Removal Effect of Strengthened Ecological Floating Beds on the Nitrogen and Phosphorus of Urban Sewage

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Abstract: In order to explore the strengthened effect of aquatic animal, plant and substrate on nitrogen and phosphorus removal from floating bed and the influence on microbial community, the intensive floating bed was studied for urban sewage is worse than grade V : NH4+-N: 7.50±2.00mg/L, TN: 8.50 ±2.00mg/L, TP: 0.55±0.10 mg/L. Through the experiments, it can be concluded that: in the aspect of nitrogen removal capacity, CSFB group can show obvious advantages of it, and the effluent water quality in summer can reach the grade III; in terms of phosphorus removal, the CSFB phosphorus removal capacity is as high as 83.83%, and the effluent phosphorus concentration 0.11 mg / L in summer, and the phosphorus removal rate of the group containing zeolite was higher than 64%. The removal of nitrogen is mainly based on microbial degradation, followed by the matrix. In terms of the removal of phosphorus, the matrix can significantly increase the removal rate of phosphorus, and the contribution rate of purification of plants and benthic animals is relatively small. Moreover, canna and snails can improve microbial abundance and community diversity. And may affect the abundance of matrix denitrifying bacteria. The denitrifyi ng bacteria enriched in the zeolite floating beds are mostly heterotrophic denitrifying bacteria, among which Acinetobacter, Pseudomonas and Bacillus play a big role in the process of TN removal.

Keywords: Municipal Engineering; Strengthened Ecological Floating Beds; Urban Sewage; Removal of Ammonium and Phosphate; Microbial Community

Introduction

As the source of life, water carries more and more functions. The demand for water for residents' living water, municipal water, industrial water, etc. is increasing. The shortage of water resources and the shortage of supply and demand are important problems in the development of cities today[1,2]. Urban rivers play an important role in the urban water environment. However, many urban rivers have serious pollution, insufficient water supply and fragile ecology[3-7]. Urban sewage is an important component of ecological water replenishment[8], and its water quality is in poor, class V and class V states. The discharge of sewage will seriously affect the water quality of rivers. At present, the discharge requirements of many water bodies meet the IV and Class IV standards. Therefore, it is urgent to treat the water quality and repair the rivers.

Ecological floating bed is a new ecological environment technology with many functions such as purifying pollution, repairing habitat, restoring ecology, improving landscape and so on[9-11]. It has a good prospect of popularization and application in the comprehensive treatment of water body[12-16] due to its low cost, wide application conditions and simple operation. In 1988, Hoeger first proposed the use of ecological floating bed for water body restoration, and many countries carried out ecological floating bed research[17-20]. Since 1991, China has successfully planted 46 families, 130 families, a variety of terrestrial plants, canna and a series of other flowers on floating beds in different waters such as large lakes and rivers, achieving better purification and landscape effects than land planting.

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Ecological floating bed has attracted the attention of many scholars and engineers due to its characteristics of ecological restoration and beautiful sewage treatment[24-26], but with the in-depth research on it, it is found that ecological floating bed has many deficiencies, such as: when the sewage concentration is high, insufficient root support causes root rot or plant withering, Water microorganisms and aquatic plants have limited ability to purify water quality[27, 28] and unstable purification effect[29]etc. The removal efficiency of nitrogen and phosphorus in sewage still needs to be enhanced[30]. In order to overcome a series of disadvantages of traditional ecological floating beds and improve the removal efficiency of nitrogen and phosphorus in polluted water bodies, combined floating beds have gradually evolved. In this experiment, matrix and benthic animals are added to strengthen the traditional plant ecological floating bed, and an enhanced ecological floating bed is constructed to explore and improve its nitrogen and phosphorus removal effect, and to explore its influence on microorganisms.

1. Materials and methods

1.1 Parallel experimental group

In order to study the effect ZSFB enhanced floating bed on water purification, four independent experimental groups have been established: blank Control group, matrix group, and matrix enhanced floating bed group. Matrix, zoobenthos enhanced floating bed experimental group, which is set up inside the campus of Chongqing university, district b, each group has 4 parallel experiments. The same hollow frames with 315mm depth were hung in the barrels as containers for plants, substrates and benthic animals. Each frame opening was fixed 100mm lower than the barrel opening.

