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Plastic Industry Development and Natural Environment Protection

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Abstract: With the improvement of China's industrial manufacturing capacity and people's living standards, more and more plastic products appear in people's daily life. Because of the use and loss of plastic products, as well as the participation of plastic products in related industrial activities, the amount of micro plastics entering the environment is also increasing, both ecological health and human health are threatened. At present, the problem of plastic pollution in the environment is becoming increasingly serious worldwide. In order to reduce the harm of plastic pollution to the environment, this paper conducts a plastic ecological risk assessment on the sewage generated in the production process of a plastic industry, explores the potential risks of plastic pollution to the natural environment, can deeply understand the current situation of plastic pollution in the environment, and then uses SMBR process to treat plastic production sewage, analyzes the removal rate of CODcr. The results show that:, SMBR has a good removal effect on micro plastics, which provides a technical reference for the implementation of plastic pollution prevention.

1. Introduction

Plastic has become an indispensable material in daily life. Plastics are difficult to degrade and can remain in the environment for a long time. The increasingly serious plastic pollution is causing the harm that is difficult to repair to the ecological environment system. After entering the natural environment, these plastic wastes will continue to undergo a series of changes. In particular, microplastics are widely detected in water, soil, atmosphere and various organisms, and their occurrence level, distribution characteristics, environmental fate and ecological toxicity are widely concerned [1, 2].

The research on plastic pollution has achieved good results. As for the harm of plastic pollution, microplastics are widely distributed in nature and are easily eaten by various animals. These ingested microplastics can clog the digestive system of animals, causing a false sense of satiety, or directly damage the digestive system of animals, thus reducing the efficiency of animal feeding and digestion, causing stunting or even death of animals. When the micro plastics are exposed in the

environment, these toxic and harmful substances will migrate to the natural environment and enter into various organisms step by step, causing adverse effects on the growth and reproduction of these organisms [3]. In terms of plastic pollution control, in the context of the international community's increasing awareness of the prevention and control of micro plastic environmental pollution, China should start to repair the existing legal regulations, and control the micro plastic pollution in water, air and soil. Based on the fact that garbage disposal and marine protection have become hot spots in environmental protection, Solid waste treatment and marine environmental protection can be taken as the initial focus of micro plastic prevention and control and work can be carried out [4, 5]. In short, plastic pollution has aroused global concern, and relevant measures must be taken to reduce its impact on the ecological environment.

In this paper, the source of plastic pollution is introduced, and the method of plastic ecological risk assessment is proposed; Then, it proposes to analyze the pollution status of a certain plastic industry to a certain basin, evaluate the risk and hazard level of plastic pollution of the stations in the basin, and propose a plastic sewage treatment process to analyze the removal effect of the process on micro plastics; Finally, the environmental protection measures of plastic pollution are put forward.

2. Basic Overview

2.1. Plastic Pollution Status

Plastic is widely used in human clothing, food, shelter and all walks of life. For example, clothes made of fiber are distributed in major clothing stores and wardrobes of thousands of households; Plastic bags, plastic packaging, disposable packaging boxes are widely used in the food field; Because of its light weight, corrosion resistance, high strength and low price, engineering plastics are gradually replacing steel bars, cement and masonry as the mainstream materials in the construction market; Polymer materials will have great potential and market value in the field of transportation in the future [6]. Recycling of plastic waste has become a major problem in the world. At present, only a small part of plastic waste has been landfilled. However, due to the difficulty in plastic degradation, most plastic particles will remain in the environment for centuries, polluting soil and consuming land resources [7]; Some garbage will be incinerated, but plastic garbage will emit toxic gas during incineration, polluting the atmosphere and seriously threatening human life, health and environmental safety; Only a few plastic wastes will be recycled, and most will be directly discarded in the environment, causing serious environmental pollution [8].

2.2. Plastic Ecological Risk Assessment Method

With the increasingly prominent problem of plastic pollution, it is urgent to assess the potential ecological and environmental risks according to the physical and chemical properties of plastics. However, there is still a lack of standard evaluation methods. Relevant researchers explored the risk of plastic pollution in different environmental media based on various assessment models. If some scholars put forward two models: plastic polymer type index and pollution load index (PLI). Its model can be applied to other pollutants to better understand and assess the ecological risks caused by plastic pollution [9, 10].

