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Granular hydrogel initiated by Fenton reagent and their performance on Cu(II) and Ni(II) removal

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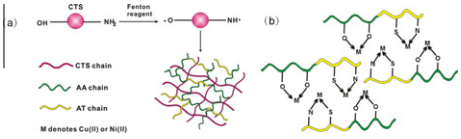
HIGHLIGHTS

- Granular hydrogel was formed using Fenton reagent in air atmosphere.
- Allylthiourea was used to decrease the swelling degree during the adsorption.
- The hydrogel can interact with Cu(II) and Ni(II) via different functional groups.
- The hydrogel can work as effective adsorbent for treatment of a real wastewater.

GRAPHICAL ABSTRACT



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ABSTRACT

With acrylic acid (AA) and allylthiourea (AT) as the monomers, an "instantaneous" granular hydrogel was prepared using Fenton reagent as redox initiator under an ambient temperature in air atmosphere, and then characterized by means of Fourier transform infrared spectroscopy and scanning electron microscope. The obtained hydrogels were investigated as the adsorbents to remove Cu(II) and Ni(II) from the aqueous solution. The effects of operating parameters on the adsorption capacity were studied, including the composition ratio (AT:AA), contact time, pH and initial concentrations of heavy metal ions. The results indicate that the introduction of allylthiourea into the hydrogel can reduce greatly the swelling ratio, but with no significant variation in the adsorption capacity as the initial Cu(II) and Ni(II) concentrations lower than 400 and 200 mg/L, respectively. In addition, the adsorption capacity shows a pH-independence at pH $\geqslant$ 4.0, and the adsorbed Cu(II) and Ni(II) can be partially desorbed using 0.01 mol/L HCl as the desorbent, rendering the as-prepared hydrogel good re-adsorption ability, especially for Cu(II). The applicability in real electroplating wastewater demonstrates that the as-prepared hydrogel with AT is promising for the removal of Cu(II) and Ni(II) for its comparable adsorption capacity with the hydrogel without AT.

1. Introduction

Chitosan (CTS), poly-β(1 → 4)-2-amino-2-deoxy-D-glucose, is the deacetylated product of chitin, poly-β(1 → 4)-*N*-acetyl-D-glucosamine, which is the second most abundant polysaccharide in nature forming the principal constituent of shells of crustaceans such as crabs, lobsters, prawns and Antarctic krill. Due to its biocompatibility and biodegradability, CTS is now receiving increasing attention and has shown prospective applications in many fields. However, CTS can only be dissolved in few diluted acid solutions, a major drawback for its further exploitation. To improve its solubility and widen its applications, there has been a growing interest in chemical modification of CTS. Among various methods, graft copolymerization is the most attractive because it is a useful technique for modifying the physical and chemical properties of natural polymers [1].

CTS bears two types of reactive groups that can be grafted: the free amino groups on deacetylated units and the hydroxyl groups

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