1.2 Construction of floating bed

Before officially carrying out the enhanced floating bed experiment, the plant is pretreated, the whole plant is cleaned, and the root system of the plant is mainly cleaned and trimmed, and then the adaptive cultivation before the experiment is carried out.

Clean the outer surfaces of snails, mussels and silver carp, and conduct a water quality test of worse than Grade V after being temporarily cultured in clear water for 2 days. It is found that the mortality rate of silver carp is higher, and the growth state and water purification ability of snails are better than that of oval back angle toothless mussels. Therefore, snails are selected as a floating bed standby benthic animal.

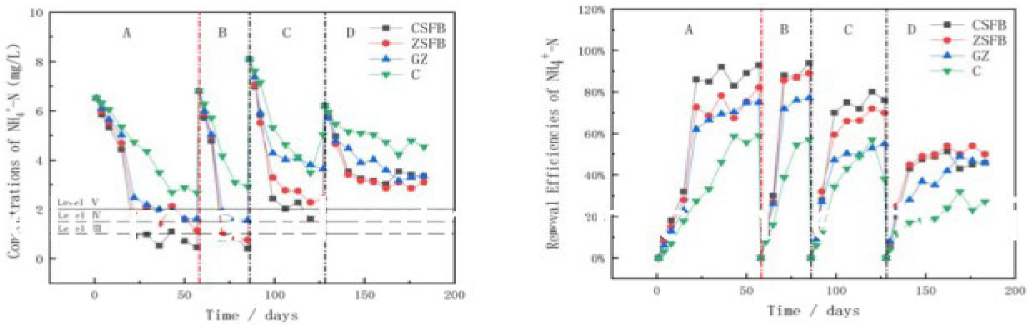
1.3 Water to be tested

The experimental water is mixed according to the inferior, V and class water quality. The actual domestic water used in the local campus of Chongqing University is used to carry out the 10 and day water quality index monitoring, and then the water is taken to dilute the mixture.

2. Results and analysis

2.1 Removal effect of ammonia nitrogen

The ammonia nitrogen in the effluent of the four groups of experiments was detected, and the detection results are shown in the figure.

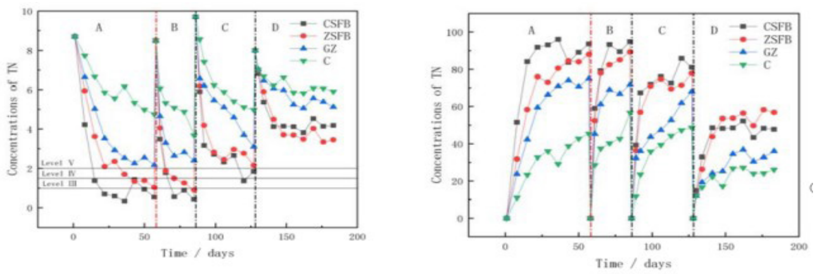


a. Helium and nitrogen concentration b. Helium nitrogen removal rate

Figure 2.1. Removal effect of NH4+-N.

As can be seen from Figure 2.1, the ammonia nitrogen removal effect of each experimental group is good. except for the blank experimental group, the other experimental groups can all reach the quasi-class iv water standard in the first three water distribution experiments. among them, CSFB experimental group shows obvious ammonia nitrogen removal advantage in the first 125 days. the effluent quality reaches the class iii water standard, with the highest ammonia nitrogen removal rate reaching 93%. However, with the decrease of temperature in the later period, the activities of plants, aquatic animals and microorganisms all decreased, the growth stagnated and the ammonia nitrogen removal rate decreased. However, the experimental group containing the green zeolite matrix still achieved an ammonia nitrogen removal rate of more than 46%, which has obvious ammonia nitrogen removal advantages over the 27% ammonia nitrogen removal rate of the blank experimental group.

2.2 Removal effect of total nitrogen



a. Total nitrogen b. Total nitrogen removal rate

Figure 2.2. Removal effect of TN.