The first method establishes the chemical toxicity hazard index of different types of micro plastic polymers to the ecological environment, and the evaluation formula is as follows:

$$G = \sum T_i \times K_i \tag{1}$$

Where G is the risk index of the polymer contained in the plastic, Ti is the percentage of the type of plastic polymer extracted at each sampling point, and Ki is the toxicity score of the plastic polymer.

The second method is to assess the ecological risk by using the pollutant load as the important index (PLI), or by using the plastic concentration instead of the pollutant load [11]. The assessment model is defined as follows:

$$PLI = \sqrt{CF}_i = \sqrt{\frac{C_i}{C_{0i}}} \tag{2}$$

CF_i is the quotient of the micro plastic concentration C_i and the minimum micro plastic concentration C_{0i} at each sampling point. C_i is the concentration of microplastics at each sample grade point. The reliability of these data depends on the reliability and accuracy of experimental methods and instruments. C_{0i} is a defined value, expressed as the minimum concentration of microplastics at all sampling points. PLI refers to the load index of micro plastics and is used as the ecological risk assessment index of micro plastics [12, 13].

3. Pollution Status of Plastic Industry on a Certain Watershed

3.1. Assessment of Plastic Pollution in the Basin

The wastewater from the production process of the plastic industry is discharged into a certain basin. Although the wastewater from the industrial production has been treated, because the plastic is difficult to degrade, there are still many microplastics entering the water body. Therefore, the plastic toxicity analysis is carried out for the basin where the plastic wastewater from the plastic industry is discharged. According to the hazard rating of plastic polymers, this paper obtains the detailed information of plastic polymers in river water, sediment and soil in this basin. There are 31 stations in this basin, and the water, sediment and soil in this area are taken from each station for plastic polymer density inspection, as shown in Table 1. The type of polymer composition is used as the evaluation index to obtain the classification and results of plastic pollution risk index of different environmental media (water, sediment and soil), as shown in Table 2.

Table 1. Details of plastic polymers in the watershed

polymer	abbreviation	Density	Hazard score
polyethylene	PE	0.84-0.95	16
polypropylene	PP	0.86-0.94	2
polyamide	PA	1.25-1.37	3
Urea formaldehyde resin	UF	1.08	1865
polystyrene	PS	1.13	53
polyacrylonitrile	PAN	1.06	12417
polyacrylic acid	PAA	1.15	228

According to Table 1, polyacrylonitrile (PAN) and urea formaldehyde resin (UF) are the two plastic polymers with the highest hazard scores, and their scores are 1865 and 12417 respectively. The plastic polymers with the lowest hazard score are polypropylene (PP) and polyamide (PA).

Table 2. Number of stations with different plastic ecological risk levels in the basin

Risk index	Risk level	Water	sediment	soil
<10	Ⅰ	13	4	6
10-100	Ⅱ	8	9	14
101-1000	Ⅲ	7	3	3
1001-10000	Ⅳ	0	5	3
>10000	Ⅴ	3	10	5

