Analysis on the Status Quo of Sewage Purification from Jiuxi Artificial Wetland in Yuxi

Xianhua Wu[1,*], Yungang Huang[2], Yadong Xue[1], Yan Li[1], Congqing Yang[1], Yanli Hu[1], Runxia Yang[1]

[1] Yuxi Research Center for Eco- environmental Sciences on Plateau Lakes, Yuxi Normal University, Yuxi, Yunnan 653100

[2] Department for the Sanitary Monitoring and Test, Yuxi Center for Disease Control and Prevention, Yuxi, Yunnan 653100

Keywords: Jiuxi Artificial Wetland; Wetland Plant; Purification Mechanism; Purification Effect

Abstract: In this paper, the concept, function and particularity of constructed wetland, matrix, aquatic plants and microorganisms in the constructed wetland sewage treatment system are used to explain the mechanism of pollutant removal in wastewater, and the Jixi artificial wetland in Yuxi City, Yunnan Province is described. For example, the experimental monitoring method is used to sample and monitor the dissolved oxygen, chemical oxygen demand, total nitrogen, total phosphorus, ammonia nitrogen, and potassium permanganate index of the water quality indicators of the inlet and outlet of Jiuxi artificial wetland, combined with Jiuxi artificial wetland.

1. Introduction

Constructed wetland refers to the use and acquisition of water resources for human beings, modeled on natural wetlands, artificially designed and constructed, and can be artificially controlled and engineered, using artificial substrates - wetland aquatic plants - aquatic animals - microorganisms, and through physical, chemical, biological Combined with water and microorganisms to achieve a new sewage treatment process for sewage purification [1]. Purification mechanism: Artificial matrix provides a growth environment for the growth of microorganisms, and provides survival carriers and nutrients for the development and growth of aquatic plants in wetlands, and purifies sewage through the combined action of physics, chemistry and biology. First, wetland aquatic plants can directly or indirectly absorb and utilize the nutrients in the wastewater for their growth and development, and absorb and enrich some toxic and harmful substances of heavy metals. Secondly, aquatic plants in the wetlands use stomata to transport oxygen in the air. To the roots of plants; the last wetland aquatic plants also have the effect of maintaining water transport. The main mechanism of degradation of organic pollutants in wastewater is the metabolism of microorganisms [2].

2. Development and Application of Constructed Wetlands

China's artificial wetland treatment technology was introduced late, but it developed very rapidly. In the early 1980s, China began to learn advanced foreign wetland wastewater treatment technology. During the "75" period, the constructed wetland sewage treatment system technology was listed as national science and technology.

Yunnan is one of China's major ecological provinces with abundant species and diverse species. With the rapid development of the economy, the awareness of water resources protection is weak. With the unorganized discharge of domestic sewage and industrial wastewater, the water pollution situation is becoming increasingly severe (such as Dianchi in Kunming). The newly constructed wetland treatment technology controls the pollution status of water resources (Dianchi) [3].

  DOI: 10.25236/acete.2019.122

3. Research Materials and Methods

Jiuxi Town is located in the west of Jiangchuan District of Yuxi City, east of the street town, west of Fenghuang Road Office, Hongta District, Gaocang Town and Liqi Town, south of Tonghai Street, Hexi border, north soil Anhua Township, avant-garde The town has fewer mountains and more resources in the territory [4]. The Jiuxi artificial wetland located in Jiuxi Town is the core hub of the “distribution and diversion” project of Fuxian Lake-Xingyun Lake. It plays an important role in protecting the water of Fuxian Lake and purifying the water quality of the Xingyun Lake. Yuxi Jiuxi Constructed Wetland is the largest constructed wetland construction project in China's lake management, and it is also a representative new type of constructed wetland treatment process in Yunnan Province. Yuxi Jiuxi Constructed Wetland and Wetland Park covers an area of 22.15 hectares with a total investment of 57.957 million yuan. The project was carried out in two phases. The first phase of the project was constructed in 2006. It covers an area of about 18 hectares, built 130,000 m2 of constructed wetland, planted 14 hectares of wetland plants, and treated 100,000 tons of sewage. The second phase covers an area of 12 hectares. , treatment of sewage volume of 100,000 tons / d. Completed in December 2007, the daily sewage treatment capacity is 200,000 m3.

