatment technologies, introduce advanced treatment equipment and processes, and improve treatment efficiency and quality. Biological treatment, physical and chemical treatment, and other methods can be used to comprehensively purify sewage, while research and improvement will be carried out on sewage treatment technology, exploring more efficient and environmentally friendly treatment solutions to

meet the needs of different industries and sewage properties [32]. In addition, strengthening the professional quality education of internal personnel is also crucial. Industrial enterprises should strengthen the training and education of their employees, improve their understanding and mastery of knowledge related to sewage treatment. Only when employees possess professional knowledge and skills can they effectively participate in sewage treatment work, ensuring the scientific and standardized nature of the treatment process. Further, optimizing and upgrading existing sewage treatment and discharge technologies is also an important measure to solve industrial wastewater problems. Industrial enterprises should closely monitor the development trends of sewage treatment technology, timely introduce and apply new technologies, and improve sewage treatment efficiency and water quality purification capacity, while optimizing sewage discharge technology to reduce adverse effects on the environment, reducing pollutant emissions, achieving compliance with emission standards, and reducing excessive emissions. It is crucial to choose appropriate treatment methods and discharge plans based on regional characteristics and sewage properties. The environmental conditions and industrial structure vary in different regions, and the requirements for sewage treatment also vary. Therefore, industrial enterprises should choose the most suitable sewage treatment technology and discharge plan based on their own situation to ensure the maximization of treatment effect and economic benefits.

Strengthening the directionality of sewage treatment

When treating industrial wastewater, it is necessary to adopt scientific and effective methods, comprehensively understand the types and characteristics of pollutants in wastewater, and pay attention to the treatment effect. With the acceleration of industrialization, the number of pollutants in the environment continues to increase, making sewage treatment work particularly important. In the treatment process,

it is necessary to fully understand the properties and characteristics of different pollutants and take targeted measures to improve the treatment effect. Attention should be paid to the treatment methods for different pollutants. For smelting wastewater containing toxic impurities, adding an appropriate amount of quicklime to accelerate the precipitation of toxic substances and reduce the harm to the environment should be considered. For soluble and toxic pollutants, other cleaner methods for treatment can also be used, while effectively regulating the specific cleaning and disposal processes to improve cleaning efficiency and strengthen cleaning effects. Attention should also be paid to the cultivation of scientific researchers and the application of research results. Enterprises should actively invest in scientific research, encourage researchers to conduct studies related to wastewater treatment, and apply the research results to practical wastewater treatments, which can avoid blindness and randomness in technology selection and improve processing efficiency and level. Meanwhile, more advanced sewage treatment technologies and equipment should also be adopted. With the continuous development of technology, sewage treatment technology is also constantly being updated. New technologies and equipment should be adopted and updated in a timely manner to improve the overall treatment level, which can more effectively treat sewage, protect the environment, and achieve sustainable development.

Increase investment in sewage treatment funds

Industrial wastewater treatment is an important environmental protection task that requires joint efforts from industrial enterprises and national governments to raise funds from multiple sources and adopt scientific and effective methods to achieve good treatment results. When implementing governance measures, there are several key aspects that need to be emphasized and strengthened. Firstly, industrial enterprises should enhance their environmental awareness and take the initiative to take responsibility for sewage treatment. Enterprises

should establish environmental protection concepts, strengthen internal management, strictly implement pollution discharge standards, and actively invest in sewage treatment work, which includes strengthening the construction and maintenance of sewage treatment facilities, improving sewage treatment efficiency, and reducing pollutant emissions. Enterprises should also strengthen technological research and development, explore more efficient and low-cost sewage treatment technologies to reduce treatment costs and improve treatment effectiveness. Secondly, the national government should increase its support for sewage treatment. The government can support enterprises in their sewage treatment work by establishing special funds, formulating policies and regulations, and other means. The government can also increase the supervision of sewage discharge, establish and improve the sewage discharge supervision system, punish enterprises with serious pollution, and force enterprises to strengthen sewage treatment work. In addition, the government can also encourage enterprises to carry out research and development of environmental protection technologies, promote the development of the environmental protection industry, and promote economic transformation and upgrading. In addition, it is necessary to strengthen the management and use of funds for sewage treatment. Government departments should establish a sound fund management system to ensure transparency and standardization in the use of funds. Strict supervision and review should be carried out on the use of sewage treatment funds, and any improper use of funds should be severely punished to ensure the effective utilization of funds and the achievement of treatment effects. It is necessary to strengthen the publicity and explanation of sewage treatment costs, so that enterprises and the public can understand the necessity and purpose of treatment costs and enhance everyone's environmental awareness.