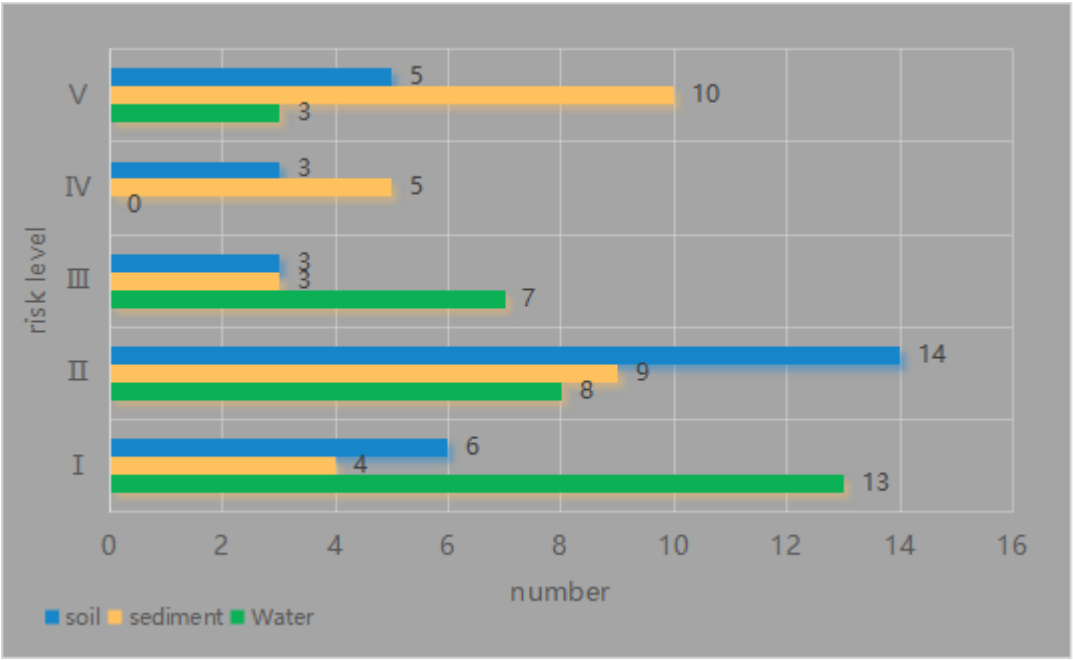

Figure 1. Site statistics on plastic ecological risk level

The risk level of plastic pollution risk index less than 10 is Class I risk, the index between 10-100 is Class II risk, the index between 101-1000 is Class III risk, the index between 1001-10000 is Class IV risk, and the index above 1000 is Class V. The results in Table 2 show that there are different levels of plastic pollution risks in different environmental media in the watershed protection area. As shown in Figure 1, there are 13 stations with Class I risk in the river water body; The number of sites with Class IV risk in sediments is the largest, 10; There are 14 sites with Class II risk in soil. On the whole, the order of plastic pollution risk level of the three environmental media is river water body<surface soil<surface sediment.

3.2. Plastic Industrial Sewage Treatment

Aiming at the sewage discharged from the plastic factory, the sequencing batch membrane bioreactor (SMBR) process was used to treat it. Through the cultivation and domestication of activated sludge, the removal efficiency of the system for micro plastics was analyzed. During sludge culture, the CODcr concentration and removal rate of influent, supernatant and supernatant filtrate in the reactor are shown in Figure 2 and Figure 3.