The water purification mechanism of Jiuxi artificial wetland: when the wastewater passes through the artificial wetland composed of horizontal subsurface flow, flows in the middle of the wetland pond and riverbed, and uses the biofilm formed by the adsorption of microorganisms on the upper surface of the artificial substrate, the developed plant root system, the surface matrix and the filler interception. The same effect not only prolongs the residence time of the wastewater, but also improves the treatment efficiency and treatment capacity of the wastewater.

Jiuxi artificial wetland pool + body combination mode: Jiuxi artificial wetland adopts pool body pond-bed combination type, and its combination form and characteristics are as follows: the combination of pond bed method is composed of oxidation pond (sedimentation tank) + subsurface flow, biological Pond as a wastewater pretreatment unit. According to the survey, the multi-level horizontal subsurface wetlands of the Jiuxi artificial wetland inlet are all biochemical ponds, with an area of about 3 hectares. There are 4 rows of single biological ponds side by side, each row consisting of 4 tandem single ponds, single biochemistry. The area of the pond is about 1500 square meters. The two rows of biochemical ponds at the inlet are mainly used for water ingress and act as sedimentation sludge. The main purpose is to plant water hyacinth and water hyacinth. The large-scale biochemical pond in the middle is a submerged artificial wetland, mainly planting floating plants, such as duckweed, gourd and water hyacinth. The biochemical pond in the south belongs to a multi-stage subsurface flow constructed wetland with an area of 5.86 hectares. There are five rows of single biochemical ponds arranged side by side. Each row has five serially connected single biochemical ponds, and the area of each single biochemical pond. The aquatic plant oxidation pond of 1200 square meters, a row of horizontal subsurface wetlands is mainly planted with floating aquatic plants such as duckweed, cress, and water hyacinth; the aquatic plants in the second row of horizontal subsurface wetlands are planted with radix. Aquatic plants such as canna and bananas are the main plants; the three rows are mainly composed of five single biochemical ponds, and the cattails, cress, and yarrow are planted under the pond. The five biochemical ponds in series are mainly used to raise shrimp, leeches and fish. The fourth and fifth rows of horizontally flow submerged artificial wetland biochemical ponds are mainly planted with leaves of Arundo donax, Umbrella, Canna, and a small amount of reeds.

All water sampling indicators are sampled and sampled according to the Technical Regulations for the Preservation and Management of Water Quality Samples of the Ministry of Environmental Protection of the People's Republic of China (HJ493-2009). The sampling point is located at the inlet and outlet of Jiuxi artificial wetland. Three samples are collected at each point for laboratory analysis and analysis: sampling time: December 3, 2017, December 13, 2017, January 13, 2018; Sampling indicators: dissolved oxygen, chemical oxygen demand, total nitrogen, total phosphorus, ammonia nitrogen, and potassium permanganate index.

According to the operation status of Jiuxi constructed wetland and the growth and distribution of

vegetation, three sets of samples were collected from the wetland inlet and three sets of purified water were collected for laboratory monitoring and analysis. The measured indicators included dissolved oxygen DO and chemical aerobics. DO is determined by iodometric method "GB7589-87", chemical oxygen demand COD adopts rapid digestion spectrophotometry "HJ/T399-2007", TN is determined by alkaline potassium persulfate ultraviolet spectrophotometry "HJ636-2012" TP was determined by ammonium molybdate spectrophotometry "GB11893-89", NH3-N was determined by Nessler's reagent spectrophotometry "HJ 535-2009", and permanganate index was determined by redox titration "GB11892" -89".

All the data were statistically analyzed by Excel, and Excel2007 software was used for drawing and table, and the maximum, minimum, and average values were calculated, and the analysis was performed by inserting a line graph. The data are expressed by (average soil standard deviation), and the removal rate of each indicator = (inlet concentration - outlet concentration) / inlet concentration * 100%.