The influent concentration of total nitrogen is 8.01-9.20mg/L ,and from Figure 2.2 Total nitrogen effect diagram, the effect of plant and animal combination enhanced floating bed for total nitrogen removal is the best, and its total nitrogen removal rate is 47.76%-93.69%, the effect of green zeolite enhanced floating bed for nitrogen removal is remarkable in the first 50 days (early summer), and the effluent can reach the surface III water quality standards. During this period, the denitrogenation effect of the matrix enhanced floating bed reached the surface IV water-like standard, and the worst was still the blank control group. In the fourth water distribution stage (D ,winter), the enhanced floating bed showed better denitrogenation ability, but the denitrogenation ability decreased by about 32%-45% compared with the first water distribution stage.

2.3 Removal effect of total phosphorus

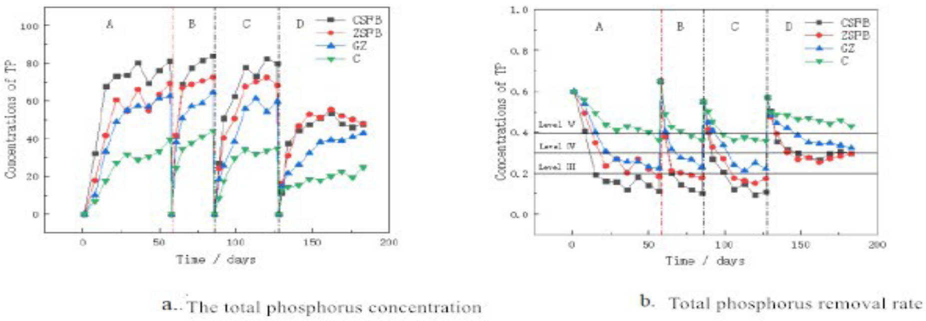


Figure 2.3. Removal effect of TP.

As can be seen from Figure 2.3, the total phosphorus removal efficiency of each experimental group is better. When the maximum influent concentration is 0.65mg/L the phosphorus removal rate of the blank experimental group reaches 44.17%, while the phosphorus removal capacity of the experimental group containing matrix is stably higher than that of the blank experimental group, CSFB phosphorus removal capacity is as high as 83.83% ,the effluent phosphorus concentration is 0.11mg/L, and the phosphorus removal rates of the other matrix-containing experimental groups are all higher than 64%.

3. Conclusion

Through the research experiment on the effect of enhanced floating bed on nitrogen and phosphorus removal in water, it can be concluded that:

(1) The floating bed experimental group has good removal effect on ammonia nitrogen, and the water quality treatment in summer and autumn can reach the standards of quasi-type, iv-type and quasi-type. Among them, CSFB and experimental group can show obvious ammonia nitrogen removal advantages, and the effluent water quality can reach the standards of iii-type and quasi-type, and the ammonia nitrogen removal rate can reach the highest of 93%. With the decrease of temperature, the ammonia nitrogen removal rate of 46% or above can still be achieved in the experimental group containing green zeolite matrix, which has obvious ammonia nitrogen removal advantages over the ammonia nitrogen removal rate of 27% in the blank experimental group.

(2) The combined enhanced floating bed has a good removal effect on total nitrogen, and its total nitrogen removal rate is 47.76%-93.69% ,and the green zeolite enhanced floating bed has a remarkable nitrogen removal effect in early summer, and the effluent can reach the surface III and water-like standards.

(3) The total phosphorus removal efficiency of each experimental group is better, but the phosphorus removal ability of the experimental group containing matrix is stably higher than that of the blank experimental group, the phosphorus removal ability of CSFB is as high as 83.83%, the phosphorus concentration in effluent is 0.11mg/L, and the phosphorus removal rate of the other experimental groups containing matrix is higher than 64%.

(4) Self-purification of water body is mainly realized through precipitation, adsorption and microbial degradation in water. The removal of nitrogen and phosphorus mainly depends on the self-purification of water body, followed by substrate, and the purification contribution rate of plants and benthic animals is relatively small.

(5) Addition of canna and snails can improve microbial richness and community diversity. Amongst the floating bed microorganisms, Proteobacteria is the most abundant.

(6) Addition of canna and snails may affect the abundance of substrate denitrifying bacteria. The denitrifying bacteria enriched in floating bed substrate are mostly heterotrophic denitrifying bacteria, among which Acinetobacter, Pseudomonas and Bacillus play a major role in TN removal.

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