Expert System for the Control of Effluent TN Exceedance of AAO Process

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Abstract: Based on the mechanism of microbial denitrification and the principle of wastewater treatment process control, an expert system is built for the purpose of dealing with the exceeding of TN standard, and the data information collected from the equipment of the wastewater treatment plant is combined with intelligent diagnostic means to make a technical analysis of the factors triggering the exceeding of TN standard in accordance with the wastewater treatment logic. According to the structure characteristics of the activated sludge AAO process, the causes of TN exceedance are analyzed step by step and the system is adjusted with the predetermined response strategy to achieve effective control of TN exceedance in the effluent, taking a wastewater treatment plant in Liaoning Province as an example to make a detailed diagnosis and provide a solution.

1 INTRODUCTION

Most wastewater treatment plants suffer from effluentNH4+-N The problem of excess TN in the effluent, especially in winter, TN，NH4+-N exceeds the standard is more frequent, and if the process is not adjusted in time, the light effluent NH4+-N If the process is not adjusted in time, the effluent will exceed the standard of TN and other indicators, and the biochemical system will "collapse". As the wastewater treatment process using biochemical treatment process, the treatment effect is affected by a number of factors, including influent factors, organic load, process section operation and many other elements, and in the treatment process by its impact and complexity and uncertainty. Most wastewater treatment plants in the management of the lack of high-level professional and technical personnel, wastewater treatment plant technicians rely on years of work experience to operate, the lack of scientific and quantitative basis, in the current context of intelligent water (Ma, 2018) In the current context of smart water, the establishment of a system with alarm, diagnosis and other functions to assist professionals in the efficient management of wastewater treatment plants is necessary, when faced with the deterioration of the effluent quality, the system can be independent according to the impact factors to investigate, through the adjustment of process parameters to better maintain the efficient operation of wastewater treatment plants. The so-called expert system is a class of intelligent computer programs with expertise and experience in a certain field. The purpose of this paper is to combine mature theoretical research and engineering experience methods in the field of wastewater treatment with wastewater treatment process control theories, technologies and methods to achieve intelligent control of the system by simulating human "brain thinking" in an unpredictable environment. The system has the advantages of The advantages of the system are: the system can simulate the human brain to a certain extent, so that it has the ability to self-decision; it can monitor the whole process of wastewater treatment process, so as to achieve the best control under certain performance indicators, and can provide operational guidance (Chen, 2016). To a certain extent, it can reduce the influence of the influent factors and environmental f actors that cause the exceedance of the effluent index; it can also diagnose and analyze the influencing factors that trigger the effluent index, and quickly issue corresponding instructions to the process section according to the corresponding influencing factor strategy until the effluent quality no longer deteriorates and meets the standard. AAO process as the traditional activated sludge method of

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denitrification and phosphorus removal process to COD removal, denitrification, phosphorus removal three integrated functions of sewage treatment process, and is not easy to trigger sludge expansion, production and management difficulties; especially suitable for large and medium-sized urban sewage treatment projects, C, N, P elements are removed in the biochemical pond, the disadvantage is that the process is subject to the biochemical system within the system of substrate competition and sludge age contradiction and other issues It is difficult to further improve the efficiency of nitrogen removal, and the TN effluent often exceeds the standard in the actual operation process.

2 ANALYSIS OF THE CAUSES OF EXCESS TN IN AAO PROCESS

Most wastewater treatment plants facing exceedance of effluent TN can be divided into two situations: one is caused by effluentNH4+-N TN exceedance caused by the exceedance of the effluent standard, and one is the TN exceedance caused by the exceedance of the effluentNO3 -N exceeds the standard caused by the TN effluent exceeds the standard. The common reasons for exceedance of effluent standard in wastewater treatment plants are: (1) exceedance of effluent standard due to the impact of subsequent treatment effect caused by influent factors, and (2) exceedance of effluent quality caused by abnormalities in the wastewater process section. For the AAO process, there are many factors affecting the denitrification efficiency, for example, the abnormalities caused by the influent include water quantity and quality. The abnormalities caused by the process section include DO, pH, sludge concentration MLSS, sludge age SRT, etc. The above factors can be divided into direct factors and indirect factors. Direct factors are the data obtained directly through sensors, such as water quantity, DO, pH, MLSS, etc.; indirect factors are the indicators obtained by transferring the data obtained from the functional sensors of the building to the central control room and calculating them with the computer, such as sludge load F/M, sludge age SRT, etc. The following is a detailed summary of the influencing factors that cause TN exceedance.