4. Results and Analysis

Analysis of Pollution Load of Jixi Artificial Wetland. Changes in dissolved oxygen in the inlet and outlet of Jiuxi artificial wetland

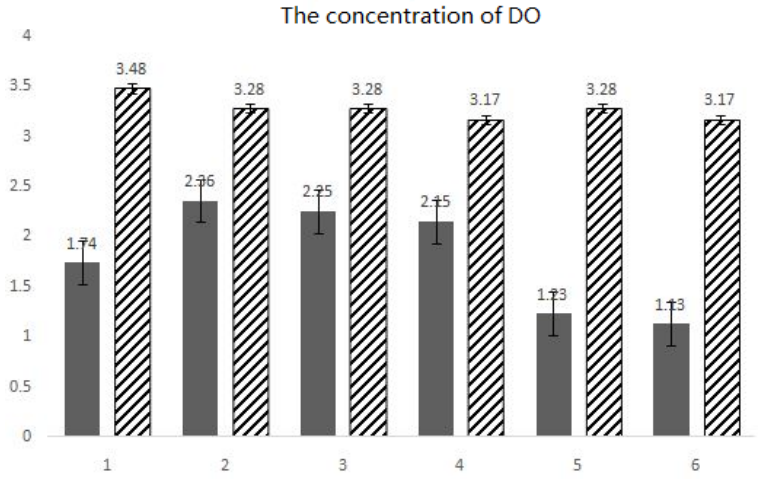

Figure 1 Dissolved oxygen changes

The dissolved oxygen content of the inlet ranged from 1.13 mg/L to 2.36 mg/L, the maximum value was 2.36 mg/L, the minimum value was 1.13 mg/L, and the average value was 1.81 mg/L. The dissolved oxygen content of the water outlet is between 3.17mg/L and 3.48mg/L, the maximum value is 3.48mg/L, the minimum value is 3.17mg/L, and the average value is 3.28mg/L;

Changes in chemical oxygen demand in the inlet and outlet of Jiuxi Wetland.

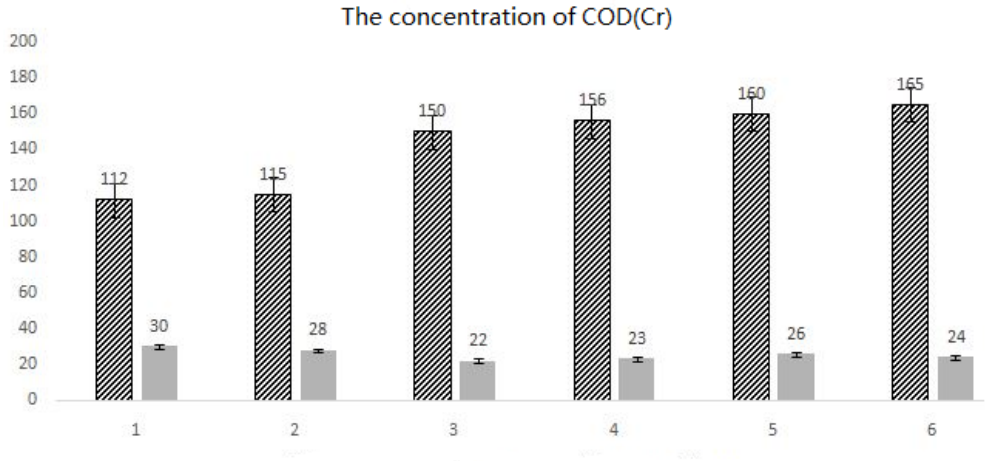

Figure 2 COD (Cr) changes

COD□ (Cr) content changes: the COD (Cr) content of the inlet is between 110mg/L and 165mg/L, the maximum value is 165 mg/L, the minimum value is 110 mg/L, and the average value is mg/L; The chemical oxygen demand of the water outlet is between 22mg/L and 30mg/L, the maximum value is 30 mg/L, the minimum value is 22 mg/L, and the average value is 25.5 mg/L.

