Study on the Influence of wetland Media on the Purifying the micro-polluted Raw Water

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ABSTRACT: In order to study the role of wetland media on the purifying the micro-polluted water, media -bacteria system is built to study experimentally in Yuqing Lake in Jinan. The removal process of a simulation wetland was studied in the absence of aquatic plants. The results show the average removal rates of COD,TN, NH_4^+-N and TP were 46.67%, 34.86%, 39.83% and 45.12%, respectively. The 16m long system was divided into four equal units along the direction of inflow. The removal of COD, TN, NH_4^+-N and TP mainly occurred in the first unit, with a removal of 21.5%, 13.5%, 19.85 and 16.64% respectively. This efficiency was much greater than those in the subsequent three units. In addition, the accumulation of P was found in media and TP of media would reach a peak. [The Journal of American Science. 2008;4(2):95-100]. (ISSN 1545-1003).

Key words: medium-bacteria system; micro-polluted raw Water; treatment effect

1. Introduction

Most of the water supply comes from Yellow River as the foundation in Jinan city of Shandong province. Due to the fast development of industry and agriculture around drainage area of Yellow River and large sewage, the water quality of Yellow River comes to deterioration. The status of Yellow River as the drinking water quality is not optimistic. The present techniques of water supply factory in Jinan can't remove COD in light polluted raw water and polluted substances such as nitrogen and phosphorous, so we need pretreatment to the raw water.

Because constructed wetland is a kind of water treatment method as a lower cost, lower energy, lower technical-demanding (Winthrop, 2002; Ji, et al., 2002; Scholes L, et al. 1998), so we adopted this method to treat. Nowadays, the research on constructed wetland system always attaches importance on the effects on the biological role during the purifying process, and the non-biological role such as the media that the plants and microorganism live by are neglected (Shen Dongsheng, 1996; Andrew, 2007). In order to explore the influence of wetland medium on purifying the light-polluted water, a media-bacteria system is built in Yuqing Lake in Jinan. At the same time, the research is in process.

2. Materials and Methods

2.1 Description of the media-bacteria system

The measurement of the system is 16m×6m×0.8m , the average depth of water is 0.2 m, The 16 m long system was divided into four equal sampling exit along the direction of inflow with 4 m，8 m，12 m，16 m. The wetland bottoms are plastered by concrete to reduce the seepage of the water losses, with brick built up in layers and mortar plastered. Both Water distribution and discharge adopt triangular weir，in order to distribute the water evenly. And each one set a water gathering pool. The media of the system was local soil in which Reed grow, which is naturalized in, April 2005.

2.2 Running of the system

The system began to run in the middle of June, 2005, with a load of 75 L/h, and the hydraulic retention time of 1.5 days. The raw water comes from effluent Grit Chamber of forepart of Yuqing Lake Reservoir. The system was completed in December.

2.3 Analytical method

Water samples were collected both from the influent and effluent at regular, short intervals (6-8 per month). COD, TN, TP, NH_4^+-N, NO_3^--N and NO_2^--N were measured according to the standard methods. Temperature and pH were measured with electrodes.

3. RESULTS AND DISCUSSION

3.1 Total purification efficiency

Table 1 shows after six month research, the experimental results show that the removal rates of COD and TP in the system were more 45%, that of NH_4^+-N, NO_3^--N and NO_2^--N were nearly 40%, that of TN were nearly 35%, respectively. According to the China standard for surface water resources (GB3838-2002), by purification function of the system, COD in water turns from Grade IV to Grade II, TP from Grade III to II, TN from much higher to Grade V into close to V, and NH_4^+-N from Grade III into II.

Table 1. The characteristic of inflow and outflow and the removal rate of nutrition

Para-meter	Inflow /mg/L			Outflow /mg/L			Removal Rate /%
	Min.	Max.	Mean (Std. Deviation）	Min.	Max.	Mean Std. Deviation）	
COD	10.9000	44.3000	23.8042 （9.5664）	5.5590	18.6060	11.8988 （3.2433）	46.67
TP	0.0047	0.4202	0.1006 （0.1287）	0.0026	0.2185	0.0530 （0.0656）	45.12
TN	1.4664	4.6100	3.2575 （0.8800）	0.8477	3.2047	2.1399 （0.6874）	34.86
NH_4^+-N	0.0370	1.1700	0.5136 （0.2683）	0.0178	0.7956	0.3260 （0.2031）	39.83
NO_3^--N	0.0309	3.9620	2.9934 （0.8118）	0.0151	2.3376	1.8291 （0.5345）	39.36
NO_2^--N	0.0140	0.9800	0.0722 （0.1941）	0.0092	0.7056	0.0476 （0.1405）	39.17

3.2 Purification efficiency in different unit

In order to illuminate Purification effect in different unit, we calculated average Purification efficiency in different unit. In Figure 1、Figure 2、Figure 3 and Figure 4，1，2，3 and 4 of abscissa show four equal units along the direction of inflow. The removal rates of TP in different units were 16.64%, 15.5%, 7.41%and 5.57%, respectively; those of COD in different units were 21.5%, 11.2%, 9.5%and4.47%, respectively. The removal rates of TN in different units were 18.32%, 7.5%, 5.3%and 3.74%, respectively; those of NH_4^+-N in different units were 19.85%, 8.7%, 6.8%and 4.48%, respectively. These show removal of contamination mainly occurred in the first half unit.

