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Research on the Construction Technology of Intelligent Platform for Wastewater Treatment in Industrial Parks

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Abstract: With the rapid development of industrial parks, the problem of sewage and wastewater treatment is becoming increasingly prominent. This article focuses on the characteristics and needs of wastewater treatment in industrial parks, and conducts in-depth research on the construction technology of intelligent platforms for wastewater treatment. By analyzing the limitations of traditional wastewater treatment methods, the key technologies and construction elements of intelligent platforms are elaborated. Detailed introduction of the data architecture design, functional implementation, and application effects of the intelligent platform in practical cases. Finally, the future development direction of intelligent platform construction was discussed, providing new ideas and methods for the treatment of wastewater in industrial parks.

Keywords: Industrial park; Wastewater treatment; Intelligent platform; technical study.

1. Background

As an important carrier of economic development, industrial parks play a crucial role in promoting industrial agglomeration and regional economic growth. However, with the continuous development of industrial parks, the discharge of sewage and wastewater is also increasing, bringing enormous pressure to the environment. The traditional sewage treatment methods are no longer able to meet the needs of industrial parks for efficient, environmentally friendly, and intelligent treatment. Therefore, building a smart platform for wastewater treatment has become an inevitable choice to solve the problem of wastewater treatment in industrial parks. This article aims to study the construction technology of a smart platform for wastewater treatment in industrial parks, improve the efficiency and quality of wastewater treatment, reduce treatment costs, and achieve intelligent, information-based, and sustainable development of wastewater treatment.

2. Current Situation of Smart Platform Construction for Traditional Industrial Wastewater Treatment

Traditional industrial wastewater treatment is mainly carried out through chemical treatment, biological treatment, and physical treatment. There are single treatment methods or a combination of multiple treatment methods [2-3]. The main problems with various methods in the process of building intelligent platforms are:

2.1. Limitations of the construction of a smart platform for chemical industrial wastewater treatment

The chemical treatment method involves adding chemical agents to wastewater to cause chemical reactions in the pollutants, thereby achieving the goal of removing pollutants. Common chemical treatment methods include neutralization, precipitation, oxidation-reduction, etc. But chemical agents have high costs and may cause secondary pollution. The treatment effect of wastewater with complex components is limited. The processing requires strict control of the dosage of chemical agents and reaction conditions, and the difficulty of intelligent feedback regulation operation is relatively high.

2.2. Limitations of the construction of a smart platform for industrial wastewater treatment using biological methods

Biological treatment is the use of microbial metabolism to convert organic pollutants in wastewater into harmless substances. Common biological treatment methods include activated sludge process, biofilm process, etc. The limitations are reflected in the sensitivity of microorganisms in biological treatment methods to changes in water quality, poor shock resistance to fluctuating industrial wastewater quality, and high requirements for intelligent operation and maintenance response speed. The biological treatment cycle is relatively long and occupies a large area. Professional technicians are required for operation and maintenance.

2.3. Limitations of Building a Smart Platform for Industrial Wastewater Treatment Using Physical Methods

The physical treatment method removes suspended solids, particulate matter, and other pollutants from wastewater through physical processes such as filtration, precipitation, centrifugation, etc. However, physical treatment can only remove some pollutants from wastewater and has limited effectiveness in removing soluble pollutants. Processing equipment is prone to clogging and requires regular cleaning and maintenance. And intelligent platforms are required to respond promptly in emergency maintenance, alarm and accident handling, with high requirements for intelligent disposal.

3. Key Technologies of Intelligent Platform

3.1. Internet of Things Technology

Sensor Technology.By installing various sensors such as liquid level sensors, flow sensors, water quality sensors, etc. in industrial wastewater treatment facilities, real-time monitoring of parameters such as flow rate, liquid level, and

water quality of sewage and wastewater can be achieved, providing data support for intelligent platforms.

Communication Technology.By utilizing wireless communication technologies such as ZigBee, Wi Fi, Bluetooth, etc., the data collected by sensors is transmitted to a smart platform to achieve remote data transmission and real-time monitoring.