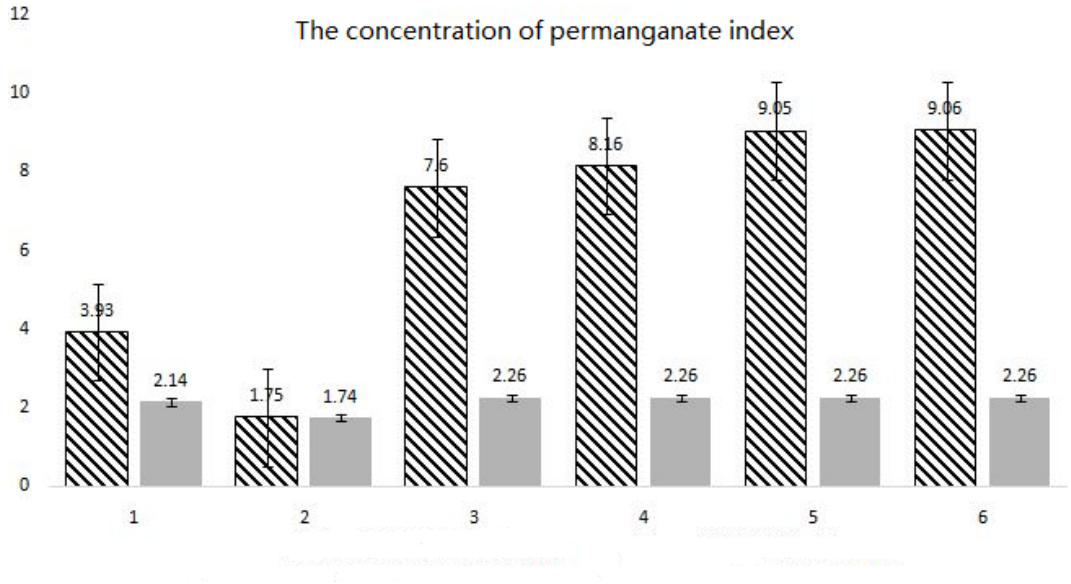

Figure 3 COD (Mn) changes

The COD(Mn) inlet is between 1.75mg/L and□permanganate index of the 9.06mg/L, the maximum value is 9.06mg/L, the minimum value is 1.75mg/L, and the average value is 6.59 mg/L; The permanganate index of the water outlet is between 1.74 mg/L and 2.26 mg/L, the maximum value is 2.26 mg/L, the minimum value is 1.74 mg/L, and the average value is 2.15 mg/L.

Changes in nitrogen content in the inlet and outlet of Jiuxi artificial wetland.

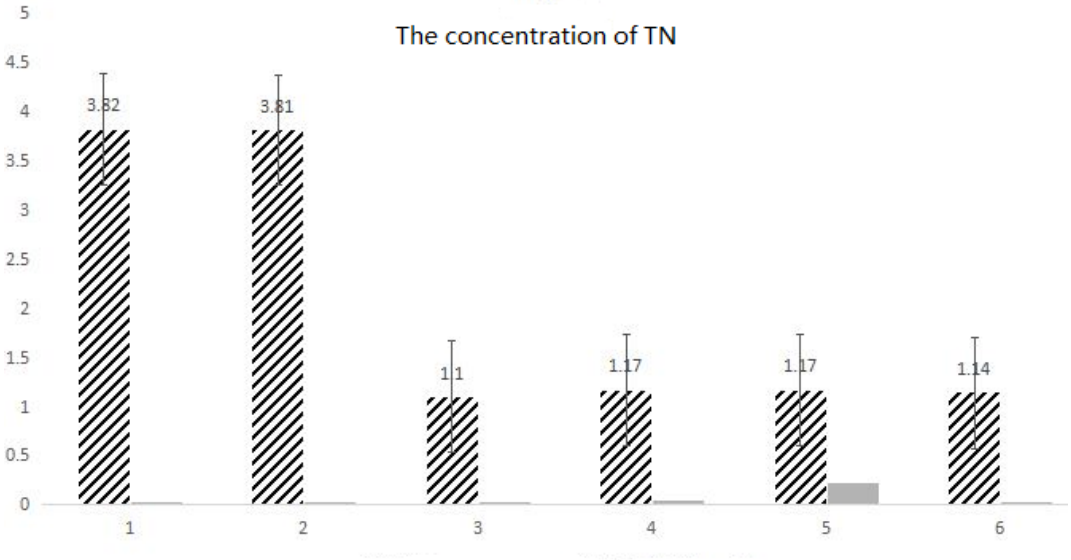

Figure 4 shows the change of total nitrogen

The total nitrogen content of the inlet is between 1.10mg/L and 3.82mg/L, the maximum value is 3.82 mg/L, the minimum value is 1.10 mg/L, the average value is 2.04 mg/L; the total nitrogen content of the outlet is 0.01. Between mg/L and 0.22 mg/L, the maximum value is 0.22 mg/L, the minimum value is 0.01 mg/L, and the average value is 0.06 mg/L.

