

以零價鐵為催化劑之類Fenton程序處理含螯合重金屬廢水之反應行為研究 = Treatment of chelated-metals containing wastewaters..

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摘要

本研究主旨係藉由以管柱式Fenton-like程序結合化學置換法處理含單一重金屬(Cu²⁺)及不同螯合劑(EDTA、NTA)之螯合重金屬廢水，探討反應系統中之各項操作因素(溶液初始pH值、零價鐵添加劑量、污染物初始濃度、進流液流速及過氧化氫添加劑量等)，瞭解對於反應物之反應行為與去除效率。經由污染物及氧化劑質量平衡計算，評估犧牲金屬與氧化劑之使用效率，並以BDST管柱動力模擬進行分析，以做為結合高級氧化程序及化學置換程序處理效能及最佳操作條件之取決依據。以Cementation程序處理含CuEDTA、CuNTA溶液進行管柱式反應時，總銅之去除率會隨溶液初始pH值升高、零價鐵劑量降低、污染物初始濃度增加及進流液流速升高而降低。此外，以質量平衡之觀點探討反應過程銅之型態分佈，實驗結果發現反應過後，固態銅生成率隨溶液初始pH值降低、零價鐵劑量增加、污染物初始濃度增加及進流液流速降低而有增加之趨勢。在Fe⁰/CuEDTA系統下，其最佳操作條件為在溶液初始pH值3.0、零價鐵劑量0.25 g/L、CuEDTA初始濃度5.0 mM及進流液流速6 ml/min等反應條件下，總銅於反應時間60分鐘後去除率達98%，而經過在4小時後，其總銅之總去除率達64%。而Fe⁰/CuNTA系統下，其最佳操作條件為在溶液初始pH值3.0、零價鐵劑量0.2 g/L、CuNTA初始濃度5.0 mM及進流液流速6 ml/min等反應條件下，總銅於反應時間2.5分鐘後去除率達73%，而經過在4小時後，其總銅之總去除率達28%。以Fenton-like程序處理含CuEDTA、CuNTA溶液進行管柱式反應時，總銅之去除率會隨溶液初始pH值升高、零價鐵劑量降低、污染物初始濃度增加、進流液流速升高及過氧化氫劑量增加而降低。此外，以質量平衡之觀點探討反應過程銅之型態分佈，實驗結果發現反應過後，固態銅生成率隨溶液初始pH值降低、零價鐵劑量增加、污染物初始濃度增加、進流液流速降低及過氧化氫劑量減少而有增加之趨勢。在Fe⁰/H₂O₂/CuEDTA系統下，其最佳操作條件為在溶液初始pH值3.0、零價鐵劑量0.25 g/L、CuEDTA初始濃度5.0 mM、過氧化氫劑量2.5 mM及進流液流速6 ml/min等反應條件下，總銅於反應時間2.5分鐘後去除率達70%，而經過在4小時後，其總銅之總去除率達15%。而Fe⁰/H₂O₂/CuNTA系統下，其最佳操作條件為在溶液初始pH值3.0、零價鐵劑量0.2 g/L、CuNTA初始濃度5.0 mM、過氧化氫劑量2.5 mM及進流液流速6 ml/min等反應條件下，總銅於反應時間2.5分鐘後去除率達51%，而經過在4小時後，總銅之總去除率達12%。相較於硫化物處理法、螯合型離子交換樹脂法、生物處理法、電聚浮除法、電化學法及薄膜過濾法等處理程序，本研究僅須添加適量的零價鐵及過氧化氫，即可得到甚佳的總銅去除效率，因此不僅能縮短處理時間，更能符合經濟效益。

關鍵詞：Fenton-like 程序、化學置換法、重金屬、螯合劑

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