Research status of heavy metal pollution evaluation in urban wetlands in China

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Abstract: *Urban wetlands are one of the ecosystems most closely related to human production and life, and have various functions such as stabilizing the environment, improving the urban environment, regulating and storing floodwater, supplementing groundwater, recreation, science and education culture, and protecting biodiversity. With the continuous shrinkage of urban wetlands in recent years and frequent pollution, many scholars at home and abroad have carried out a lot of research work on urban wetlands, of which the evaluation of heavy metal pollution in urban wetlands is one of the priorities. In this paper, this paper analyzes the reports on heavy metal pollution in urban wetlands in China in recent years, reviews the current situation of pollution evaluation in sediment, soil and water bodies of urban wetlands, and summarizes and summarizes the pollution evaluation methods of heavy metals. Among the many evaluation methods, the single index method, the ground accumulation index method, the potential ecological risk assessment method and the water quality standard level method are the most used.*

Keywords: *Wireless sensor networks, Intelligent workshop products, Moving target tracking*

1. Introduction

A wetland is a marshland, wetland, peatland, or water, with or static or flowing, or freshwater, brackish or brackish water bodies, regardless of whether it is natural or artificial, permanent or temporary [1, 2]. The transition zone between terrestrial and aquatic ecosystems that intersect spatially with cities and are influenced by human production and life is urban wetlands [3]. Urban wetlands have the values of protecting biodiversity, improving the urban environment, regulating and storing floods, supplementing groundwater, recreation, science and education, and culture [4-6]. For a long time, due to the continuous expansion of the city, a large number of wetlands have been encroached upon and transformed into other lands, and a large number of polluting substances have been enriched by the influence of human production and life [7].

With the innovation of urban development concept and the continuous deepening of wetland research, the unique ecological value of urban wetlands has attracted more and more attention, and many scholars have also conducted a lot of research on the causes of wetlands, environmental interactions, biological protection and pollution status [8, 9]. Urban wetlands exist in cities and around cities, and heavy metal pollutants in urban water bodies are easily deposited or adsorbed in wetlands when passing through urban wetlands, so many cities also use urban wetlands as a tool for water pollution control [10]. However, the large concentration of heavy metal pollutants in wetlands will directly affect human health along with the food chain or human activities, and when the environmental conditions of wetlands change, the heavy metals adsorbed are likely to be released, causing pollution of water bodies and the surrounding wetlands [11]. Urban wetlands have such characteristics, making the protection, restoration and rational use of wetlands a matter of widespread concern, so more and more scholars and experts are also committed to the study of the current situation of heavy metal pollution in urban wetlands.

2. Evaluation method of heavy metal pollution status in urban wetlands

In the study of urban wetland pollution, the most studied at present is the evaluation of heavy metal pollution in urban wetlands. To determine whether a wetland is polluted and the degree of pollution, it is necessary to use the pollutant evaluation method to judge. The most common evaluation methods are the single index method in the index method, the ground accumulation index method, the Nemero composite index method and the potential ecological risk assessment method.

The single-exponential method divides the value of the polluting element in the test sample by the evaluation criteria [12]. Evaluation criteria typically use local pollutant quality standards or pollutant background values. The singular method is simple and easy to use, providing indicators of the degree of contamination of a single element or substance, often in conjunction with other evaluation methods to dig up more information.

The Nemerow composite index method first calculates the sub-index of each factor (superscalar multiple), then calculates the average value of each sub-index, and calculates the maximum sub-index and average value [13]. Calculated using several elements at the same time, or an area average and maximum value of the single pollution index of the single element, highlight the high degree of pollution elements of contribution to the overall pollution of soil, both evaluation of a variety of elements integrated contribution to the pollution of the soil, and the area of a soil or from other areas of the existing research record, but as well as the single index method, It can only reflect the status of pollution, but it is difficult to reflect the risk, toxicity and other information of pollution.

Ground accumulation index method is a method proposed by Muller to evaluate the degree of heavy metal pollution in sediments [14]. Geopotinic accumulation index increases the influence factors of natural geological processes on the background values when evaluating heavy metal pollution. Therefore, geopotinic accumulation index method can judge the impact of anthropogenic activities on sediments or soil, and plays an important role in evaluating the extent of anthropogenic activities in polluted areas. However, the correction coefficient in the geo-accumulation index method is restricted by the natural geological process. If the geological process is unclear, it is difficult to select the coefficient, which has a great impact on the research results [15].

The potential ecological risk assessment method is a comprehensive evaluation method for the pollution degree, toxicity risk and potential ecological hazard of pollutants in wetlands based on the single-index method, combined with the toxicity of elements and the potential ecological hazard capacity [16]. The potential ecological risk assessment method combines the single pollution index of heavy metal elements and integrates the elemental toxicity coefficient into the evaluation method, which comprehensively reflects the potential risks of multiple heavy metals in the soil, and is suitable for the evaluation of the pollution risk of heavy metals such as lead in the whole land. However, the toxicity coefficient has a certain subjectivity, so the calculated potential ecological risk value has a certain subjectivity.