2.1 Sludge Load (F/M)

In the activated sludge AAO process, theNH4 + -N removal rate was negatively correlated with F/M, and low F/M facilitated the system toNH4 + -N removal and higher nitrogen removal efficiency. Some studies have demonstrated that (WU, 2017), nitrogen removal is best when the sludge load F/M is between 0.14 and 0.22gBOD5-gMLSS-1-d.-1The reasons for this are: nitrifying bacteria, as strictly autotrophic bacteria with good oxidative energy, require few sources of energy in oxidizing elemental nitrogen, oxidize elemental nitrogen more slowly, and the long retention time of effluent in low F/M operation is conducive toNH4+-N andNO2--N are fully oxidized (WU, 2017).

2.2 Hydraulic Retention Time (HRT)

During the nitrification reaction, the oxidation of nitrogen elements is slow and requires a long residence time for full oxidationNH4+-N andNO2--N. Relevant experiments have proved that as the hydraulic residence time increases, theNH4+-N The removal effect becomes better and better (Chen, 2017). If the HRT is too short, the nitrifying bacteria in the aeration tank will be lost with the water flow when they do not fully grow upto play a role, and the nitrification reaction will not be sufficient and the denitrification efficiency will not be high.

2.3 Mixture Reflux Ratio (R)

It has been shown that the mixed liquor reflux ratio hasNH4 + -N The effect on the removal rate of TN is not obvious, but the effect on the removal rate of TN is large. If the ratio is too large, it will cause the mixture containing some DO to flow back to the anoxic tank and the denitrification will be inhibited. The mixture reflux ratio is too small, which will lead to the anoxic tank in $NO3 -$ insufficient, and the denitrification is not complete, thus resulting in poor TN removal (Lv, 2016). This results in poorTN removal.

2.4 Dissolved Oxygen (DO)

It has been shown that the DO gradually increases at the first and end of the aerobic tank, and the nitrification rate is accelerated, and the effluentNH4 + -N decreases. The effect of denitrification is not affected due to the internal reflux effect and to ensure that the DO of the anoxic tank is <0.5 mg/L. In addition, maintaining a certain level of dissolved oxygen is beneficial to sludge settling, avoiding the growth of filamentous bacteria due to low DO, which leads to sludge expansion and thus affects the sludge settling performance(Chang, 2016). In addition, maintaining a certain amount of dissolved oxygen is beneficial to sludge settling, avoiding the growth of filamentous bacteria due to low DO, which can lead to sludge expansion and thus affect the sludge settling performance.

2.5 Carbon Source (C/N)

Carbon source is one of the important factors affecting denitrification. In the process of denitrification reaction, denitrifying bacteria need to consume organic matter in wastewater as electron donor for denitrification reaction, so it needs to meet the denitrification system C/N morethan 4. If the above requirements are not met, carbon source needs to be added to the wastewater to ensure that denitrification is carried out smoothly.

2.6 Sludge Age (SRT)

Sludge age reflects the growth state, growth conditions and generation time of activated sludge in the biochemical tank. Studies have shown that for AAO process, the age of nitrifying bacteria sludge should not be <15d. The reason for longer nitrifying bacteria sludge age is that nitrifying bacteria reproduce slowly and have long generation time, if a longer sludge age of nitrifying bacteria is not guaranteed, nitrifying bacteria cannot function and denitrification is not effective.

2.7 Temperature

In northern wastewater treatment plants, exceedances of effluent TN standards tend to occur frequently in winter. Low temperature is an important factor to limit the growth of microorganisms. The suitable growth temperature range of nitrifying bacteria is 20~40℃, and the suitable growth temperature range of denitrifying bacteria is 20~40℃. When the temperature is lower than 15℃, the efficiency of biological denitrification will be significantly reduced, and the growth rate of nitrifying bacteria will be reduced by 10% for every 1℃ (Xu, 2017).

2.8 pH and Alkalinity

The suitable pH for microbial growth is 6.5~8.5, and the pH of incoming wastewater from most wastewater plants is generally alkaline. Nitrification in aerobic tank will lower the pH and alkalinity of the system. If the nitrification system in aerobic tank drops to pH <7.0, the nitrification process will be hindered and alkalinity must be replenished to maintain the pH stability of the treatment process.