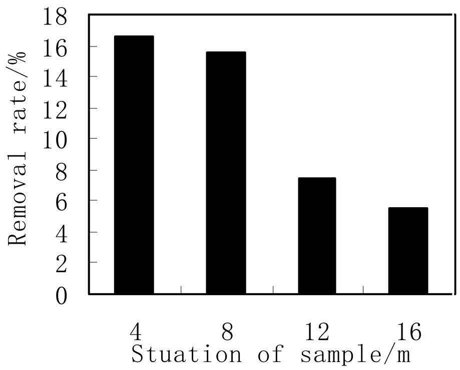

Figure 1. The average Removal rate of TP in different units

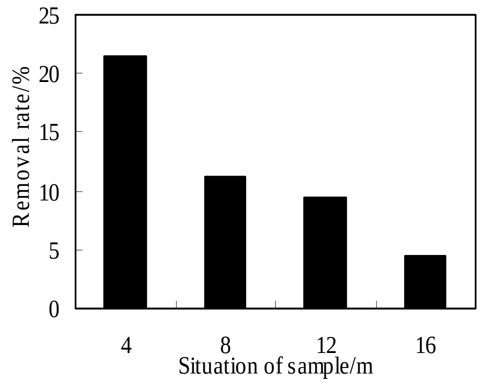

Figure 2. The average Removal rate of COD in different units

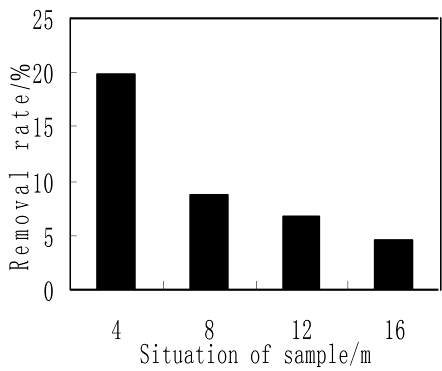

Figure 3. The average Removal rate of NH_4^+-Nin different units

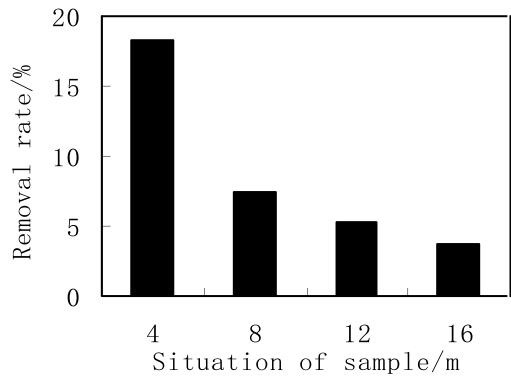

Figure 4. The average Removal rate of TN in different units

3.3 Concentration variety of TN and TP of media of different experimental phase

In experimental phase of early, metaphase and final，TN and TP of media were measured (Corstanje, 2007), respectively. The results are shown in Table 2 and Table 3. Increase of media´s TN is isochronous in different units. There were a lot of nitrobacteria, de-nitrobacteria by identifying, which facilitate removal of N.

From experimental early phase to metaphase, TP of media distinctly increase in the first unit of system. However, TP of media has no obvious increase in the final stage. In the later stage of experiment, concentration of TP distinctly increase in the following second, third, and fourth units of system. This shows there is a saturation of sorption sites in media. TP Concentration of media increase in proper order from early phase to the fourth unit, and the early phase comes to saturation at first.

Table 2. TN concentration of media（%）

Situation of situation	4m	8m	12m	16m
Early phase	0.071	0.072	0.069	0.071
Metaphase	0.121	0.113	0.108	0.095
final phase	0.152	0.135	0.128	0.118

Table 3. TP concentration of media（%）

Situation of situation	4m	8m	12m	16m
Early phase	0.046	0.045	0.048	0.047
Metaphase	0.121	0.87	0.064	0.56
final phase	0.135	0.119	0.093	0.074

3.4 Temperature influence

Any microbe has a proper temperature of growth. In the range of temperature，with growth of temperature，the microbe grow rapidly. Correspondingly, contamination is eliminated rapidly. Not only does temperature influence organic matter Biodegradation by altering microbial metabolism velocity, but also influence solubility of organic matter. Therefore, in actual treatment, Controling microbial proper temperature of growth can better improve restoring function.