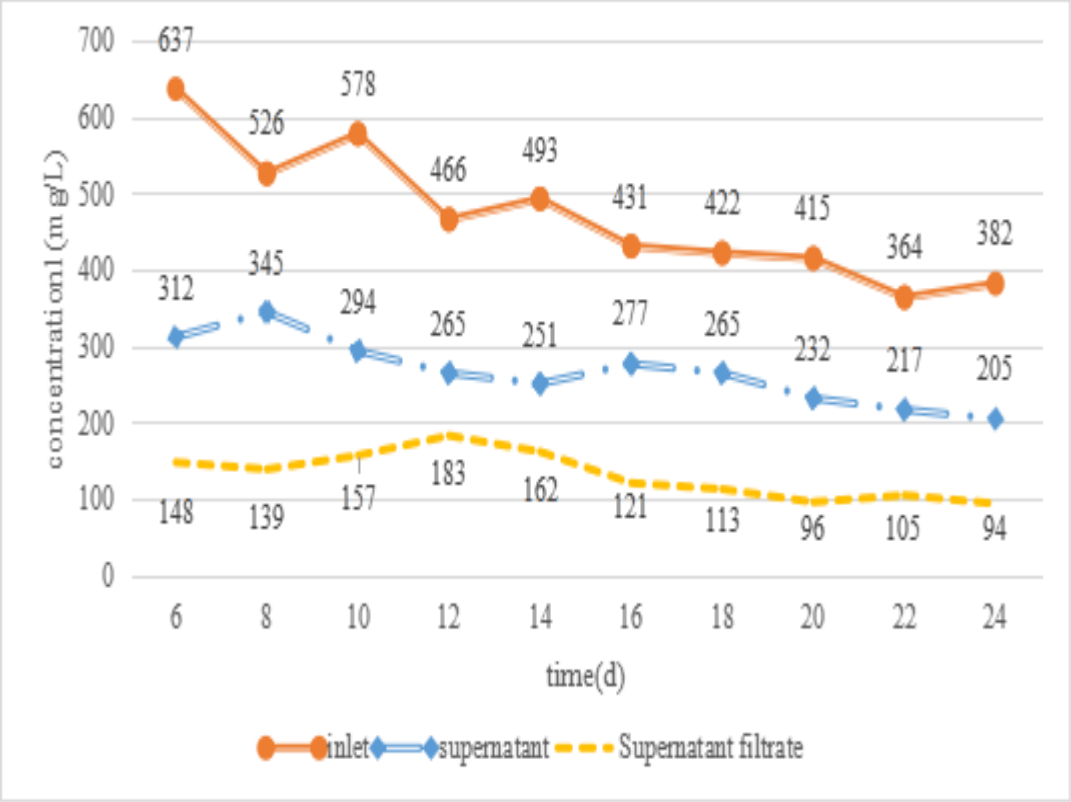

Figure 2. CODcr concentration during sludge culture

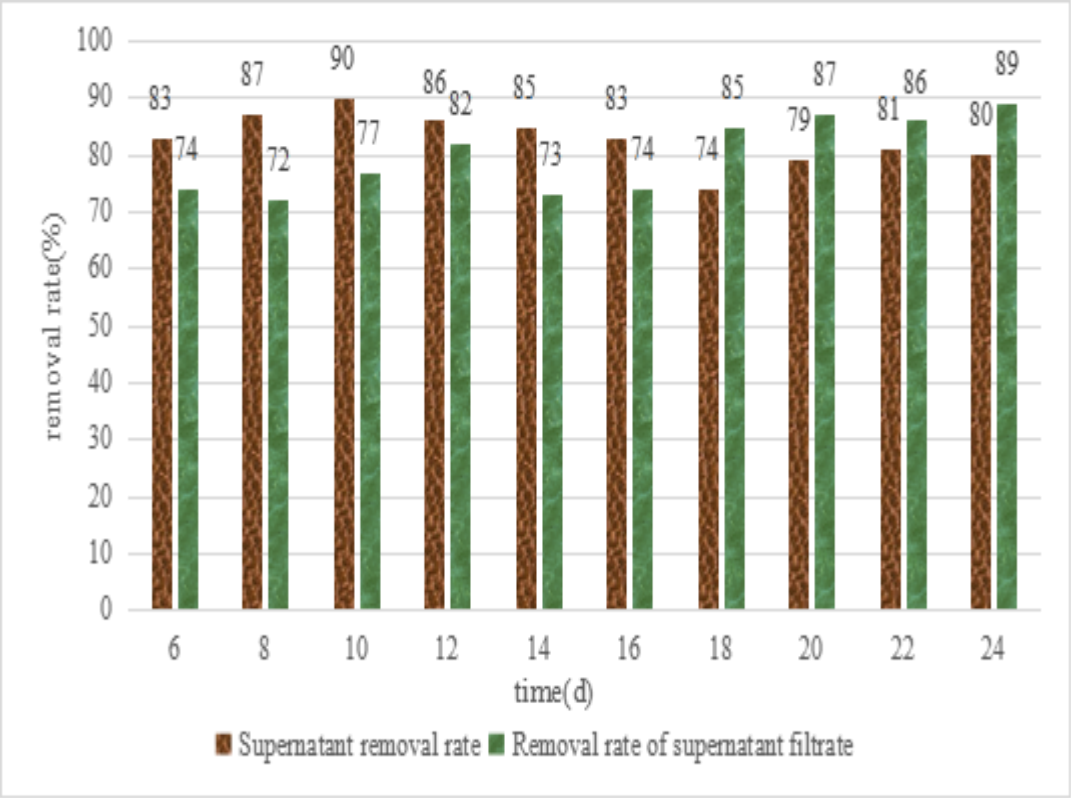

Figure 3. CODcr removal rate

After the SMBR aeration is completed, the CODcr will be detected after it is transferred to the periodic culture. It can be seen from Figure 2 and Figure 3 that the sludge concentration is relatively high at the beginning of the periodic culture, so the CODcr removal rate of the supernatant is relatively high at the beginning, with a removal rate of 83%. Before the 18th day, there were many microorganisms in the supernatant, so the CODcr of the supernatant was high. In order to obtain the true removal rate of CODcr, the supernatant was filtered by membrane, and the CODcr of the supernatant filtrate was detected. It can be seen from Figure 2 that the CODcr of the supernatant filtrate is always lower than that of the supernatant. It can be seen from Figure 3 that on the 22nd day, the CODa removal rate of the supernatant and its filtrate has reached 81% and 86%.