3 THE ESTABLISHMENT OF EXPERT SYSTEM FOR THE CONTROL OF TOTAL NITROGEN EXCEEDANCE

With the development of big data, artificial intelligence and the gradual improvement of intelligent control technology, the field of wastewater treatment already has the conditions and ability to realize expert system control. The system is supported by mature scientific theories, through monitoring, collecting and storing process data, sieving and analyzing each factor on the basis of known theories and in line with logical thinking, diagnosing process abnormalities, adjusting the process in time, and containing the risk of effluent exceedance in the early stage of budding, while also improving the quality and efficiency of wastewater treatment. The following will be the introduction of the TN exceedance expert system combined with the causes of TN exceedance andthe characteristics of AAO process.

In this paper, the diagnostic process idea is as follows. In order to establish the logical relationship between the abnormal condition of effluent TN and the cause (or influence factor) of the failure, intermediate nodes need to be introduced, which include influent water quality parameters, process section operating parameters, and design standard values (design standard range). The influent water quality parameters reflect whether the effluent exceeds the standard because the influent concentration is too large leading to an increase in system load: the process section operation parameters reflect the operation status of the wastewater treatment plant, such as whether the effluent is not completely nitrification of the aerobic pond because the DO is too low,resulting inNH4+-N exceeds the standard; the design standard value reflects the design specifications and standards of the indicators during the construction of the wastewater treatment plant. For this reason, firstly, according to the information obtained from the inlet,outlet and process section operating conditions along the actual measurement data, determine whether the effluent water quality concentration is greater than the design effluent standard, and if it is greater than that, determine the effluent TN exceeds the standard, then it is necessary to check the corresponding triggering factors according to the TN effluent exceeds the standard, check the process parameters affecting the effluent TN in the process section and conduct diagnostic analysis, and finally propose a fault diagnosis in line with the logic of wastewater treatment thinking The system combines the principle of microbial denitrification with the principle of microbial nitrogen removal. The system combines the principle of microbial denitrification and a large amount of practical engineering experience to classify the problem of excess TN in the effluent of a wastewater plant into two different types of problems: denitrification system failure and nitrification system failure.

3.1 Abnormal Denitrification System of the Aeration Tank

Abnormal data: effluent TN> 15mg/L, effluentNO3--N > 10mg/L, theNH4+-N < 5mg/L. If the effluent TN> 15mg/L, you should pay attention to the aerobic tank effluent.NO3--N If it is > 10mg/L, it means the effluent is caused by poor denitrification.NO3--N exceeds the standard, also can be observed by observing the end of the anoxic tankNO3--N concentration value is higher than that at the end of the aerobic tankNO3--N concentration value; the first section of the anoxic tankNO3--N concentration is close to the end of the anoxic tankNO3--N The concentration valueof the first section of the anoxic tank is close to the concentration value of the end of the anoxic tank.

The diagnosis process is as follows: The first stage is mainly for the sudden water intake factors to be investigated, using intelligent meters at the water intake for pH, CODNH4+-N TN, toxic substances and other incoming water indicators for 24 hours monitoring, if found that the incoming water monitoring of a certain indicator or a number of indicators appear abnormal, or the incoming water has an obvious irritatingsmell, color appears abnormal color, such as green, yellow and other phenomena are required to alarm in a timely manner, but also with the help of microscopic technology to determine the type, abundance and number of microorganisms to check the impact of incoming water factors. At this time the system issued a signal feedback to the lifting pump, should be taken to reduce the inlet water operation strategy, and the high concentration of wastewater into the accident pool or regulating pool, through all possible measures, in appropriate circumstances in a timely manner to reduce the impact of the system on the hydraulic impact load, such as increasing the denitrification pool required carbon source and chemical phosphorus removal drug dosing, increase the amount of dewatering of sludge dosing, extend the treatment equipment For example, when the plant's influent waterNH4+-N concentration is 1.5 times of the design value, it will increase the influentNH4+-N For example, when the plant's influent concentration is 1.5 times the design value, it will increase the influent load.NH4+-N concentration to reduce theNH4+-N load. As far as possible to eliminate the influent factors caused by the impact on the effluent water quality decline. At the same time need to cooperate with the environmental protection department team pollution sources to investigate, from the source to solve the sewage treatment plant sewage exceeds the standard problem.

