The research about how to absorb the Heavy metal chromium by Leersia Hexandra Wetland system

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Abstract. Heavy metal chromium is a hazardous environmental pollutant, and it is an economical and efficient way to purify large area of chrome-contaminated water by Leersia Hexandra. On the basis of existing researches, we summarized the methods of treating Cr(Cr) wastewater and the adsorption characteristics of Li's wetland system. Now we raised some hypotheses for future research directions.

1. Introduction

1.1. Heavy metal

Heavy metal is one of the most important substance in the environment. When the content of heavy metals in the environment exceeds a certain threshold, it will produce toxic effects [1]. Chromium is a heavy metal with cumulative toxicity [2]. Although it is one of the essential trace elements in human body, too much consumption will do harm to their health. Studies have demonstrated that excessive trivalent chromium can bind to chromosomes, which affect the replication of DNA [3]. At the same time, hexavalent chromium has been listed as the first class of carcinogen by the International Agency for Research on Cancer(IARC) [4].

1.2. Existence of Chromium.

Chromium exists mainly as Cr (III) and Cr (VI) valence states in water. The toxicity of Cr (VI) is over 100 times than Cr (III). The presence of Cr in the water body is consistent. The Cr (VI) has great migration ability in the environment. It can be reduced to Cr (III) under the certain environments. Cr (III) is easy to be absorbed by the bottom mud, and most of them can be transferred to solid phase, with a small amount of Cr (III) being soluted in water. It will be hydrolyzed by the alkalescent environment, then produce chromium hydroxide precipitate, or be adsorbed by particulate matter in water. This
weakens the migration ability of Cr (III). Therefore, the conversion of Cr(VI) to Cr(III) is the key point of wetland treatment [5-6].

2. Definition of constructed wetlands.
Constructed wetland is a system based on natural ecological principle, artificial construction and control operation. Through the adsorption, precipitation, ion exchange, plant absorption and microbial decomposition of the substrate, it can realize the ecological treatment technology [12]. The wetland substrate is the main site to remove chrome, which is also the main reaction interface of reduction, precipitation and adsorption of Cr. Matrix not only provides the stable surface for the growth of microorganisms, but also provides carrier and nutriment for aquatic plant. It also provides an answer interface for most physical, chemical and biological reactions in wetlands [13-14]. The purification effect of artificial wetland system was established by the combination of physical and chemical characteristics, area and collocation, hydraulic residence time (HRT) and organic matter content [15]. Therefore, it is important to choose suitable matrix to optimize the design of the wetland system and improve the effect of chromium purification.

3. Treatment for Cr (VI) wastewater.

3.1. Methods
At present, according to the physical and chemical properties of the Cr (VI) and the characteristics of the Cr (VI) wastewater, the methods of treating Cr (VI) wastewater at home and abroad mainly include adsorption, membrane separation, ion exchange, reduction of precipitation, electrochemical method and biological method. This can achieve environmental benefit, economic benefit and social benefit and has a broad prospect for development while we using the technology of artificial wetland to treatment Cr (VI) wastewater.

3.2. Leersia hexandra Swartz
Leersia hexagram Swartz is a kind of wet raw chromium super-rich plant [7], as showed in Fig.1.1 and Fig.1.2 [6]. It has strong tolerance and enrichment ability to heavy metal chromium, and it has the advantages of strong adaptability to environment, a better root system, and rapid growth. Also it is easy to artificially plant [8].

The order of the concentration of chromium in the plant is root > stem > leaf, and it's absorption of chromium is a single direction process. First of all, the chromium is accumulated in the root system of the plant and then shipped to the stem by transmembrane. A small amount of chromium is taken to the leaves. Once the chromium enters the plant, it is sometimes difficult to redistribute [9]. In the process of
repair to Cr contaminated soil by Lee's plants, we can improve the biomass and repair efficiency of plants by providing adequate nutrition and adequate fertilizer to the plants and soil\cite{10-12}. Therefore, it represents an efficient, and sustainable treatment method with low consumption for Cr wastewater to build Leersia hexandra-based artificial wetland system.

