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高岭土负载纳米Fe/Ni同时去除水中Cu^{2+}和NO_3^-

Simultaneous removal of Cu (Ⅱ) and nitrate from aqueous solution by K-Fe/Ni nanoparticles

关键词：K-Fe/Ni 同步 去除 Cu^{2+} NO_3^-

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摘要：工业废水常含有不同污染物如重金属离子和无机阴离子,而如何有效去除复合污染物就成为环境科学前沿研究的挑战性课题.这些污染物因化学性质不同而导致去除机理和途径也不同.本文采用合成高岭土负载纳米双金属Fe/Ni(K-Fe/Ni)同步去除水中Cu^{2+}和NO_3^-.结果表明K-Fe/Ni能有效去除水中Cu^{2+}和NO_3^-,但它们的去除效果却会相互受到影响.在Cu^{2+}浓度为200 mg·L^{-1}时,NO_3^-的去除率达到42.5%;而未加入Cu^{2+}时,NO_3^-的去除率仅有26.9%,说明Cu^{2+}的存在提高了NO_3^-降解效率.同样,水中NO_3^-的存在也影响Cu^{2+}的去除(Cu^{2+}去除率从99.7%降到96.5%).但NO_3^-浓度对去除Cu^{2+}的影响小于Cu^{2+}浓度对NO_3^-的影响.通过BET比表面积、X射线衍射(XRD)、扫描电镜(SEM)、X射线能量散射(EDS)和X射线光电分析(XPS)对K-Fe/Ni表征的结果显示,反应后K-Fe/Ni的表面存在铁的氧化物、Ni^0和被还原的Cu^0.基于以上结果,我们发现K-Fe/Ni同步去除水中Cu^{2+}和NO_3^-的机理是:高岭土负载下的纳米Fe^0作为还原剂,在Ni^0的催化产氢作用下将Cu^{2+}还原成Cu^0并沉积在K-Fe/Ni上而形成纳米Fe/Ni/Cu三金属催化剂,从而加速催化水中NO_3^-降解.

Abstract: Treatment of wastewater containing heavy metal and inorganic anions is challenging as they have different fates and transport mechanisms in the industrial wastewater. In this paper, bimetallic nano-Fe/Ni supported by kaolinite (K-Fe/Ni) was used for simultaneous removal of Cu (Ⅱ) and nitrate. The results showed that the removal rate of nitrate using K-Fe/Ni was mainly affected by the presence of Cu (Ⅱ). More specifically, 42.51% of nitrate was reduced in the presence of 200 mg·L^{-1} Cu (Ⅱ), while only 26.90% was reduced in the absence of Cu (Ⅱ). Similar results were also observed during the removal of Cu (Ⅱ) with the presence of nitrate. However, the effect of nitrate concentrations on the removal of Cu (Ⅱ) was less than the effect of Cu (Ⅱ) concentrations on the degradation of nitrate. To explore the degradation mechanism, K-Fe/Ni before and after reaction with Cu (Ⅱ) and nitrate was characterized by specific area BET-analyzer, X-ray diffraction (XRD), scanning electron microscope (SEM), X-ray energy-dispersive spectrometer (EDS), and X-ray photoelectron spectroscopy (XPS). The results showed that the formation of iron oxide and metallic Cu and Ni was achieved after K-Fe/Ni reacted with Cu (Ⅱ) or nitrate. This indicates that Cu (Ⅱ) was reduced to Cu^0 onto the surface of K-Fe/Ni, and eventually formed the K-Fe/Ni/Cu novel trimetal catalyst. Finally, it was proposed for the degradation mechanism model of Cu (Ⅱ) and nitrate that both Ni and Cu acted as catalysts, Fe^0 as the reductive agent and kaolinite as a support.

Key words: K-Fe/Ni simultaneous removal Cu (Ⅱ) nitrate

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