If there is no abnormality at the end of the first phase, the second phase will becarried out, mainly for DO, temperature, pH, C/N, to check. The system first identifies the DO value or oxidation reduction potential (ORP) of the anoxic tank, and needs to check whether the DO of the anoxic tank is 0.2~0.5 mg/L, or whether the ORP of the anoxic tank is in the range of -50mV~50mV. If the DO value of the anoxic tank is > 0.5 mg/L, and the DO content at the end of the aerobic tank is > 3 mg/L, it is determined that the anoxic tank is caused by Aerobic pool end aeration caused by excessive, then the mixture reflux liquid will carry part of the DO back to the anoxic pool, destroy the front anoxic section denitrification reaction, so set the aerobic pool end DO critical value, this critical value just will not make the anoxic pool DO higher than 0.5mg / L, the system will be temporarily defined as 2 ~ 3mg / L aerobic pool DO (critical value). If the end of the aerobic pool DO> critical value, it means that the aerobic pool is over-aerated or the internal reflux is too large to cause the anoxic pool denitrification is not good, the system to obtain DO value feedback to the aeration system, at this time, the aeration system to adjust the aeration of the blower, the internal reflux is too large need to recalculate the internal reflux ratio, and feedback tocontrol the internal reflux pump system for flow adjustment. If there is no abnormality in DO of anoxic pool, further judge whether pH of anoxic pool is abnormal, according to the mechanism of denitrification reaction, denitrification produces alkalinity, which will increase pH of anoxic pool, generally speaking, no measures are needed to increase pH of anoxic pool, it is enough to ensure pH 7.0~8.5 of aerobic pool nitrification system. If the pH of the anoxic tank is abnormally high and the pH cannot be controlled to about 7.3 for a long time, then you can consider to add some acid to the anoxic tank, you can add a large amount at once, and add it several times in a day to control the pH of the wastewater at about 7.3 for about one to two hours, which can also restore the system as soon as possible. If the pH of the anoxic tank is not abnormal, then further judge whether the water temperature is lower than the design value, if yes, it means that the denitrification is not good due to the low water temperature, so we should increase the SRT or increase the sludge return flow to reduce the influence of low temperature on denitrification, or add steam heating device to keepthe water temperature constant. If the water temperature is not abnormal, then the system needs to determine whether the C/N value of the system is less than the design value (C/N4 to meet the denitrification requirements (Chen, 2019; Yang. 2019). The actual operation of the wastewater treatment plant generally C/N>4 to meet the nitrogen removal requirements. If C/N, it means that the denitrification caused by low C/N is not good, and the control system needs to choose a suitable feeding position to add external high-quality carbon source in order to improve the denitrification capacity of the system and other comprehensive measures to control and restore the system in a normal state.

3.2 The Nitrification System of the Aeration Tank Is Abnormal

Abnormal data: effluent TN> 15mg/L, effluentNH^{4+}-N > 5mg/L, effluentNO^{3-}-N < 10mg/L. If the effluent TN> 15mg/L, then pay attention to the aerobic tank effluentNH^{4+}-N is > 5 mg/L.

If yes, it means that the poor nitrification causes the effluentNH^{4+}-N exceeds the standard. When the index exceeds the standard, the system will immediately send an alarm to the central control room.

The diagnostic process is as follows: the first stage is basically the same as the first stage of the denitrification system of the aeration tank.

If there is no abnormality at the end of the first phase, the second phase will be carried out, mainly for DO, temperature, pH, C/N, mud age SRT and sludge load F/M. The system first judge the DO value of aerobic pool, through the DO analyzer online data

