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介孔氮化碳对水中全氟辛烷磺酸的吸附去除研究

Adsorptive removal of perfluorooctane sulfonate from water by mesoporous carbon nitride

关键词：介孔氮化碳 全氟辛烷磺酸 吸附 动力学 等温线

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摘要：以SBA-15为模板、四氯化碳和乙二胺为前驱体，通过聚合反应制备了介孔氮化碳（Mesoporous Carbon Nitride， MCN）.同时，采用X射线衍射（XRD）、扫描电子显微镜（SEM）、透射电子显微镜（TEM）、傅里叶红外光谱（FT-IR）、X射线光电子能谱（XPS）和元素分析等手段对MCN进行了表征分析，并考察了MCN对水中全氟辛烷磺酸（PFOS）的吸附性能.结果表明，MCN吸附PFOS的过程符合准二级动力学模型，其吸附行为遵循Langmuir等温线模型；MCN吸附去除PFOS的效率受溶液pH值、溶液温度及共存离子等因素的影响，其中，溶液pH值的影响最为显著，当溶液pH值分别为2.2和10.6时，MCN对PFOS的去除率分别为98.15%和5.59%；吸附PFOS饱和后的MCN可以用0.1 mol·L^{-1} NaOH溶液进行解吸，经5次循环/再生后的MCN对PFOS的去除率仍在95%以上.与介孔碳（CMK-3）和活性炭（AC）相比，MCN对PFOS显示出更优越的吸附能力.

Abstract：Mesoporous carbon nitride (MCN) was prepared using a mesoporous silica SBA-15 as the template through a simple polymerization reaction between ethylenediamine and carbon tetrachloride. The structure and surface properties of MCN were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM), Fourier transform infrared spectroscopy(FT-IR), X-ray photoelectron spectroscopy (XPS) and elemental analysis. The adsorption behaviors of MCN for perfluorooctane sulfonate (PFOS) were investigated. The results showed that the adsorption of PFOS on MCN fitted well to the pseudo-second-order kinetic model. The adsorption of PFOS on MCN followed the Langmuir isotherm model. Moreover, the adsorption capacities of MCN for PFOS were influenced by solution pH, temperature and co-existing ions, and the solution pH was the most important factor. The removal efficiency of PFOS by MCN was 98.15% at pH 2.2, but dropped to 5.59% at pH 10.6. MCN could be easily regenerated using 0.1 mol·L^{-1} NaOH solution after saturation adsorption. PFOS removal efficiency was still higher than 95% after five cycle regeneration tests. Additionally, MCN exhibited a higher adsorption capability for PFOS compared to mesoporous carbon (CMK-3) and activated carbon (AC).

Key words：mesoporous carbon nitride perfluorooctane sulfonate adsorption kinetics isotherm

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