Improve sewage treatment technology

In recent years, with the acceleration of industrialization and rapid economic development, industrial wastewater discharge has become a severe environmental challenge. To address this challenge, enterprises must take proactive environmental measures, improve sewage treatment processes, and further improve the sewage treatment system. Against the backdrop of increasing environmental awareness, the government's requirements for environmental protection are becoming increasingly strict, which has prompted continuous innovation and improvement in China's sewage treatment technology. Among them, efficient precipitation technology is one of the most important technologies that receive much attention. Based on ensuring sludge reflux, this technology achieves rapid separation of impurities in industrial wastewater by adding chemical reagents that can adsorb suspended solids. The outstanding advantage of this technology is that it can significantly improve the treatment efficiency of industrial water purification, while saving labor costs, providing a feasible and economical solution for industrial wastewater treatment. Another important technology is iron carbon electrolysis, which utilizes the catalytic effect of current and ions to oxidize and decompose pollutants in industrial wastewater, achieving complete removal of harmful substances. The technology is relatively simple, easy to operate, and has high profits, so it is highly favored by enterprises. Through iron carbon micro electrolysis technology, the industrial wastewater treatment process is more efficient and controllable, providing reliable technical support for environmental protection and resource utilization. In addition, Fenton oxidation technology has also received much attention. The core of this technology lies in the formation of highly active hydroxyl radicals under the action of Fenton reagent active components. Through the oxidation of hydroxyl radicals, they can effectively decompose harmful substances in industrial wastewater and destroy their molecular structure. Fenton oxidation technology is easy to operate and not prone to secondary pollution, therefore it has a wide

range of application prospects in the field of industrial wastewater treatment.

Reasonable use of big data technology

When establishing a sewage treatment simulation system, a combination of various software and technologies was used. Simulink software system is used to model and simulate the sewage treatment process. Simulink is a powerful simulation software that helps engineers establish dynamic system models, conduct simulations and analyses, and evaluate the effectiveness of different processing methods as well as the stability of system operation. Through Simulink modeling and simulation, various aspects of the sewage treatment system can be finely simulated including sewage entering the system, the working process of various treatment units, and chemical reactions in the reactor, which helps engineers better understand the operating mechanism of the entire processing system, optimize system design, improve processing efficiency and resource utilization. Meanwhile, by utilizing Borland software to develop an upper level system, monitoring and control of the sewage treatment system can be achieved. Borland is a professional software development company that develops a software platform that can collect, process, and display real-time data, providing real-time monitoring and remote control functions for operators to ensure the stable operation of sewage treatment systems. In the system design phase, unified modeling language (UML) design philosophy is adopted for analysis and modeling [33]. UML is a universal modeling language that can help engineers better understand the structure and functionality of a system, clarify system requirements, and guide the design and implementation process of the system. Through UML modeling, the relationships and interactions between the various components of a sewage treatment system can be clearly described, which facilitates communication and collaboration among team members and improves the accuracy and reliability of system design. In the actual development process, big data technology was

used to optimize and analyze the system. Big data technology has the characteristics of processing massive data, high real-time requirements, and complex data relationship processing, making it suitable for modeling, simulation, and optimization of sewage treatment systems. Through big data technology, system databases, data control libraries, and simulation databases can be constructed to collect, store, and analyze operational data of sewage treatment systems, providing scientific basis for system optimization and cost control. By analyzing system data, the cost, construction period, and effectiveness of different processing schemes can be evaluated, and the best solution can be determined. Big data technology can also achieve real-time monitoring and prediction of sewage treatment systems [34], timely discover and solve problems, and ensure the stable operation of the system.

Conclusion

Since entering the 21st century, China's industrial development has made tremendous achievements, but at the same time, the increase in industrial wastewater discharge has brought enormous challenges and hazards to the environment. The continuous advancement of industrialization and the expansion of the scale and quantity of various industrial production activities have led to a continuous increase in the discharge of industrial wastewater. If the attention and treatment of industrial wastewater are ignored, it will have a serious impact on industrial development, sustainable social development, and the safety of human living environment. Therefore, in the field of ecological environment, it is crucial to attach importance to the treatment of industrial wastewater. Although the national government has been taking measures to strengthen industrial wastewater treatment such as formulating a series of environmental protection laws and regulations and increasing penalties for illegal discharge, it still faces many challenges. This review study analyzed the industrial wastewater treatment technology and current situation and suggested

that industrial wastewater pollution control could be strengthened by improving the level and form of industrial wastewater treatment, strengthening the direction of sewage disposal, increasing investment in sewage treatment funds, improving sewage treatment technology, and rationally using big data technology in the future.

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