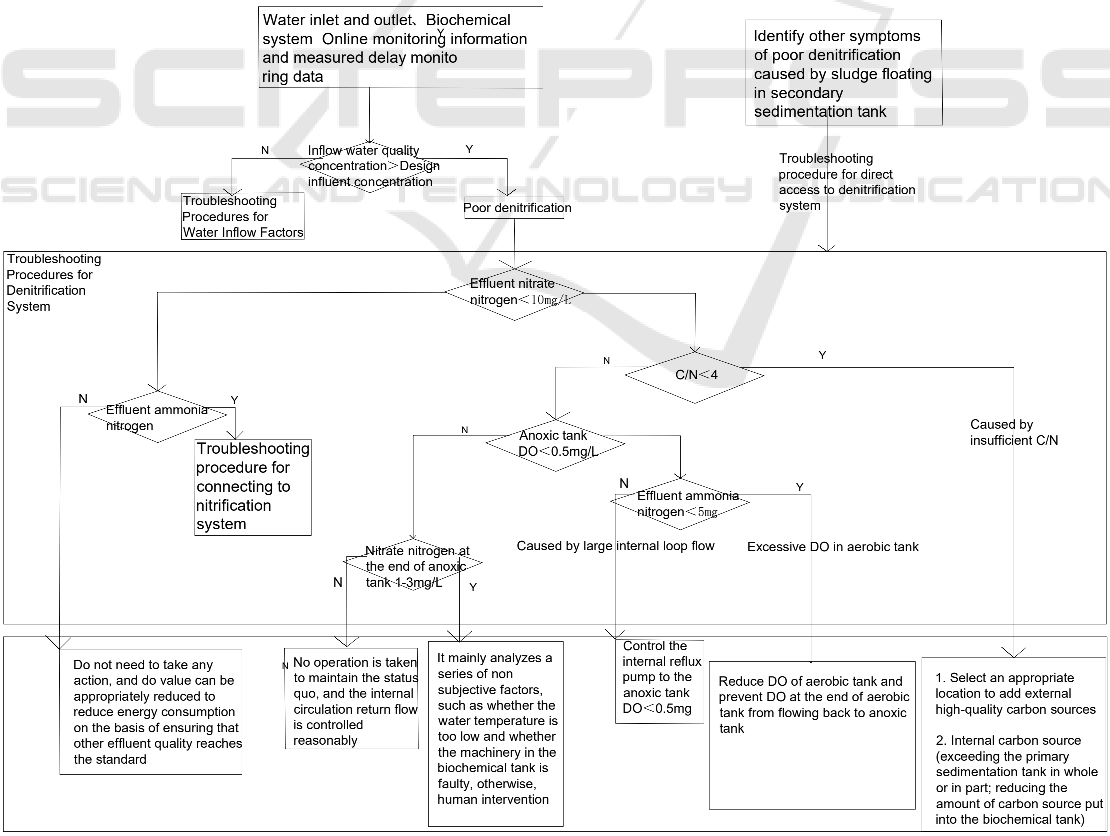

Figure 1: Flow Chart for Abnormal Diagnosis of Denitrification System.

obtained DO value todetermine whether the aerobic pool DO between 2 ~ 3 mg/L, a large number of experimental results prove that when the aerobic pool DO value of at least ≥ 2 mg/L to meet the aerobic pool in the nitrifyingbacteria growth conditions (Zhang, 2015). If the DO of aerobic pool is <2 mg/L, it means that the aeration of aerobic pool is too low caused byNH^{4+}-N exceeds the standard, at this time the system feeds back the monitoring data to the aeration system and initiates the instruction to adjust the aeration of the blower to increase the DO at the end of the aerobic tank. If the DO is normal, indicates that the effluentNH^{4+}-N is not caused by DO abnormality, need to further check whether the alkalinity of the effluent from the secondary sedimentation tank is <20 mg/L, if so, need to check whether the pH of the influent water is less than the design value, if so, it is determined that the wastewater plant is subject to pH shock, at this time, take lime neutralization for treatment. If the influent pH is not abnormal, the aerobic tank pH curve needs to be observed. According to the mechanism of nitrification process, oxidation of 1 mg ofNH^{4+}-N needs to consume 7.14 mg of alkalinity (Zhang, 2012), if there is a continuous