Remote Control Technology.By using an intelligent platform to remotely control industrial wastewater treatment facilities, such as starting, stopping, and adjusting equipment operating parameters, the operational efficiency and management level of the equipment can be improved.

3.2. Big Data Analysis Technology

Data Collection and Storage.The wastewater treatment data collected through Io T technology needs to be stored and managed. Using distributed storage technologies such as Hadoop, Spark, etc., data is stored on multiple nodes to improve storage capacity and reliability.

Data Analysis and Mining.Using big data analysis technology to analyze and mine stored wastewater treatment data, identify patterns and trends in the data, and provide a basis for optimizing wastewater treatment processes.

Data Visualization.Visualize the analyzed and mined wastewater treatment data in the form of charts, reports, etc., to facilitate management personnel to intuitively understand the wastewater treatment situation and make timely decisions.

3.3. Artificial Intelligence Technology

Intelligent diagnosis and prediction.Utilizing artificial intelligence technologies such as machine learning, deep learning, etc., to intelligently diagnose and predict the operational status of industrial wastewater treatment facilities, detect equipment failures and potential problems in advance, and improve equipment reliability and stability.

Intelligent Optimization Control.By using artificial intelligence algorithms to optimize and control the wastewater treatment process, such as adjusting aeration and chemical dosage, the efficiency and quality of wastewater treatment can be improved, and treatment costs can be reduced.

Intelligent Decision Support.Utilizing artificial intelligence technology to provide intelligent decision support for management personnel, such as developing wastewater treatment plans, adjusting operational strategies, etc., to improve management level and decision-making efficiency.

4. Elements of Intelligent Platform Construction

4.1. Platform Construction Principles

Data Security Principles.The intelligent platform involves a large amount of wastewater treatment data, and data security is crucial. Adopting encryption technology, access control technology, etc. to ensure the security and confidentiality of data.

Principle of functional integration.The intelligent platform should integrate various aspects of wastewater treatment, such as data collection, monitoring, analysis, control, etc., to achieve integrated and collaborative functions.

Scalability principle.The intelligent platform should have good scalability and be able to continuously add new functions and modules with the development of industrial parks and changes in sewage treatment needs.

Principle of Usability.The intelligent platform should have a good user interface and operating experience, making it convenient for management and technical personnel to use.

4.2. Data Architecture Design

Data Collection Layer. Collect various data on wastewater treatment, such as flow rate, liquid level, water quality, etc., through sensors, instruments, and other devices.

Data Transmission Layer. Utilize communication technology to transmit the collected data to the data storage layer.

Data Storage Layer.Using distributed storage technology to store and manage data, ensuring its security and reliability.

Data Analysis Layer.Utilizing big data analysis technology to analyze and mine stored data, providing decision support for wastewater treatment.

Data Display Layer.Display the analyzed and mined data in a visual form to users, facilitating their intuitive understanding of the industrial wastewater treatment situation.

4.3. Functional Module Design

Data Collection and Monitoring Module.Real time collection of operational data of industrial wastewater treatment facilities, such as flow rate, liquid level, water quality, etc., and monitoring of equipment operation status.

Data Analysis and Mining Module. Analyze and mine the collected data, identify patterns and trends in the data, and provide a basis for optimizing wastewater treatment processes.

Intelligent Control and Optimization Module. Optimizing and controlling the wastewater treatment process through artificial intelligence algorithms to improve the efficiency and quality of wastewater treatment.

Fault diagnosis and warning module.Intelligent diagnosis and prediction of the operation status of industrial wastewater treatment facilities, early detection of equipment failures and potential problems, and issuance of warning information.

Decision Support Module.Provide intelligent decision support for management personnel, such as developing industrial wastewater treatment process plans, adjusting operational strategies, etc.

5. Implementation of Intelligent Platform Functions

5.1. Sewage treatment function

Real time monitoring.Real time monitoring of the operation status of sewage treatment facilities through sensors and monitoring devices, including parameters such as flow rate, liquid level, and water quality.

