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铊在河流沉积物上的吸附解吸行为研究

Adsorption and desorption behavior of Tl(I) in river sediments

关键词：铊 沉积物 吸附解吸

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摘要：水体环境条件的改变直接影响铊在水体沉积物的吸附解吸行为,进而影响到铊在水环境中的迁移、转化途径.本实验采用北京市凉水河(L8)及其沿岸的藕田(L6)沉积物作为研究对象,研究了Tl(I)在沉积物上的吸附特征及pH对其吸附过程的影响,并考察了以沉积物浸出液和背景电解质作为解吸体系时,Tl(I)自沉积物上解吸的变化情况.研究结果表明:1两种沉积物对铊的吸附速度较快,初始的5 min内,沉积物对铊的吸附量达到最大吸附量的90%(L6)和80%(L8)以上,12 h基本达到吸附平衡.2沉积物L6和L8对Tl(I)吸附量均随着初始浓度的升高而增大,但是L6的吸附量明显高于L8.两种沉积物对铊的吸附等温线用Freundlich方程和Langmuir方程拟合均得到较好的拟合结果,在分析吸附解吸机理时, Langmuir方程更能说明其物理化学意义.3pH对铊在沉积物上的吸附影响较大,随着体系pH的增大,吸附量逐渐增大.4沉积物浸出液的高效体积排阻色谱和三维荧光表征结果表明沉积物浸出液中主要以类蛋白和腐殖酸类物质为主,荧光强度集中在1100~1550之间.用沉积物浸出液代替背景电解质作为解吸体系时,解吸量增加了2.232 mg·kg^{-1}(L6)和1.494 mg·kg^{-1}(L8)(C_0=0.33 mg·L^{-1}),铊更易从沉积物浸出液的环境下解吸下来,进入水体.

Abstract: The water environment has a direct effect on the adsorption and desorption behavior of thallium (Tl) in sediments and further influences its transportation and transformation. In this study, the adsorption behavior of Tl(I) and the effect of pH on the adsorption in sediments taken from Liangshui River of Beijing (L8) and the nearby lotus pond (L6) was investigated. In addition, background electrolyte and sediment leaching solutions were used as the desorption system to examine the desorption characteristics of adsorbed Tl(I) from the sediments. Results indicated that the rates of absorption of Tl(I) onto both sediments were relatively fast, with adsorption capacities reaching 90% of the maximum (L6) and over 80% of the maximum (L8) in the initial five minutes, and the adsorption equilibrium was reached after 12 hours of reaction. With the increased initial concentration of Tl(I), the adsorption capacities of Tl(I) in sediments of L6 and L8 increased, and the adsorption capacity of Tl(I) on L6 was remarkably higher than that of on L8. Adsorption isotherms of Tl(I) on the two sediments fit well with both the Freundlich and Langmuir equation. On the analysis of mechanism of adsorption and desorption, the Langmuir equation could better illustrate its chemical and physical properties than that of Freundlich equation. pH had a great effect on the adsorption of Tl in sediments. The adsorption capacity increased gradually with the increase of the pH. The sediment leaching solution was characterized by high pressure size exclusion chromatography (HPSEC) and fluorescence excitation-emission matrix (EEM) spectrometry. The results showed that the main components in the leaching solution were proteinoid and humic substance with fluorescence intensity between 1100 and 1550. When the sediment leaching solution was used as desorption system, the desorption amount of Tl(I) increased about 2.232 mg·kg^{-1} (L6) and 1.494 mg·kg^{-1} (L8) (C_0=0.33 mg·L^{-1}). Desorption of Tl(I) in the sediment leaching solution was easier compared to $NaNO_3$ background solution, leading to a release of Tl(I) back into the water environment.

Key words: thallium sediments adsorption and desorption

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