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IOT TECHNOLOGIES IN BIOLOGICAL WATER TREATMENT

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Abstract
It is necessary to use Internet of things technology (IOT) sensing and control equipment to realize the dynamic monitoring of sewage treatment process parameters, so as to serve the drug delivery and equipment online control. This study introduces an application case based on IOT sensor control and supporting maintenance business. Through the practical application of this technology in an environmental protection sewage treatment enterprise in Wuxi, this study introduces a method of bringing the IOT into the MBR system of industrial wastewater treatment which can continuously and accurately monitoring the nodes of the system. Based on this study, an analysis and decision-making system based on real-time monitoring data can be realized to adjust operation parameters in time.

Keywords: Wastewater, IOT, Internet of things technology, Digital signal processor, Windows control center.

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Introduction

In AO (anoxic–oxic) process, the ‘A’ (anaerobic) is the anaerobic section, which is used to remove nitrogen and phosphorus and the ‘O’ (oxic) is the aerobic section, which is used to remove organic matter in wastewater. The advantage from AO is that in addition to the degradation of organic pollutants, it also has a certain function of nitrogen and phosphorus removal. It is the pretreatment of activated sludge with anaerobic hydrolysis technology. Membrane bioreactor (MBR) is a classical wastewater treatment process (Meng et al. 2021) combining membrane technology with biological method for its solid–liquid separation efficiency is significantly higher than that of conventional activated sludge (CAS) process (Huang et al. 2010).

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MATERIALS AND METHODS

As a kind of wireless sensor networks using a promising technology for water quality monitoring and management, the use of wireless sensor on IOT networks facilities improves the current centralized systems and traditional manual methods, which makes the distributed intelligent water quality monitoring system adapt to the urban dynamic heterogeneous water distribution infrastructures (Martinez et al. 2020).

Just like in the Middle East and North Africa region, the use of wastewater is treated to an advancement by using IoT technologies and it can offer obvious benefits of freshwater without the problems of supply and cost (Rashid 2020). With these digital Internet of Things (IoT), well-designed systems may incorporate any or a combination of membrane bioreactor solutions supported by the right chemistry, delivered in the right quantity at the right spot under approach (Rashid 2020). And the Internet of Things (IoT) is an important technological innovation that can enhance industrial competitiveness and sustainability. In several districts, the applicability for promoting industrial sustainability of IoTs in smart manufacturing industry (including wastewater treatment) was verified by an empirical study (Kao et al. 2019). Further, as an important part of wastewater treatment plants, IOT can provide important online monitoring data for the preparation of facility maintenance plan which is known as an electrical preventive maintenance (EPM) programs and prevent unnecessary damage and/or replacement due to neglect (Malhotra et al. 2021).

RESULTS AND DISCUSSION

The wastewater treatment project discussed in this paper mainly serves the newly built large silicon chip and components supporting enterprises, and it is an independent supporting sewage treatment plant for the area and is also a necessary condition for the smooth operation of the large silicon industrial park. The daily processing capacity is 50,000 tons. The park consists of three areas, which are chemical industry area (electronic chemicals area, 5.5 km^2), large silicon wafer supporting area (800 acres) and components supporting area (700 acres). According to the implementation plan of water environment comprehensive treatment in Taihu Lake Basin, the over allowable discharge of COD_{Cr}, ammonia nitrogen,

total nitrogen and total phosphorus is reduced by 50% (2005

is the base year) from 2012. The water quality target of hemp section of the canal is lower than 2.0, reaching class The wastewater treatment project discussed in this paper mainly serves the newly built large silicon chip and components supporting enterprises, and it is an independent supporting sewage treatment plant for the area and is also a necessary condition for the smooth operation of the large silicon industrial park. The daily processing capacity is 50,000 tons. The park consists of three areas, which are chemical industry area (electronic chemicals area, 5.5 km^2), large silicon wafer supporting area (800 acres) and components supporting area (700 acres). According to the implementation plan of water environment comprehensive treatment in Taihu Lake Basin, the over allowable discharge of COD_{Cr}, ammonia nitrogen, total nitrogen and total phosphorus is reduced by 50% (2005 is the base year) from 2012.