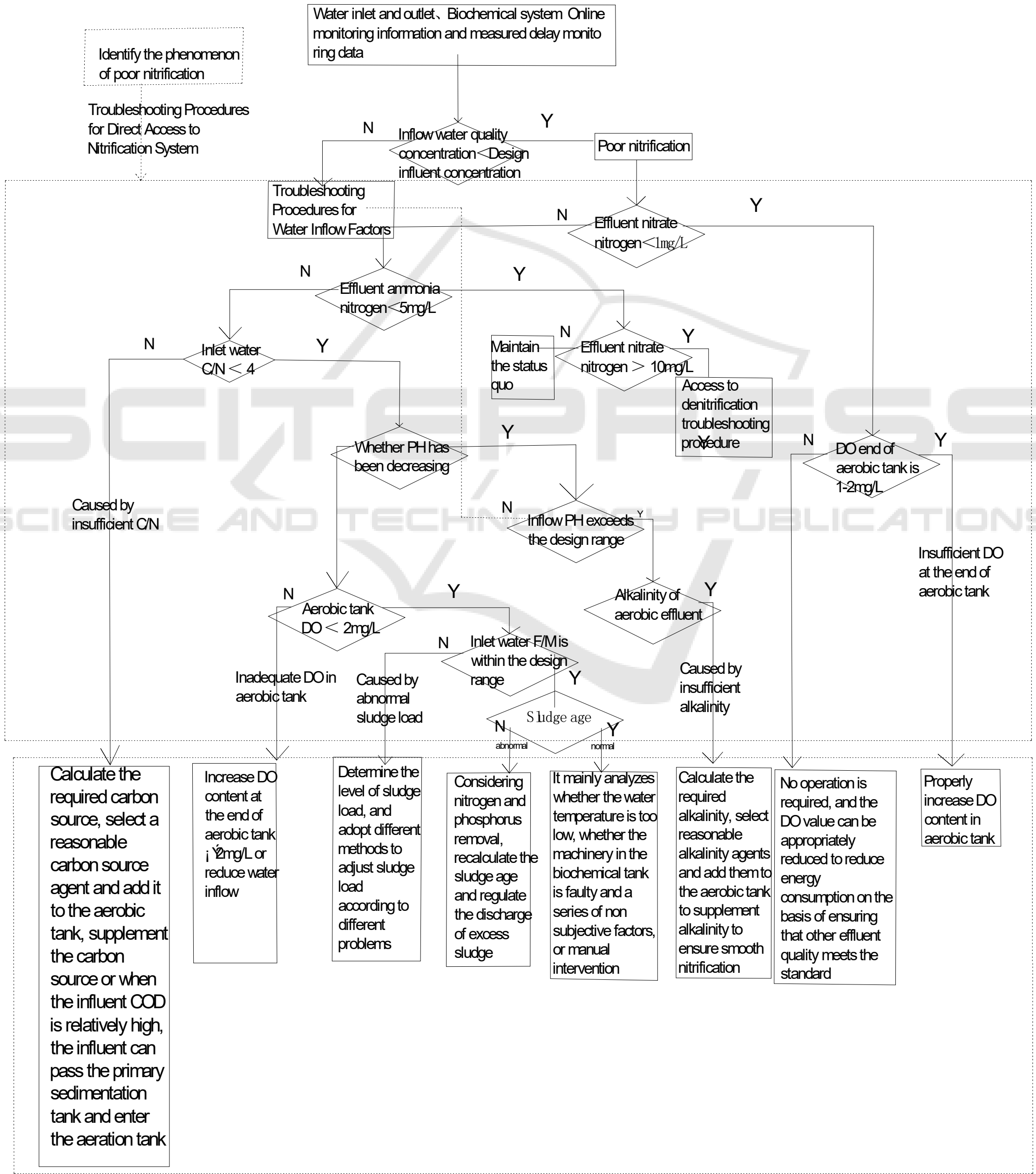

Figure 2: Abnormal Diagnosis Flow Chart of Nitrification System.

decrease of pH curve, it can be judged that the system is caused by insufficient alkalinity, and alkalinity accounting should be carried out to determine the amount of chemical dosing. If the pH is in the normal range, then determine whether the water temperature caused by the water dischargeNH^{4+}-N When the water temperature is lower than 15℃, the temperature becomes an important reason to limit the nitrification rate of nitrifying bacteria. At this time, the nitrification efficiency can be improved by increasing the sludge reflux ratio, appropriately increasing the aerationand extending the SRT, or installing additional steam heating devices to keep the water temperature constant. In addition, the influent waterNH^{4+}-N concentration is too high resulting inNH^{4+}-N The removal rate is severely reduced (YANG, 2017). The system needs to identify the frontend influentNH^{4+}-N analyzer monitoring data whether it exceeds 1.5 times of the design flow value, if yes, it means the system is subject toNH^{4+}-N shock caused the discharge waterNH^{4+}-N exceeds the standard, at this time, see the first stage of the diagnostic process. If the inlet waterNH^{4+}-N concentration is less thanor equal to the design water volume, indicating that the system waterNH^{4+}-N exceeds the standard is not caused byNH^{4+}-N If there is no abnormality above, the system needs to determine the C/N, mud age SRT, sludge load F/M of the system through online and offline data, and check the C/N to determine whether the inflow of sewage C/N is too large, so that the proportion of nitrifying bacteria in microorganisms is reduced. In this case, we can increase the residence time of primary sedimentation tank to reduce the C/N value; check whether the mud age of nitrifying bacteria is ≥ 15 d, and need to extend the SRT; check whether the sludge load is within the design range. For the sludge load F/M and sludge age SRT, as the above F/M and SRT influencing factors are introduced, additional carbon source, change the water intake method to multi-point water intake method, beyond the primary sedimentation tank directly into the biochemical tank and other measures can be taken to change the F/M and SRT (Liu, 2016). As described above, the F/M and SRT can be changed by adding a carbon source, changing the influent to a multipoint influent, and going beyond the primary settling tank directly into the biochemical tank.cIf each of the above impact factors is within the normal range, it is indicated by amalfunction of the equipment, it is possible that the treatment structure has a short flow phenomenon, the system triggers an alarm and requires manual intervention to overhaul the faulty equipment.