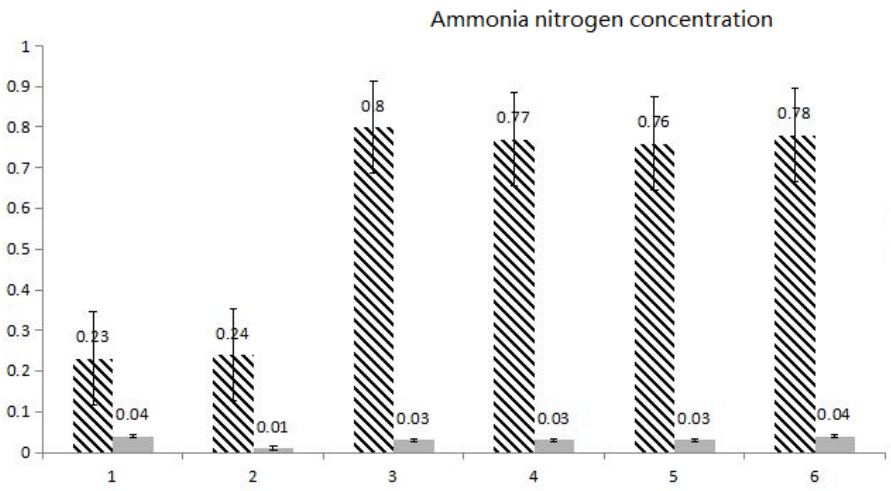

Figure 5 ammonia nitrogen changes

The ammonia nitrogen content in the inlet is between 0.23mg/L and 0.8mg/L, the maximum value is 0.8 mg/L, the minimum value is 0.23 mg/L, the average value is 0.60 mg/L, and the ammonia nitrogen content in the outlet is 0.01 mg/L. Between L and 0.04 mg/L, the maximum value is 0.04 mg/L, the minimum value is 0.01 mg/L, and the average value is 0.03 mg/L.

Changes in phosphorus content in the inlet and outlet of Jiuxi artificial wetland.

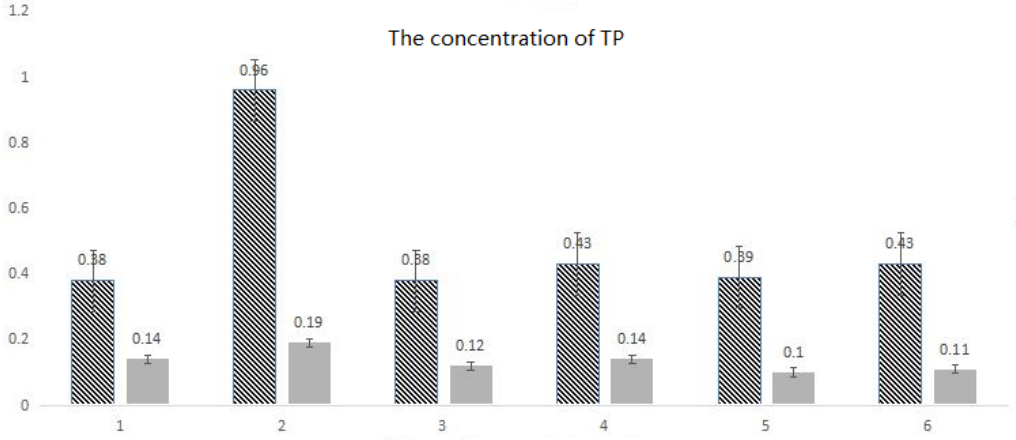

Figure 6 shows the change of total phosphorus

The total phosphorus content of the inlet is between 0.38mg/L and 0.96mg/L, the maximum value is 0.96 mg/L, the minimum value is 0.38 mg/L, the average value is 0.49 mg/L; the total phosphorus content of the water outlet is 0.1 mg. Between /L and 0.19 mg/L, the maximum value is 0.19 mg/L, the minimum value is 0.1 mg/L, and the average value is 0.13 mg/L.