Intelligent Control. Using artificial intelligence algorithms to optimize and control sewage treatment processes, such as adjusting aeration and chemical dosage, to improve treatment efficiency and quality.

Fault diagnosis. Intelligent diagnosis of the operation status of sewage treatment facilities, timely detection of equipment failures and potential problems, and provision of solutions.

5.2. Purification Effect Evaluation

Water quality monitoring.Real time monitoring of industrial wastewater at the inlet, treatment stages, and treated effluent is carried out through online water quality monitoring equipment to ensure that the water quality meets discharge standards.

Effect evaluation. Utilize big data analysis technology to

evaluate the effectiveness of sewage treatment, identify factors that affect treatment effectiveness, and make optimization adjustments.

5.3. Resource Recycling and Utilization

Reclaimed Water. Reuse the treated reclaimed water for greening, flushing, etc. in the park to improve the utilization rate of water resources.

Sludge Treatment and Utilization. Treat and utilize the sludge generated during the sewage treatment process, such as making organic fertilizers, building materials, etc., to achieve resource recycling.

6. Case Study on The Construction of Intelligent Platform for Industrial Wastewater Treatment in Industrial Parks

Taking Q Industrial Park in Guangxi, China as an example, this article introduces the construction and application effects of the intelligent platform for sewage and wastewater treatment in the park.

6.1. Platform Construction Background

The industrial park is located in the eastern coastal area. With the continuous development of the park, the discharge of sewage and wastewater is increasing day by day, and traditional sewage and wastewater treatment methods are no longer able to meet the demand. Therefore, the park has decided to build a smart platform for wastewater treatment to improve the efficiency and quality of wastewater treatment.

6.2. Platform Construction Content

Data Collection and Monitoring System.Various sensors and monitoring devices have been installed in sewage treatment facilities to achieve real-time monitoring of the sewage treatment process.

Data Analysis and Mining System.By utilizing big data analysis technology to analyze and mine the collected data, factors affecting the effectiveness of sewage treatment were identified and optimized.

Intelligent Control and Optimization System.The optimization and control of sewage treatment processes through artificial intelligence algorithms have improved treatment efficiency and quality.

Fault diagnosis and warning system. Intelligent diagnosis and prediction of the operation status of sewage treatment facilities, early detection of equipment failures and potential problems, and issuance of warning information.

6.3. Application Effect

Improved the efficiency and quality of wastewater treatment. Through the construction of an intelligent platform, the efficiency and quality of wastewater treatment in the park have been significantly improved, and the effluent quality has remained stable and meets the standard.

Reduced processing costs. Through intelligent control and optimization, the dosage of chemical agents and energy consumption have been reduced, resulting in lower processing costs.

Realized resource recycling and utilization. The treated reclaimed water has been reused, improving the utilization rate of water resources; The sludge has been treated and utilized, achieving the recycling of resources.

7. Summary

With the continuous advancement of technology, the future intelligent platform for wastewater treatment will continuously introduce new technologies such as block-chain technology, quantum computing technology, etc., to improve the security, reliability, and treatment efficiency of the platform. Strengthen cooperation among government, enterprises, universities, research institutions, and other parties to jointly promote the construction and development of intelligent platforms for sewage and wastewater treatment. Develop unified standards and specifications for the construction of intelligent platforms for sewage and wastewater treatment, and improve the platform's universality and scalability. Actively guide the public to participate in sewage and wastewater treatment, enhance their environmental awareness and sense of responsibility, and jointly promote the sustainable development of industrial parks.

In short, the construction of a smart platform for wastewater treatment in industrial parks is a work of great significance. By continuously innovating and improving technology, strengthening cooperation among all parties, formulating standards and norms, and guiding public participation, we believe that the intelligent platform for sewage and wastewater treatment will play a more important role in industrial parks in the future, and make greater contributions to achieving coordinated development of the economy, society, and environment.

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