In addition to the index method, there are currently studies on pollution evaluation using mathematical model method [17], although the mathematical model method can more comprehensively evaluate the current situation of pollution, but the mathematical model method also has the problem of the objectivity of weight processing and the complexity of the calculation process, so although the index method is difficult to judge some complex and hidden pollution, it is still widely used because of the simplicity of calculation. For example, in 2017, Shao Shuai et al. [18] evaluated the heavy metal pollution of Wenruitang River wetland through a fuzzy synthesis-weighted- model, and compared the results of the evaluation of the Nemero index method and the potential ecological hazard coefficient method. The results of the Nemero index method and the potential ecological hazard coefficient method are consistent with the fuzzy comprehensive evaluation results.

3. Evaluation method of heavy metal pollution status in urban wetlands

Domestic research on heavy metals in urban wetlands mainly focuses on three aspects: sediment, soil and water.

3.1. Research progress of urban wetland sediment

The heavy metal pollutants produced by cities and other pollution sources will eventually be deposited and enriched in the sediment of urban wetlands after being transported through water bodies after atmospheric sedimentation, wastewater discharge, leaching and scouring [19].

In the existing urban wetland sediment research, a variety of evaluation methods are applied to the analysis of the current situation of heavy metal pollution. Among them, the index evaluation method is a commonly used evaluation method, such as the single index method, the Nemero composite index method, the enrichment factor method, the potential ecological risk evaluation method, etc., of which the most commonly used are the single index method, the ground accumulation index method and the potential ecological risk evaluation method. Usually, researchers first use the single index method to determine whether there is obvious pollution phenomenon, and then comprehensively evaluate the harm of pollution through the potential ecological risk assessment method.

Zhao Maosen et al. [20] conducted a study on urban wetlands in Bishan District, Chongqing, and among the wetland sediments of Guanyintang Wetland Park and Xiuhu Wetland Park, Cd was above moderate ecological hazards, and other heavy metal elements were minor ecological hazards, and the comprehensive potential ecological risk index (RI) of Guanyintang Wetland /b15>80.74, which is a minor ecological hazard; Xiuhu Wetland (RI) has a value of 99.96 and is a moderate ecological hazard.

Ma Yongling [21] collected the sediment digestion of Wuhe Wetland and determined 6 kinds of heavy metals (As, Cd, Cu, /b110>Hg, Pb, and Zn). The results show that the heavy metal content in the surface sediments of Wuhe wetland is mostly higher than that of the environmental background value, and the potential ecological risk assessment shows that the potential ecological hazard index in the sediments of Wuhe wetland is extremely strong ecological hazard. The reason for this phenomenon may be related to the fact that all the water source of the Wuhe Wetland comes from the Lanshan Sewage Treatment Plant in the upper reaches of the Sinking River and the municipal sewage treated by the Luozhuang Sewage Treatment Plant of the Nanshu River.

Cai Xiang Cuo Mao et al. [22] analyzed the pollution of heavy metals in the sediment of the urban wetland of Huoyangou in Xining City. The study found that in terms of time, the average content of most heavy metal elements in mud at the end of 2018 had a downward trend compared with the monitoring results in 2012, but the overall level was still at a moderate or mild pollution level; The comprehensive potential ecological hazard index shows that the heavy metal element Cd is at a high ecological risk level, and the highest value of the ecological hazard index is in the upper reaches of the wetland. This study can provide a reference for the management and risk prevention and control of plateau urban wetlands.

Shao Shuai's research on San'an wetland in Wenzhou City [23] found through correlation analysis that the correlation between Zn and Pb in the exchangeable, oxidizable and residual states reached a strong correlation. Both may come from the same source of contamination. In the correlation between Cu and Cd, in the reductible state is strongly correlated. The two are strongly correlated in the correlation analysis of the totals. Both come from the same source of pollution, are mainly discharged in a reductible form.

Sun Baojin [24] sampled and analyzed the wetland sediments of Suzhou Industrial Park in Suzhou Sponge City Pilot Zone, and the results showed that As, Cd, Co and Cr /b19>, Cu, Ni, Pb, Zn, etc. 8 The content of the elements exceeds the background value; The Potential Ecological Risk Index method shows that Cd elements have the highest degree of potential risk. Through correlation analysis and principal component analysis, it can be seen that the pollution of heavy metals is mainly from human sources.

3.2. Research progress of urban wetland soil

The study of soil heavy metal pollution in urban wetlands is usually carried out simultaneously in conjunction with the study of sediments, and the research methods are basically the same as the study of sediment, and the single index method, the ground accumulation index method and the potential ecological risk assessment method are often used for the evaluation of the degree of heavy metal pollution in urban wetlands.

