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研究论文

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# 改性颗粒活性炭对水中溴酸根的吸附特性研究

# Adsorptive characteristics of bromate from aqueous solutions by modified granular activated carbon

关键词：溴酸根 阳离子表面活性剂 颗粒活性炭 动力学 等温模型 热力学

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摘要：采用阳离子表面活性剂氯化十六烷基吡啶（CPC）改性颗粒活性炭以提高活性炭对溴酸根的吸附能力.通过小试研究了改性颗粒活性炭（GAC-CPC）对溴酸根的吸附特性，考察了$BrO_3^-$初始浓度、pH、共存阴离子等因素对吸附过程的影响.结果表明，CPC改性能显著提高GAC对$BrO_3^-$的吸附能力，吸附量随着初始浓度升高而增大；在碱性条件下GAC-CPC对$BrO_3^-$的吸附量减小；共存阴离子与$BrO_3^-$在GAC-CPC上存在竞争吸附，其影响顺序为：$NO_3^-$>$SO_4^{2-}$>$PO_4^{3-}$>$CO_3^{2-}$.用准一级、准二级和颗粒内扩散动力学模型拟合GAC-CPC吸附$BrO_3^-$的动力学过程，结果表明，准二级动力学能更好的描述吸附过程，且孔扩散可能是改性GAC吸附$BrO_3^-$初始阶段的主要速率控制因素.用Langmuir和Freundlich等温吸附模型拟合不同温度下$BrO_3^-$的吸附平衡过程，结果表明，Langmuir等温吸附模型能很好的描述吸附平衡过程，GAC-CPC吸附$BrO_3^-$的过程是自发且放热的，温度升高不利于吸附.

**Abstract**: Granular activated carbon (GAC) coated with cation surfactant cetypyridinium chloride (CPC) was synthesized to enhance the adsorption of bromate on activated carbon. The adsorption characteristics of bromate on CPC modified GAC (GAC-CPC) were investigated through batch experiments. The effects of initial concentration, pH, coexisting anions on $BrO_3^-$ adsorption by modified GAC were studied. The results showed that CPC significantly increased the adsorption capacity of GAC for bromate. The adsorption capacity of $BrO_3^-$ on GAC-CPC increased with the increase of initial concentration and decreased in alkaline solution. The competitive adsorption exists between coexisting anions in the order of $NO_3^-$>$SO_4^{2-}$>$PO_4^{3-}$>$CO_3^{2-}$. The pseudo first-order and second-order kinetics models and intraparticle diffusion model were employed to fit the process of bromate removal. The results demonstrated that adsorptive kinetics followed pseudo second-order kinetic models. The existed pore diffusion probably was the main controlling step of initial adsorption stage. Langmuir and Freunflich isotherms were applied to fit the $BrO_3^-$ equilibrium at four different temperatures. The resuls indicated that the adsorption equilibrium could be well fitted by Langmuir isotherm. The adsorption of bromate on GAC-CPC was spontaneous and exothermic and the adsorption capacity decreased with the increase of temperature.

**Key words**: bromate cation surfactant granular activated carbon kinetics isothermal model thermodynamics