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Study on Treatment of Campus Domestic Wastewater for Landscape Water Treatment by Hydrolytic Acidification - Biological Contact Oxidation Process

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In this paper, the issue of supplementing water source for landscape water is discussed. The quality of domestic sewage after treatment by hydrolytic acidification-biological contact oxidation method is analysed from the three aspects of effluent ammonia concentration, BOD concentration and turbidity in a certain period of time. It is proved that it is feasible the campus sewage as a water feature to supplement water. This will provide the reasonable suggestion for the domestic sewage as the supplementary water source for landscape water.

1. Introduction

Building a resource - saving society is the trend of development of the times, the development of universities must also follow this principle, focus on saving - oriented construction, and conservation - oriented landscape construction is one of the important part (Li, 2016; Sun, 2015). Water features include rivers, lakes, fountains and other forms in the university, but no matter what form of water features there is a common problem - to add water, here we take the river landscape as an example to discuss the facility of using campus sewage as the replenish water source of landscape water (Toor and LuskReclaimed, 2015). Due to poor mobility and a series of reasons, river landscape water only through constant replenishment, changing the water to maintain its water quality (Cabrera, 2013). At present, the vast majority of areas are using pipe network tap water as a supplementary source of landscape water, but this is a great waste of clean water resources (Toor and Lusk, 2014). Therefore, it is considered that the domestic sewage in the campus can be treated as the supplementary water source of the landscape water body by using the hydrolytic acidification-biological contact oxidation method, thus saving the water resources and reducing the running cost of the university (Cheng, 2010; Pan Qi et al, 2010).

2. Characteristics of campus sewage water quality

With the expansion of the scale of the university and the gradual improvement of functions, set of learning, living, living, leisure and other functions in one the general, and personnel in colleges and universities are more intensive, daily water consumption is larger, resulting in relatively stable water quality and water quality, including food and sewage, bathing water, toilet waste water. It is in good biodegradability and pollutants are mainly organic matter, easy to handle and the processing cost is relatively low, so it is a very good landscape water supplement source (Wu et al, 2016; Yang, 2012). Campus sewage generally has the following characteristics:

(1) Water, water quality and stability of pollutants, mainly organic matter.
(2) Biodegradable, and up to two emission standards.
(3) Large amount of sewage discharge, to meet the characteristics of landscape water consumption, easy to achieve water balance.
(4) Sewage treatment can be carried out in the school, the implementation of convenient and quick, as landscape water reuse water, has a high guarantee rate.

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3. Characteristics of landscape water and related standards for reuse

Landscape water requirements on the sensory index are high, such as colour, odour and so on. The change of colour and odour of landscape water is mainly due to the eutrophication of water body and microbes and algae breeding. After the eutrophication, the first will have a stench smell, the wind spread everywhere, seriously affecting people's normal life; Secondly, in eutrophic water, with cyanobacteria, green algae as the dominant species of large algae floating in the landscape water body surface, the formation of a layer of "green scum", so that the water becomes more turbid, sensory water greatly reduced; at the same time, due to the large number of algae multiply, water transparency greatly reduced, dissolved oxygen in water consumption into an anoxic environment, a large number of other aerobic organisms in water death, accelerated the deterioration of water quality process (Giulio and Onorio, 2015; Giulio et al., 2016; Suvanjan et al., 2016; Xia et al., 2016; Gurpal Toor et al, 2011; Rahmanm et al, 2014).
For the landscape water to add water quality in accordance with relevant provisions of China should meet the following requirements:

Table 1: Water quality standard for reuse of reclaimed water for landscape water use

Specification and standard names		Main Water Quality Index (mg / L)			Scope of application	Issuing department
		BOD	Ammonia Nitrogen (N)	Turbidity		
Standard for water quality of reclaimed water used for landscape water bodies CJ / T 95-2000	1	10	5	-	1, the body of non-systemic contact with the entertainment landscape water body; 2, the body of non-direct contact with the ornamental landscape water	Urban construction industry standards, the Ministry of Construction
	2	20	5	-		