4. Environmental Protection Measures for Plastic Pollution

4.1. Carry out Ecological Education

To cultivate the social awareness of plastic pollution prevention, we should attach importance to the role of education, especially the development of ecological education. The improvement of the ecological education system is conducive to popularizing the concept of environmental and ecological protection to the society, coordinating the contradiction between social development and environmental pollution at the public level, and promoting the construction of a sustainable society. The concept of plastic pollution and its prevention and control was incorporated into the content of ecological education, and the corresponding signals were disseminated to the public to promote the formation of public awareness of plastic pollution prevention and control [14]. Practical ecological education mainly strengthens ecological education by carrying out practical activities, so that participants can intuitively learn environmental protection knowledge. Hot soil education and rooted education mainly play a role in stimulating and cultivating the sense of belonging of participants. Focusing on "rooted" natural education can establish a close relationship between people and nature, form a correct awareness of environmental protection, and thus help the concept of plastic pollution prevention become a social consensus.

4.2. Improve the Waste Plastic Recycling Legislation System

There are many kinds of waste, and legislation on classification of recycled waste by type should be an important content in the construction of EPR system [15]. Take the recycling of electronic and electrical appliances as an example. China's legal system on the recycling of electronic and electrical appliances wastes is relatively perfect. The reason for the remarkable results in the recycling of electronic and electrical appliances is that the rare metals and electronic components contained in such wastes have high economic value. Although some plastics are also recycled at the same time, the amount is very small and the final disposal can not guarantee that these can enter the regeneration link, Improper disposal may become the source of micro plastic pollution. These plastics attached to the waste with high recycling rate are still like this. It is conceivable how to recycle the cheap plastic products produced in daily production and life. Moreover, plastic products such as packaging bags have no reuse value based on the existing industrial technology and are directly used for garbage disposal. At present, there is no special law to regulate the recycling and disposal of this kind of plastic waste, and the operation of the existing plastic recycling system also lacks legal basis. Therefore, in the process of constructing the EPR system, it is necessary to give priority to improving the legal basis for the recycling of waste plastics.

4.3. Clarify the Producer Responsibility of Plastic Industry Related Enterprises

Clarifying the responsibility subject and the corresponding responsibilities can effectively avoid the occurrence of buck passing. Source control is the most effective way to control plastic pollution, focusing on regulating the product design and production behavior of plastic industry producers. In terms of responsibility distribution, plastic manufacturers should be the first to help establish a responsibility system that takes them as the leader and assumes the main responsibility. Plastic product manufacturers have the responsibility to check raw materials and ensure clean production. They use low toxic or even non-toxic raw materials for production to reduce the self toxicity of secondary micro plastics in the later stage. Producers should take the main responsibility for recycling. At the end of the life cycle of plastic products, producers should carry out the main recycling work. The importance of improving the waste plastic recycling legislation system is shown here. At the same time, producers should also bear the corresponding responsibility for information disclosure, such as product information and information related to recycling work [16, 17].

4.4. Establish a Diversified Supervision and Management Mechanism

A complete and effective supervision mechanism is conducive to the good operation of the extended producer responsibility system of plastic enterprises and ensures the effectiveness of the system. The diversified supervision and management mechanism mainly includes government (power department) supervision, industry supervision and social supervision. The authoritative attribute of public power has a deterrent effect. The government should strengthen the management of the operation of the producer responsibility system of plastic enterprises, improve the corresponding administrative regulations, track the performance of producers, and impose administrative penalties on producers when necessary [18]. At the same time, strengthen the training of environmental protection administrative departments, clarify their responsibilities and maintain their sensitivity.

5. Conclusion

Plastic pollution is an environmental pollution problem that the world should jointly deal with. China's plastic industry has a huge system and huge capacity, and the output of plastic products is among the best in the world. The rapid development of plastic industry brings about environmental pollution. This paper analyzes the harm of plastic industry wastewater to the watershed, evaluates the plastic ecological risk level, and uses SMBR to treat plastic wastewater to achieve better decontamination effect. In the light of the prevention and control of plastic pollution, environmental protection measures such as carrying out ecological education, improving legislation and improving the regulatory mechanism are proposed.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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