

任清新, 刘杰, 游少鸿, 周凯宁. 李氏禾湿地系统净化Cr(VI)污染水体的机理研究[J]. 环境科学学报, 2014, 34(9): 2306-2312

李氏禾湿地系统净化Cr(VI)污染水体的机理研究

### Decontamination mechanism of Cr(VI)-polluted water in constructed wetland planted with *Leersia hexandra* Swartz

关键词: [李氏禾](#) [人工湿地](#) [六价铬](#) [还原](#) [有机质](#)

基金项目: [国家自然科学基金\(No.41273142\)](#); [“八桂学者”建设工程专项经费](#); [广西危险废物处置产业化人才小高地项目](#)

作者 单位

任清新 桂林理工大学广西矿冶与环境科学实验中心, 桂林 541004

刘杰 桂林理工大学广西矿冶与环境科学实验中心, 桂林 541004

游少鸿 桂林理工大学广西矿冶与环境科学实验中心, 桂林 541004

周凯宁 桂林理工大学广西矿冶与环境科学实验中心, 桂林 541004

**摘要:** 利用湿生结瘤富集植物李氏禾构建了三段式波形潜流式人工湿地, 并以相同设计的无植物湿地系统作为对照, 比较研究了李氏禾湿地系统对Cr(VI)的净化效果。同时, 综合运用电子顺磁共振(EPR)、X光电子能谱(XPS)、傅里叶变换红外光谱(FTIR)等手段, 并结合有机质含量、pH、 $E_h$ 和Cr质量平衡分析, 探讨了李氏禾湿地系统对Cr(VI)的去除机理。结果显示, 李氏禾湿地系统对Cr(VI)的去除率显著高于对照湿地, 且李氏禾湿地基质中的有机质含量是对照湿地的3倍。这表明李氏禾增加了湿地基质中的有机质含量, 从而提高了湿地系统对Cr(VI)的净化能力。李氏禾组织中的Cr主要以Cr(III)形式存在, 其中, 茎部和叶部未检测到Cr(VI), 而仅有1.95%的Cr以Cr(VI)形式存在于根部中。EPR分析结果显示, 李氏禾叶部中的Cr(III)以有机酸结合态的形式存在, 根部中的Cr(III)以氢氧化物的形式存在, 这表明李氏禾能有效地将Cr(VI)还原成Cr(III)。基质表面吸附的Cr大部分为Cr(III), 而Cr(VI)仅占4.99%。XPS分析进一步证明, 基质表面同时吸附了Cr(III)和Cr(VI), 但主要以Cr(III)为主, 且Cr(III)可能以氢氧化物的形式存在。由此判断, 进入湿地的Cr(VI)在基质中被还原成Cr(III)。FTIR分析结果显示, 基质表面的羟基、氨基、羧基、C—O、C—O—C—H等基团与Cr的吸附有关, 这表明湿地基质中的有机质作为电子供体参与了Cr(VI)的还原。李氏禾湿地系统能将水体中可溶性的Cr(VI)有效地还原成难溶的Cr(III)化合物, 并将其转化成湿地生态系统物质循环的惰性部分。

**Abstract:** A three-stage wavy subsurface flow-constructed wetland planted with *Leersia hexandra* Swartz (SFCW-L) was set up to decontaminate Cr(VI) from water, and an unplanted system with same design parameters was used as the control. Electron paramagnetic resonance (EPR), X-ray photoelectron spectroscopy (XPS) and Fourier transform infrared spectroscopy (FTIR) analyses were applied to determine chromium species in plants and sediments. Organic matter, pH, and  $E_h$  in the sediments were analyzed, and the mass balances of Cr in SFCW-L were conducted. Cr(VI) removal efficiencies in the SFCW-L were significantly higher than those in control. Accordingly, the organic matter content in the sediment of SFCW-L was found three times that of control. The results indicated that *L. hexandra* was able to increase organic matter, thereby enhancing Cr(VI) removal. Chromium was found to predominate as Cr(III) in plant tissues, though 1.95% of the Cr(VI) was observed in roots. *L. hexandra* was able to reduce Cr(VI) to Cr(III) which was observed as a Cr(III) hydroxide phase at the roots and as a Cr(III)-organic complex in the shoots. In the sediments, Cr was found predominately in the trivalent state, while Cr(VI) accounted for only 4.99%. XPS spectra revealed that Cr(III) and Cr(VI) were both adsorbed on the sediment surface; however, most of the Cr was trivalent and might be in the form of hydroxide. These results suggested that Cr(VI) was reduced to Cr(III) in the sediments. FTIR data indicated that hydroxyl, amino, carboxyl, C—O, C—O—C—H were involved in Cr adsorption on the sediment surface. Therefore, organic matter may act as an electron donor for Cr(VI) reduction. The SFCW-L effectively reduced soluble Cr(VI) to insoluble Cr(III) compounds and transformed them into inactive parts of the biogeological cycle in the wetland ecosystem, thereby removing Cr from water.

**Key words:** [Leersia hexandra Swartz](#) [constructed wetland](#) [Cr\(VI\)](#) [reduction](#) [organic matter](#)

摘要点击次数: 236 全文下载次数: 270

关闭

下载PDF阅读器

您是第10261041位访问者

主办单位：中国科学院生态环境研究中心

单位地址：北京市海淀区双清路18号 邮编：100085

服务热线：010-62941073 传真：010-62941073 Email: [hjkxxb@rcees.ac.cn](mailto:hjkxxb@rcees.ac.cn)

本系统由北京勤云科技发展有限公司设计