4. Feasibility analysis of hydrolysing acidification-biological contact oxidation in treating campus wastewater for landscape water reuse

According to the characteristics of the sewage water quality of the campus, it is proposed to use the system of hydrolytic acidification - biological contact oxidation to process it. The system has a series of features such as simple process flow, stable operation, strong anti-shock load capability and easy management (Shan and Che, 2011; Sun et al, 2015).
The influent concentration of influent BOD was 111 ~ 290mg / L, the influent ammonia concentration was 27.1-53mg / L, and the influent turbidity was 19.2-119mg / L.

4.1 Analysis of BOD removal efficiency

When T = 26 ~ 32 °C, HRT = 6h, the DO value in the 2 ~ 3mg / L (the best working conditions), the influent BOD concentration and removal rate changes shown in Figure 1.

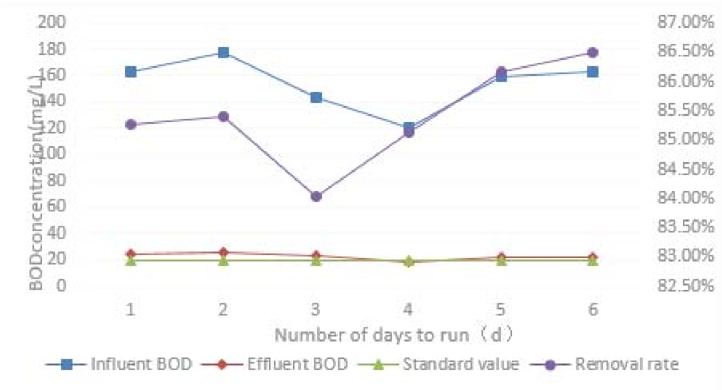

Figure 1: Influent and effluent BOD concentration and removal rate change

From the hydrolysis and acidification - biological contact oxidation process run for 30 days of the BOD concentration of water monitoring results can be obtained from the figure3-1, the effluent concentration was 18 ~ 26mg / L, the average concentration was 22.5mg / L, and the effluent concentration was relatively stable under the optimal operating conditions. The removal rate of BOD was 84.02% ~ 86.50%, the average removal rate was 85.41%, the treatment effect was good. The removal rate of BOD in the initial 5 ~ 15 days of the system operation is lower than that of 20 ~ 30 days, Consider the result of this result is: the initial operation of the system is in an unstable state, the temperature does not reach the specified experimental temperature, microbial growth time and lack of activity, but the removal of BOD mainly depends on the reproduction and metabolism of microorganisms under aerobic condition. Therefore, the quantity and activity of microorganisms directly affect the removal efficiency of BOD. With the increase of operation days, the temperature of the system gradually stabilized, and the activity of microorganisms increased with the increase of temperature, so the removal rate of BOD increased. During the 5 ~ 30 days of operation, the effluent BOD concentration fluctuates 20mg / L in the BOD concentration standard stipulated in the Water Quality Standard for Landscape Environment, further considering the deep treatment of the system effluent and further reducing the concentration of BOD in the water to make it completely compliant.

4.2 Analysis of ammonia nitrogen removal

When T = 26 ~ 32 °C, HRT = 6h, and the DO value is 2 ~ 3mg / L, the concentration and removal rate of NH3-N in the effluent are shown in Fig. 2.