Table 5 shows in the whole motion of the system, the temperature of water varies from 0 to 32, and the removal of contamination in water is influenced obviously by the system under the temperature. As the temperature goes down, the removal rate of contamination is eliminated rapidly.

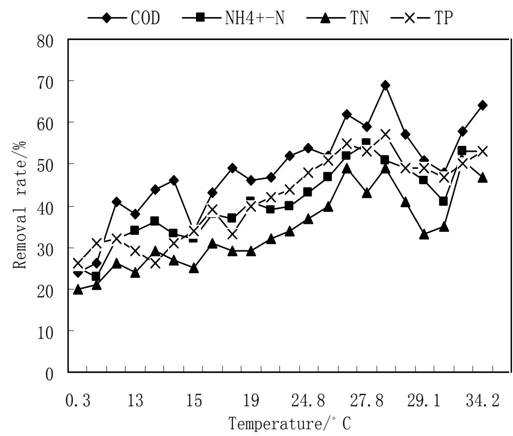

Figure 5. The impact of temperature on pollutant removal efficiency

3.5 Removal relations of contamination Concentration

Figure.6 to Figure.9 show there is a liner relation between the variations of influent and effluent COD、TN、TP and NH_4^+-Nconcentrations. Moreover, TP have a good pertinence. Removal concentration, with the increase of contamination and Concentration of influent have steady increase. On the whole, there is degressive inflexion. This shows current load has no problem on over loading. This also shows potential of taking on more loads in the system.

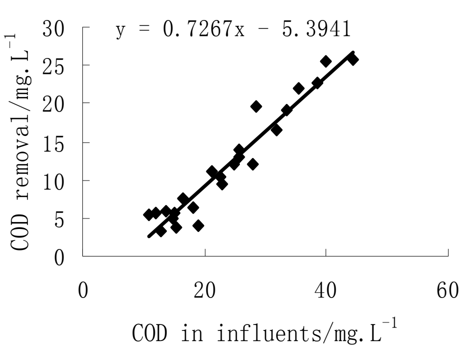

Figure 6. Relationship between COD in influents and COD removal

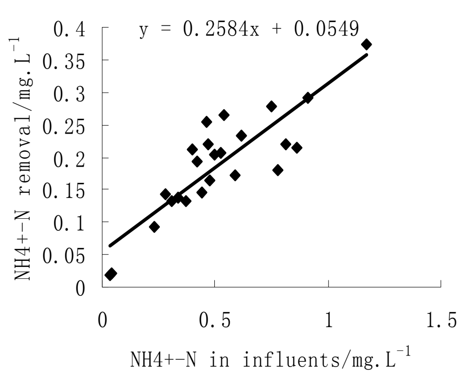

Figure 7. Relationship between NH_4^+-N in Influents and NH_4^+-N removal

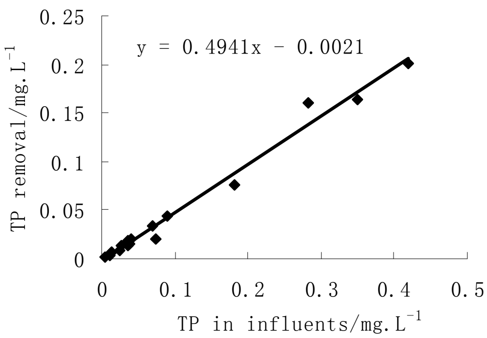

Figure 8. Relationship between TP in influents and TP removal

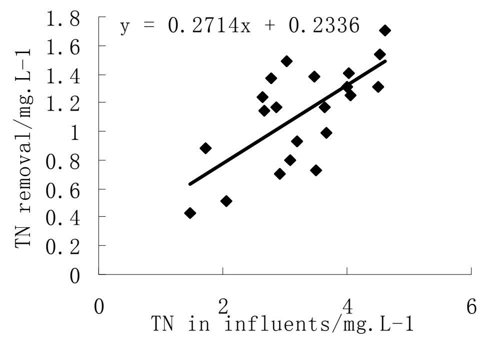

Figure 9. Relationship between TN in influents and TN removal

4. CONCLUSIONS

4.1 Without regard to role of plant, micro-polluted water has better treatment effect by the constructed wetland. This shows media play important role in micro-polluted water treatment.

4.2 Micro-polluted water flew the whole system, with different disposal in different phase. The disposal efficiency decreased under the increase of system. The early and final phases have the highest disposal efficiency.

4.3 In course of system running, there is an accumulation of P there is a saturation of sorption sites，the phenomenon of accumulation shifted gradually from the early phase to the final phase of the system.

4.4 Temperature has a positive effect on the removal efficiency. A higher removal rate can be obtained when the water temperature is higher.

4.5 Because load is low and the removal function of system can't be fully used, so the future experiment can improve load in suitable time and fully used the removal effect of system.

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