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张小璇,任源,韦朝海,陈金贵.焦化废水生物处理尾水中残余有机污染物的活性炭吸附及其机理[J].环境科学学报,2007,(7):1113-1120

焦化废水生物处理尾水中残余有机污染物的活性炭吸附及其机理

Adsorption mechanism of organic pollutants from biologically treated coking wastewater by powdered activated carbon

关键词: [焦化废水](#) [有机污染物](#) [粉末活性炭](#) [动力学](#) [热力学](#)

基金项目: [国家自然科学基金资助项目\(No.50278036\)](#)

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摘要: 采用粉末活性炭静态吸附焦化废水生物处理尾水中的TOC成分,考察pH值、活性炭用量等因素对吸附效果的影响.从分子结构、动力学和热力学数据等方面来判断其吸附类型和吸附速率的控制步骤,并从理论上解析活性炭对尾水中残余有机污染物的吸附过程.对选定的活性炭,pH值升高对吸附有负效应;在TOC浓度为40.0~60.0mg·L⁻¹的水样中投加1.000mg·L⁻¹活性炭,吸附容量可达(37.2±7.8)mg·g⁻¹;长链烃、苯系物、卤代物等非极性有机物和酚类等酸性有机物在pH<8.0时吸附效果较好,胺类等碱性有机物在碱性条件下易于被吸附;TOC的吸附动力学符合拟二级动力学模型,液膜扩散和颗粒内扩散分别是吸附初期和吸附后期的主要速率控制步骤,吸附活化能Ea=38.75kJ·mol⁻¹;吸附等温线符合linear方程,说明吸附过程主要是有机污染物在活性炭与水溶液中的分配过程;热力学参数ΔG⁰、ΔH⁰为负值,表明该吸附是一个自发的放热过程.焦化废水生物处理尾水中残留的长链烃、卤代物、多环芳烃等难降解有机物可以通过吸附法分离去除,酚羟基、羧基等极性基团含量少的活性炭或其它非极性有机吸附剂适合于处理该类废水.

Abstract: The adsorption of the organic pollutants from biologically treated coking wastewater on powdered activated carbon (PAC) was studied. The kinetics, thermodynamics, and the main factors affecting adsorption, such as pH, PACdose and molecular structure of the pollutants were investigated. The results show that the pH value and the PACdose play important roles in the adsorption process. Raising the pH has a negative effect on TOC removal efficiency. The TOC adsorption capacity on PAC was (37.2±7.8) mg·g⁻¹ under the initial TOC concentration of 40.0~60.0 mg·L⁻¹ and a PACdose of 1.000 mg·L⁻¹, the pH value of 6.2~7.2. Long chain alkanes, benzoid compounds, halogenated organic compounds and phenolic compounds are adsorbed well at pH<8.00, while amines are adsorbed well under basic conditions. The kinetics data were regressed using Lagergren kinetic model and pseudo-second-order kinetic model. The activation energy was 38.75 kJ·mol⁻¹. The adsorption process fits a pseudo-second-order model and is controlled by external film diffusion at earlier stages and by intraparticle diffusion at later stages. The equilibrium data fit the linear model well, which shows that the process conformed to the mechanism of the linear model. ΔG⁰ and ΔH⁰ were both negative, so the adsorption is spontaneous and exothermic. Thus, activated carbon without carboxyl and phenolic hydroxyl or other nonpolar organic adsorbents is suitable for the treatment of wastewater containing refractory organic compounds such as long chain alkanes, halogenated organic compounds and polycyclic aromatic hydrocarbons.

Key words: [coking wastewater](#) [organic pollutants](#) [powdered activated carbon](#) [kinetics](#) [thermodynamics](#)

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