Analysis of various pollution load removal effects. After three experiments, the average removal efficiency of Jiuxi artificial wetness for each water quality index is as follows: DO is between 31% and 64%, COD (Cr) is between 50% and 85%, and TN is between 60% and 95%. Between 63% and 80%, the ammonia nitrogen is between 50% and 95%, and the permanganate index is between 43% and 95%. Research shows: horizontal subsurface flow artificial wet

The ground has better purification effect and higher stability. The average removal rate of COD (Cr) is about 80%, the average removal rate of TN is relatively low at 56.8%, the average removal rate of TP is about 75%, and the average removal rate of ammonia nitrogen is above and below 52%. Permanganate index the average removal rate is around 46.3%. The Jiuxi artificial wetland is a horizontal subsurface flow constructed wetland that basically meets the requirements for the purification of sewage by horizontal subsurface flow wetlands.

Through the wetland field visits and investigations, the main function of Jiuxi artificial wetland is to purify the outflow water quality of Xingyun Lake and provide landscape tourism. Therefore, in

the process of planting selected plants, the selected plants are more aquatic ornamental plants and have better purification ability. The wetland plants are mainly used, and the aquatic plants in the wetland are planted in a concentrated manner; one area and two pieces are separated by Yujiang Expressway and pedestrian roads, and the pedestrian roads are mainly planted with weeping willows, Zhongshan fir and crisp persimmon trees; The pond has a sedimentation effect. The amount of floating plants used is small and the species are relatively simple. The plants are mainly composed of water hyacinth, pink-green foxtail bath, water hyacinth, and duckweed. The two-zone project mainly produces wet aquatic plants, such as water onions. , canna, sedge, reed, arundo, barracuda, cattail, calamus, water celery, etc., complex purification effects (see Table 2)

5. Conclusion

The outflowing sewage from Xingyun Lake flows through the Yuxi Jiuxi artificial wetland, and the sediment in the oxidation pond of a zone is used to remove suspended solids from the sewage. The wetland aquatic plants in the two areas are water hyacinth, reed, canna, water onion, etc. Wetland aquatic animals Frogs, fish, leeches, etc., microorganisms, through physical, chemical, biological and other effects on the organic pollutants, the effluent treated by artificial wetland, the average removal rate of dissolved oxygen reached 47.5%, COD (Cr) average removal The rate is 67.5%, the average removal rate of total nitrogen is 70%, the average removal rate of total phosphorus is 63%, the average removal rate of ammonia nitrogen is 80%, the average removal rate of permanganate index is 50%, and the dissolved oxygen concentration in the outflow water is The increase in other indicators has decreased, the water quality has improved compared to the influent water, the effluent water quality is good, and the purification effect is remarkable. In the operation process of Jiuxi artificial wetland, combined with the local government's comprehensive management, the treated sewage volume is 20m3/d, and the outlet water quality reaches the national surface water type III water, and the operation effect is good. The constructed wetland not only purifies and improves the outflow water quality of Xingyun Lake, but also made outstanding contributions to the protection of Fuxian Lake Class I water, and also played a key role for Yuxi City's supplementary water resources (Dongfeng Reservoir), and with the outlet waterfall, Nie The ear culture music plaza and the Yuxi Zhou Dahe have become a tourist landscape belt, which promoted the development of tourism in Yuxi City.

References

[1] Wang Huan School. Pollution ecology. Beijing: Higher Education Press, 2011.6:211

[2] Wu Xianhua, Hou Changding, Wang Lin, Li Yinwei. Mechanism of sewage treatment by constructed wetlands. 1009-9506(2002)01-0103-03

[3] Wang Yan, Li Xuexue. Research report on the promotion of sewage treatment technology in rural wetlands in Yunnan. 1004-1168 (2008) 02-0085-04

[4] Fei Bing, Ma Jianwu. Planning and design of Jiuxi Wetland Park in Yuxi City. 1007-5739(2011)06-0223-02