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Current characteristics of municipal-scale industrial effluents

1. More special equipment. Industrial wastewater treatment is an emerging sunrise industry, which has a broad application prospect. A variety of new sensors constantly spring up. This leads to poor interchangeability with the same type of equipment and a unified maintenance standard. At the same time, with rapid development of electronic technology, wastewater treatment equipment and intelligent IT components, it is difficult to purchase the fittings when the old equipment upgrades.
2. Wastewater treatment capacity increases rapidly. With the raising of urbanization quality, industrial urban sewage treatment plants are used more and more widely. It also needs more capacity and new types of waste- water treatment. With the addition of different types of industrial production lines in the city, different industrial wastewater treatment facilities will be built.
3. Wastewater component changes significantly. The urban industrial wastewater to be treated will change significantly with the changes of seasons and plant process. Changes in the evolution of the wastewater components occur, resulting in the need for simultaneous and timely adjustments to subsequent wastewater treatment processes. In addition, in different seasons and weather, urban storm water can also significantly increase the management of urban industrial wastewater treatment.

Multi-mode AO + MBR process

The multi-mode AO + MBR process performs a function of degradation resistance, but bioreactors alone or membrane filtration alone cannot perform. Organic pollutants and suspended solids have a certain treatment effect. The conventional process of sludge separation is achieved by sedimentation tank, while the multi-mode AO + MBR process applies membrane separation technology. It replaces the conventional activated sludge process with secondary sedimentation tanks and deep treatment processes, and has the effect of removing the microorganisms on which the biological treatment process depends on the biological treatment process. The separation of the microorganisms from the culture medium (mixture) allows the microorganisms to be retained in the biochemical reaction tank, while ensuring that the effluent contains fewer microorganisms and other suspended solids. The multi-mode AO + MBR process is characterized by a complete separation of hydraulic retention time and sludge age in the bioreactor. The high sludge age with low residence time allows for a better and richer microbial population in the sludge, which not only increases the ability of resisting shock loads but also more stable effluent. The process provides an opportunity for organic pollutants, nitrogen and other pollutants to be discharged. The degradation of contaminants creates favorable conditions.

Process design scheme

The wastewater from enterprises in the park is transported to the plant area of the project by special pressure pipes, in which the process of regulating tank + calcium removal tank + nitrification tank is adopted for the treatment of fluorine-containing wastewater, fine grid + aerated grit chamber + membrane grid tank + hydrolysis acidification tank is used for pretreatment; multi-mode AO tank + MBR tank + UV disinfection process is adopted for main waste- water treatment; pretreatment + multi-mode AO + MBR is used for main process of the project membrane process; this scheme has the advantages of stable treatment effect, rich

operation experience, strong shock load resistance and saving floor area. Moreover, the proportion of industrial waste- water in this project is relatively high. MBR is more suitable for the complex water quality of industrial wastewater (Liu et al. 2021). It can be combined with subsequent treatment units to remove pollutants such as refractory organics. The process flow is shown in Fig. 1.