4 CASE APPLICATION ANALYSIS

The treatment scale of a city wastewater treatment plant in Liaoning Province is 10×104 m3 /d, and the treatment process uses AAO process + amplitude flow secondary sedimentation tank + contact disinfection tank. This wastewater plant has been found since December 2019~January 2020 that the effluent TN, NH4+-N often exceeded the Class I A standard of the Discharge Standard for Pollutants from Urban Wastewater Treatment Plants (GB18918-2002). Taking this plant as an example, the effluent TN, the NH4+-N exceeded the standard problem for troubleshooting analysis, diagnosis, and regulation. This paper introduces the system to guide the plant for the effluent TN, theNH4+-N The problem of excess effluent is carried out, and the specific guidance process is as follows.

The monitoring platform monitors the water TN, theNH4+-N exceeds the standard, the platform immediately issues an alarm and reports to the person in charge. The system determines that the TN exceedance isNH4+-N exceeds the standard, and solving theNH4+-N exceeds the standard is to solve the problem of exceeding the TN， NH4+-N The exceedance is often due to abnormalities in the nitrification system.

The diagnostic process is as follows: in the first stage, the intake factors were first checked and the monitoring data for two months, December 2019 and January 2020, were retrieved. The data are shown in Table 1.

Table 1: Actual Incoming and Outgoing Water Quality in December and January 2019.

Water quality parameters	COD (mg/L)	NH_4^+-N (mg/L)	TN (mg/L)	TP (mg/L)	SS (mg/L)	pH (mg/L)	Temperature (℃)
Water inlet range	150~310	31~48	38~53	2.5~5.2	105~155	6.3~8.9	12~15
Effluent range	31~63	13~28	21~36	0.2~0.6	8~23	6.7~9.1	-
Effluent standard value	< 50	< 5 （8）	< 15	< 0.5	< 10	-	-

The conclusions of the influent factors are as follows: the influent COD fluctuates less, the effluent is more stable, and occasionally does not meet the standard; the influent TN, theNH4+-N fluctuations are small, but the effluent does not meet the standard; influent TP, SS fluctuations, the effluent is more stable and basically meets the discharge standard.

The results of microscopic examination were as follows: the mixture contained caseworms of the genus Caspius, Trachomorpha, bell worms, cover ciliates, etiolated ciliates, etc. The protozoa were slightly reduced compared to normal.

The first stage of investigation concluded that the influent water was not abnormal,and the influent water quality was within the design range and not affected by the influent shock load. The results of the microscopic examination indicate that the activated sludge is in a state of too low load. For the problem of too low load, additional carbon source can be adopted, adjusting the influent mode to multi-point influent mode and improving the sludge load of the biochemical tank beyond the primary sedimentation tank directly into the biochemical tank. In the second stage, first of all, DO, through DO analyzer to monitor the anoxic pool first and last two ends DO is 0.24 mg/L ~ 0.35 mg/L, aerobic pool DO first and last DO is 1.7 ~ 3.6 mg/L, then it means that DO is not the cause ofNH4+-N The system was measured, and the water temperature was basically around 13℃, so it was suspected that the low water temperature caused the exceedance. In the case of determining that the pH of the inlet water is notcaused byNH4+-N The pH value at the end of the aerobic tank is 6.9, and the alkalinity of the water from the secondary sedimentation tank is 35 mg/L. Therefore, the pH value is also not a factor causing theNH4+-N Therefore, the pH value is not a factor for exceeding the standard. The design sludge load value of the wastewater treatment plant is 0.09 kgBOD5 /(kgMLSS-d), but the actual detected sludge load is 0.035 kgBOD5 /(kgMLSS-d), which indicates that the sludge load is too low, which is consistent with the diagnosis of the first stage. It is proved that too low sludge load willput nitrifying bacteria at a disadvantage in the competition with heterotrophic bacteria (organic matter degrading bacteria), reducing nitrification rate and denitrification efficiency[3]. Then the MLSS value was investigated and the MLSS value of 4500 mg/L was collected by the sludge concentration meter. After inspection, it was found that the MLSS increased because the sludge discharge volume became smaller due to the sludge pump not being maintained for a long time, and the increased MLSS value also had an effect on the F/M value.