For example, Yong Qianyi et al. [25] In the study of Liling Guanzhuang Lake wetland, it was found that heavy metals such as copper, zinc, lead, cadmium, and chromium exceeded the soil background value of Hunan Province to varying degrees, and combined with the potential ecological hazards, it was

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concluded that the soil and surrounding environment of Liling Guanzhuang Lake Wetland were in urgent need of comprehensive improvement.

Li Weiping [26] also used the single-index method and the potential ecological risk assessment method when studying the Nanhai Wetland in Baotou, and found that based on the soil background value evaluation benchmark, the heavy metals in the soil of the Nanhai Wetland generally exceeded the standard, and the single-factor pollution index showed that Cd was in moderate pollution; /b14>As, Cu, Pb and Zn are lightly contaminated; /b112>Cr, Ni and Mn are in slight contamination. The Potential Ecological Risk Index indicates that Cd is at a high-risk level, the study area as a whole is at a medium risk level, and the source analysis indicates that the main source of pollution should be industrial activities.

3.3. Research progress of urban wetland water bodies

In urban wetland pollution, water pollution has always been the focus of research. Existing studies have shown that human-generated pollution sources are the main input sources of pollutants in urban wetlands, and various heavy metal pollutants enter water bodies through various channels, are transferred to wetlands through river surface runoff, etc., and enter sediment or exist in water bodies [19, 27]. The evaluation of the degree of metal pollution by body weight in urban wetlands is often carried out using the single index method, the Nemero composite index method, the potential ecological risk assessment method and the water quality standard level method. The water quality standard level method is a method to judge the degree of pollution of urban wetlands based on the water quality standards formulated by the national or local government agencies as the evaluation standard, and the standard is usually used by domestic researchers as the Chinese surface water environmental quality standard (GB 3838-2002).

Ye Yajie [28] studied Cr, Pb, Cd, Zn in the Zhalong wetland system using samples such as wetland sediment, water bodies, and feathers of aquatic animals /b19>There are 5 levels of heavy metal contamination with Cu. The results show that the water bodies in the study area are Class II water or Class I water quality standards except Cu, Zn, Cr and Cd are both Class V, and heavy metal pollution in sediment close to urban areas reaches a strong degree of pollution. Heavy metal enrichment has affected the ecological health of large waterfowl in the region. Common waterfowl that inhabit and reproduce in the Zhalong wetland are enriched with certain heavy metals to varying degrees. Studies have shown that human production and living activities have caused significant heavy metal pollution to the Zhalong wetland.

Chen Xuelong [29] studied Cu, Cd, Zn, Pb in soil, water and animal and plant samples in Longfeng Wetland in Daqing City Heavy metals such as As, and Hg were statistically analyzed to analyze their correlation with each other. The results showed that the environmental quality of Longfeng Wetland was good, the soil heavy metal content was lower than the average value of Songnen Plain, the environmental quality of water bodies was lower than the surface water environmental quality, level, II standard; The analysis showed that,, there was a clear positive correlation between the heavy metal content of the soil and the metal content of the plant and fish body weight, while the water and, the plant were in the same way, Although there is also a certain positive correlation between the fish, none of them has reached a significant level.

Quan Qingzhou [30] studied the sampling of the water bodies of the Puhe River wetland during the flat water period and the flood period. The analysis found that the content of eight heavy metals in the flat water period and the abundant water period of the wetland water body was low, and all of them reached the Class I standards of the "Sanitary Standard for Drinking Water" and the "Surface Water Environmental Quality Standard". The evaluation results of the single pollution index method show that the content of each heavy metal element belongs to the clean grade. The results of the potential ecological hazard index method show that the individual potential ecological risks of Pb, Cd, Hg and as are larger, Pb The potential ecological risk is the largest, but the ecological risk level of heavy metals in the study area is mild and mild pollution.

4. Conclusions

Domestic experts and scholars have done a lot of research on heavy metal pollution in urban wetlands, and in general, the research work focuses on the heavy metal content testing and evaluation of heavy metal pollution in the three aspects of sediment, soil and water bodies of urban wetlands. The evaluation methods for heavy metal pollution are mainly concentrated in the relatively simple evaluation methods such as the single index method, the ground accumulation index method, the Nemero composite index method and the potential ecological risk assessment method, while the model method such as fuzzy mathematics and gray clustering method are relatively rare. Compared with the research and evaluation of heavy metals in soil, heavy metal pollution in urban wetlands lacks research on a variety of heavy metal collaborative pollution, heavy metal element storage status and source analysis.

At present, heavy metal pollution in urban wetlands in China is still serious, and there is still a lot of work to be done by experts and scholars. In the future research of heavy metal pollution in urban wetlands, on the basis of continuously improving the heavy metal pollution evaluation system, the establishment of a more comprehensive, span long time and large space comprehensive evaluation research may be a direction of research. At the same time, some new methods in soil and air pollution research, such as non-traditional stable isotopes, may also be an important supplement to the study of metal pollution in heavy urban wetlands.

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