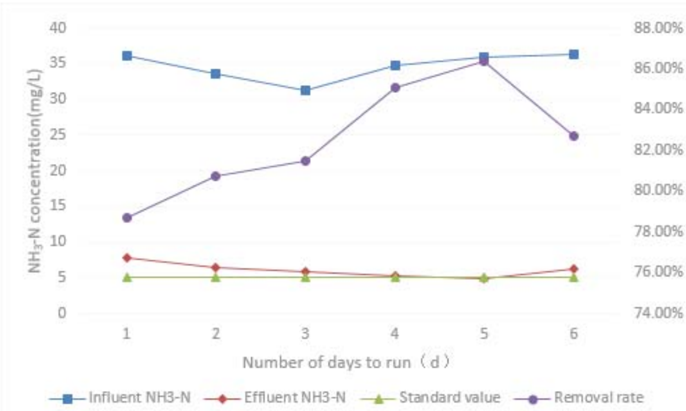

Figure 2: Influent and effluent NH3-N concentration and removal rate change

The results of the monitoring of NH3-N concentration in the effluent from the hydration-acidification-biological contact oxidation process for 30 days are shown in Figure 2, the effluent concentration was 4.9 ~ 7.7mg / L, the average concentration was 6.07mg / L, and the effluent concentration was stable, under the optimal operating conditions. The removal rate of ammonia nitrogen was about 82.5% and the highest was 86.35%. At the beginning of the operation, the removal rate of ammonia nitrogen was at a low level, and the removal rate increased gradually with the increase of operation days. The reason of this phenomenon is that the removal of ammonia nitrogen mainly depends on the nitrification of nitrifying bacteria, and the nitrification reaction takes a long time. In the early stage of the system operation, the growth time of nitrifying bacteria was not enough, and the nitrification reaction was not enough, which led to the low removal rate of ammonia nitrogen. During the 5 ~ 30 days of operation, the average concentration of NH3-N effluent was slightly higher than the standard value of NH3-N in the standard of "water quality standard for landscape environment" 5mg / L, further considering the deep treatment of system effluent and further reducing the concentration of NH3- to make it fully up to the standard.

4.3 Analysis of turbidity removal efficiency

When T = 26 ~ 32 °C, HRT = 6h, the DO value in the 2 ~ 3mg / L (the best working condition), the turbidity in the water concentration and removal rate changes shown in Figure 3

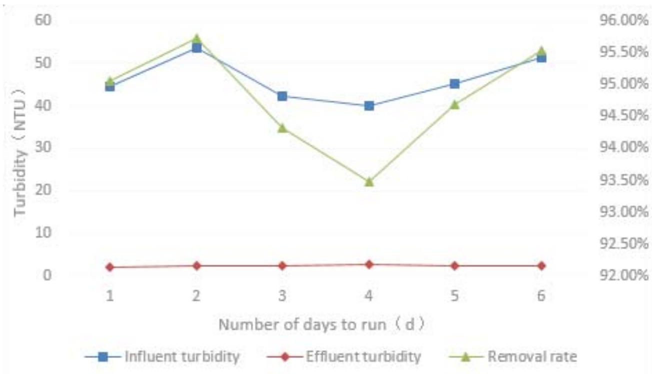

Figure 3: Influent and effluent turbidity concentration and removal rate change

The results of the turbidity monitoring of the influent and effluent from the process of hydrolysis and acidification-biological contact oxidation for 30 days are shown in Figure 3. Under the optimal operating conditions, the turbidity removal efficiency of the system is very obvious, the turbidity of the effluent is very stable, which is kept below 2.5NTU, the average concentration is 2.37NTU.The average removal rate of turbidity is 94.80%, the highest can reach 95.72%.On the 20th day of operation, the removal rate of turbidity was at the lowest point. The reason of this situation was that the influent suspended matter content was high, and the packing inside the pool was blocked, so the area of biofilm was greatly reduced. This problem can then be solved by backwashing the packing. Taking into account the "landscape environmental water quality standards" for the turbidity is not particularly specified, after this process after treatment of the water turbidity is also at a relatively low level, it can be considered that the effluent back to the landscape water is feasible.

4.4 Comparison of effluent water quality and regulatory requirements

When T = 26 ~ 32 °C, HRT = 6h, the DO value in the 2 ~ 3mg / L (the best conditions), the water quality situation shown in Figure 4.

