修飾纖維素表面對銅離子吸附之研究

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摘 要

本研究探討以纖維素(Cellulose)進行改質，並配合不同改質方法，吸附重金屬銅(Cu2+)廢水之反應行為與效率研究。實驗之設計可分成三階段，第一階段為改質纖維素之製備與探討，主要利用檸檬酸表面修飾(單獨改質與複合改質)、磷酸及硫酸表面修飾四種方法進行改質。第二階段為最佳化條件進行表面改質之探討，利用不同改質濃度(0.3、0.6、0.9、1.2 M)、溫度(90、120、150、180°C)、時間(60、120、180、240 min)影響因子探討反應行為與效率研究。第三階段為針對不同實驗因子如pH效應(pH 3、4、5)、劑量效應(0.5、1.0、2.5 g/L)、濃度效應(10、20、40 mg/L)、背景離子強度效應(0、0.1 N NaCl)以及平衡吸附以溫度效應(15、25、35°C)之改變，探討與分析其對Cu2+吸附處理效果之影響。 本研究利用SEM、BET、界達電位以及FTIR對吸附劑做詳細物化分析測定。SEM分析顯示，未改質纖維素呈現片狀不規則物且大小不一，經由檸檬酸表面修飾(單獨改質與複合改質)、磷酸及硫酸表面修飾纖維素呈現桿狀物且大小與長度不一，顯示以不同表面修飾纖維素方法，證實會改其微觀結構。未改質纖維素BET為0.30 m2/g，經由磷酸與檸檬酸單獨表面修飾纖維素方法，提供改質纖維素更多比表面積，分別為2.44與0.43 m2/g。未改質纖維素等電點為pH 5.4，而其改質纖維素樣品皆無等電點表現，其界達電位皆為負值。FTIR穿透光譜分析之光譜波峰分佈，纖維素在3200-3600 cm-1出現O-H之特性吸收峰，在 2850-2970 cm-1出現C-H之特性吸收峰，在2364 cm-1 -NH之特性吸收峰，在1610-1680 cm-1出現C=C之特性吸收峰，在1340-1470 cm-1出現C-H之特性吸收峰，在1050-1300 cm-1出現C-O之特性吸收峰，在600-800 cm-1出現C-Cl之特性吸收峰。 利用不同動力學模式(Bangham's equation、Pseudo- first -order kinetic model 、Pseudo-second-order kinetic model以及Intrapariticle diffusion model)、等溫吸附模式(Langmuir、Freundlich、 Redlich-Paterson、Dubinin-Radushkevich以及Temkin)以及熱力學分析實驗數據。實驗結果在趨近於pH值金屬沉降、吸附劑劑量越高、被吸附質濃度越低、無離子強度干擾及高溫環境條件下，其對檸檬酸單獨表面修飾Cellulose Cu2+吸附效果越佳。動力學模式以Bangham's equation與實驗數據趨勢相符。平衡吸附模式以Freundlich線性回歸模擬，最符合等溫吸附模式。利用Dubinin-Radushkevich等吸附模式，求得在25°C時Ea吸附自由能為11.95 kJ/mol，顯示檸檬酸單獨改質纖維素對Cu2+吸附為離子交換吸附。利用Langmuir等溫吸附模式，算出Cu2+在25°C時最大吸附量約為15.13mg/g，且Langmuir之RL值介於0與1之間，且Freundlich之n值>1，顯示檸檬酸單獨改質纖維素對Cu2+吸附為有利吸附。吸附熱力學算出 ΔH°與ΔS°，分別為11.85 kJ/mol和 0.13 kJ/mol/K，代表此反應為吸熱且自發之反應，此吸附質容易吸附至吸附劑上，故檸檬酸單獨表面修飾纖維素容易吸附Cu2+。

關鍵詞 : 表面改質、纖維素、吸附、銅

目錄

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