4. Results and Conclusions

Artificial wetland plays an important role in the treatment of heavy metal pollution, but there are many problems that need to be further studied.

Different super rich plants may have different adsorption effects on heavy metal. Singular matrix mixtures in wetlands may produce different adsorption effects. In terms of how to extract and reuse the heavy metals in plants after harvesting these super rich plants, we still need further study so as to improve more efficient utilization of Leersia hexagram Swartz.

References

\cite{1} Zheng Shan, Qiu Dongliang. Development progress of molecular biology in heavy metals pollution of plants\cite[J]. Journal of Agro-Environment Science, 2006, 25 (Suppl) : 792-798.

\cite{2} Newman M C, Unger M A. Fundamentals of ecotoxicology\cite[M]. Second Edition. Beijing: Chemical Industry Press, 2007: 1-10. More references

\cite{3} Yue Jun, Huang Bixia. Trace element chromium and human-body health care\cite[J]. The Science and Technology of Gelatin, 2005, 25 (1): 1-3.

\cite{4} International Agency for Research on Cancer, IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. IARC monographs on the evaluation of carcinogenic risks to humans\cite[M]. IARC, 2004.

\cite{5} Blowes D. Tracking hexavalent Cr in groundwater \cite[J]. Science, 2002, 295(5562): 2024-2025

\cite{6} Zhang Xuehong, Luo Yaping, Huang Haitao, etc. A new discovered hygrophyte with chromium hyperaccumulator properties—Leersia hexandra Swartz \cite[J]. Acta Ecologica Sinica, 2006, 26(3): 950-953.

\cite{7} Liu J, Duan C Q, Zhang X H, et al. Potential of Leersia hexandra Swartz for phytoextraction of Cr from soil \cite[J]. Journal of hazardous materials, 2011, 188(1-3): 85-91.

\cite{8} Liu J, Zhu Yinian, Luo Yaping, etc. Plant restoration techniques to remove heavy metals from soil\cite[J]. Journal of Jiangxi Agriculture, 2004(4): 507-511.

\cite{9} You Shaohong. Study on the properties and mechanism of Cr (adsorption) in the water purification water of lichenhe wetland\cite[D]. GUANGXI UNIVERSITY, 2017.

\cite{10} Zhang Yuyuan, Cao Chenliang, Ren Lijun, Tian Shuang, Li Ning, An Shuqing, Leng Xin. Rese arch on Pollutants Removal Effect of Different Combined Substrate under Different Hydraul ic Retention Time in Vertical Flow Constructed Wetlands \cite[J]. Ecology and Environmental Sciences, 2016, 25(2): 292-299.

\cite{11} Liu Feng,Xiang Lan, Jin Yong. Alkali - type magnesium sulfate whisker was prepared by hydrothermal method. \cite[J] Haihu salt and chemical industry.2003, 32(4):4 8.

\cite{12} Bo Yonghui,Liu Jie, You Shaohong. Different in Cr(VI) removal by constructed wetland planted with Leersia Hexandra swards using six different substrates\cite[J]. Industry Safety and Environmental Protection, 2017,43 (4) : 64-65

\cite{13} Liu J,Zhang Xh,Y SH,etc.Cr( VI) removal and detoxification in constructed wetlands planted with Leersia hexandra Swartz\cite[J]. Ecological Engineering, 2014,71: 36-40.

\cite{14} Zhang Xuehong, Luo Yaping, Huang Haitao, etc. Leersia hexandra Swartz: a newly discovered hygrophyte with chromium hyperaccumulator properties\cite[J]. Acta Ecologica Sinica, 2006, 26(3): 264-267. (in Chinese)

\cite{15} Zhang Xuehong, Chen Jun, Li Haixiang, etc. Characteristics of copper uptake by Cr-hyperaccumulator Leersia Hexandra Swartz\cite[J]. Journal of Agro-environment Science, 2008, 27 (2): 521-524. (in Chinese)