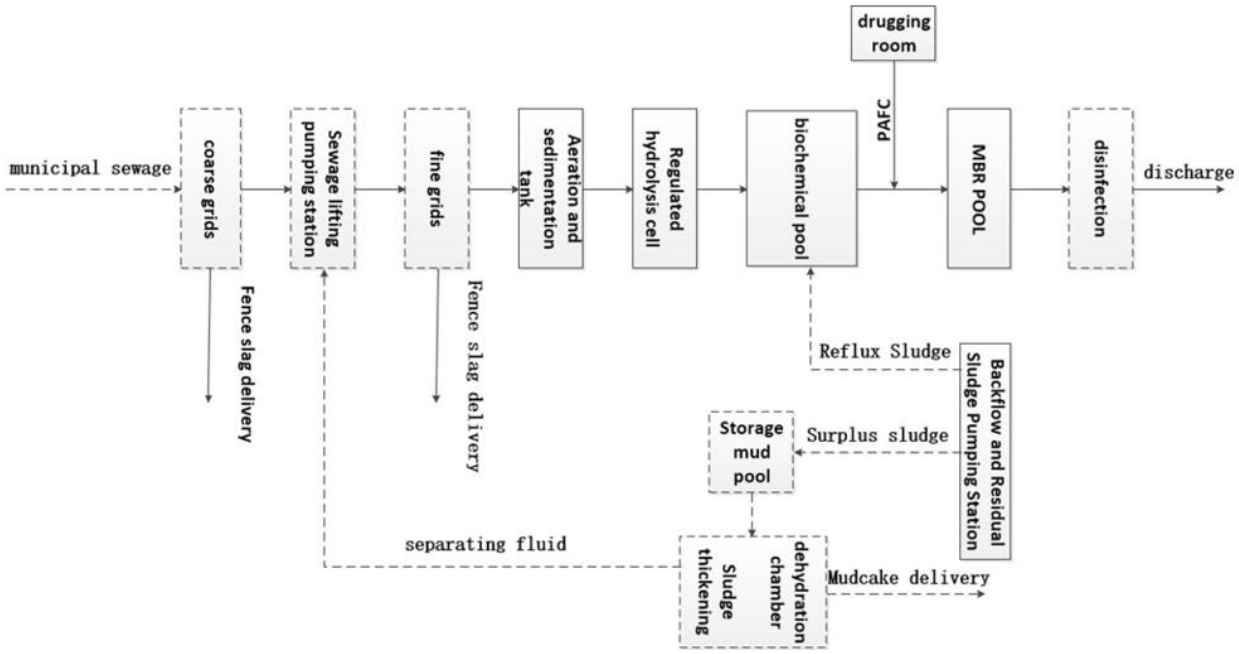

Fig. 1. The flow charts of scheme

IoT system design solutions

Comprehensive China's water treatment plants are scattered and small. In addition, the water quality is different. They also have the disadvantages of weak investment, resource dispersion, backward management and technical personnel and lack of professional guidance.

The application of IoT can monitor various types of sewage treatment equipment network, which are attached in the whole process of the automatic control system, the city's sewage treatment nodes, production and sewage in the running state. Online control of pipe valves by IoT control nodes can also solve the shortcomings in the existing sewage treatment model. The establishment of the wastewater treatment system based on the IoT system can achieve real-time control of treatment production of all kinds of resources by preset configurations (Su et al. 2020), and it also can further enhance the crisis operational response speed, standardized management, energy saving and economic efficiency.

The sensory layer is mainly composed of water quality monitoring and flow control IOT sensors (Somov et al. 2018), which realize basic function control and strategy configuration through on-site intelligent gateway, water quality collection, flow rate and valve status at regular and frequent intervals. The sensory can execute switch and restart command.

The network layer consists of a data transmission bus such as Zigbee and a GPRS remote data transmission network (Liu et al. 2010), which is responsible for the transmission of wastewater treatment data to the central server.

The data layer is responsible for receiving and processing the sensor monitoring data transmitted from the field IOT devices (Xiu et al. 2019). Its function definition is preliminarily

filtered and pre-processed to the real-time collected data according to the device preset business thresholds and intelligent supervisory strategies. It also forms a number of different data modules such as device online status, device real-time parameters, device history status, device real-time alarms, device history alarms, and so on.

CONCLUSION

After the sewage treatment plant is completed and put into operation, a large amount of pollutants can be intercepted every year. Furthermore, the treated tail water can be used as water supply source for road landscape. Obviously, the project has a significant effect on improving regional water environment quality, and its environmental benefits are huge. The estimated pollutants can be reduced each year as follows.

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