Through the comprehensive analysis of the system; due to the biochemical system F/M is too low and the discharge of sludge is too low, there are also suspicions of low water temperature caused by the effluentNH4+-N exceeded the standard. For the low F/M, it is possible to add carbon source, adjust the water intake to multi-point water intake, and increase the sludge load of the biochemical tank beyond the primary sedimentation tank directly into the biochemical tank; for the sludge discharge, without affecting the actual capacity of the dewatering process of the wastewater plant, increase the sludge discharge as much as possible until the sludge concentration of the aerobic tank is controlled at 3500 mg/L. For the low water temperature, it is possible to increase the external reflux ratio, appropriately increase the aeration, and extend the SRT. It should be noted that the above operation is best to choose only one operation for each adjustment to avoid multifaceted regulation, resulting in confusion, so the following regulation scheme needs to be taken in conjunction

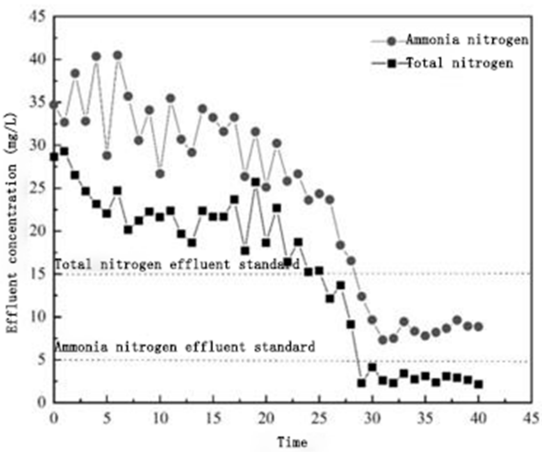

Figure 3: Changes in effluent TN andNH^{4+}-N changes.

with the results of diagnostic analysis, and the following process can be taken to adjust the MLSS: carry out maintenance, recalculate the sludge discharge volume, and resume normal discharge to ensure the sludge concentration MLSS is about 3500 mg/L. F/ M: when the influent COD is large, you can improve F/M by going beyond the primary sedimentation tank directly into the biochemical tank; when the influent COD is low, you need to supplement the carbon source organic matter to improve F/M. Water temperature: you can increase the aeration without affecting the denitrification reaction of the anoxic tank. These three measures in turn, each measure and other effectiveness after the next step. As shown in Figure 3, take the above operation, after a period of time, the end of the secondary sedimentation tank effluent TN, theNH_4^+-N The concentration gradually decreases, and after keeping the state for 8 hours, if the effluent quality does not exceed the standard again, the problem can be considered solved.

5 CONCLUSION

This paper combines the theory of microbial denitrification principle and wastewatertreatment process control theory to make a diagnosis and analysis process for TN exceedance. The system takes the data information collected from the monitoring platformof the wastewater treatment plant as a decision support platform and uses intelligent diagnosis methods and technologies to diagnose and analyze the triggering factors that cause TN exceedance, such as whether the DO, MLSS is too low, F/M is within the design range and a series of other factors. The system can identify the root cause of the problem and analyze it. The system can identify the root cause of the problem and make adjustments to the operation of the process section independently. In case the TN exceeds the standard in the AAO process, the system will issue an early warning prompt at the first time, and then the system will start to identify that the effluent is caused by a certain nitrogen component exceeding the standard, for example, the effluent exceeds the standard and then the TN exceeds the standard.NH_4^+-N Then the system starts to identify the excess of TN caused by a certain nitrogen component in the effluent, such as the excess of TN caused by the excess of effluent, and then conducts a special diagnosis and analysis of the nitrification system to solve the problem of excess TN caused by the inlet water factor or improper operation of the process section. With the introduction of the process control system, the causes of TN exceedance can be analyzed step by step according to the steps set up in the system, and the existing methods and means can be used to tap the advantages of the AAO process to adjust the system, so that the aeration tank can recover itself under the assistance and guidance of the system and ensure the stable discharge of effluent to meet the standard.

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