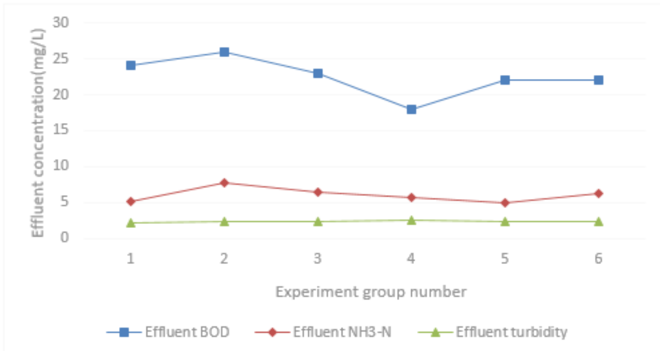

Figure 4: Hydrolysis Acidification - Biological Contact Oxidation Process effluent quality change

Table 2: Comparison of water quality and specification of Hydrolytic Acidification - Biological Contact Oxidation Process

	Experimental results (mg/L)	Specification (mg/L)
BOD	22.50	20
NH_3-N	6.07	5
Turbidity (NTU)	3.62	-

From the hydrolysis and acidification - biological contact oxidation process run for 30 days on the water quality monitoring results from the figure available, the average concentration of BOD in effluent was 22.50mg / L; the average concentration of effluent NH3-N was 6.07mg / L; the effluent turbidity averaged 3.62 NTU. Compared with the standard data, such as the above table, the resemble degree is high. Taking into account the experimental conditions are limited and experimental error and other reasons, the results compared to the existence of a professional sewage treatment station a certain gap, subsequent consideration of effluent advanced treatment, therefore, it can be considered that it is feasible to reuse the campus domestic wastewater treated by the hydrolytic acidification-biological contact oxidation method in the campus landscape channel.

5. Conclusion

(1) When the temperature of the system was controlled at 26 ~ 32 °C, the hydraulic retention time was controlled at 6h, and the dissolved oxygen concentration was controlled at 2 ~ 3mg / L, can guarantee the integrated effluent quality is ideal, which is most closely to ‘landscape water reuse water quality standards’
(2) The maximal activity of the microorganism can be guaranteed when the temperature of the system is controlled at about 30 °C; too much deviation from this range will affect the normal microbial survival and reproduction or even death and thus affect the treatment effect. In some cold areas can be considered to increase the insulation layer or temperature maintenance device to maintain the temperature of the reaction tank.
(3) Hydraulic retention time (HRT) remained at about 6h, cannot exceed too much. Because if residence time is too long, it will make the sludge age increased, thus reduce the treatment effect. And too long residence time from the economic point of view is not cost-effective.
(4) Application of hydrolysis acidification - biological contact oxidation system for the treatment of campus sewage effluent quality is stable enough and generally meets the state for the reclaimed water for ornamental river landscape water quality requirements, Therefore, it can be considered that it is feasible to use the domestic sewage as supplementary water source for the campus landscape.

6. Suggestion

Based on independent hydrolysis and acidification - biological contact oxidation system, there is still a small gap between the effluent quality of wastewater treatment and the "landscape water reuse water quality standards”, so consider the advanced treatment of the water. The current advanced treatment technology is coagulation sedimentation method and activated carbon adsorption, both of them application in a wide range. Through these methods can effectively reduce the water chrome, turbidity, but also can remove phosphorus, nitrogen and other elements which easily lead to eutrophication of commutation water. So, that the water meets the landscape water requirements (Li and Liu, 2011; Liu, 2014).
In this paper, we do not carry out detailed experiments on the advanced treatment, cited the current domestic and foreign mature technology theory, so there are many deficiencies. Only provide some reference suggestions for colleges to use domestic sewage as landscape water to replenish water resources.

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