Synthesis of Tapioca Cellulose-based Poly(amidoxime) Ligand for Removal of Heavy Metal Ions

ABSTRACT

Poly(acrylonitrile)/cellulose block copolymer (PAN-b-cell) was prepared by using a free radical initiating process and then the nitrile functional groups of the PAN blocks of the copolymers were transformed into amidoxime ligands. The resulting poly(amidoxime) ligands could complex with heavy metal ions; for example, the reflectance spectra of the [Cu -ligand]$^{n+}$ was found to be at the highest absorbance, about 94%, at pH 6. The pH was the key parameter for metal ions sensing by the ligand. The adsorption capacity for copper was very good, 272 mg g^{-1}, with a fast adsorption rate ($t_{1/2}$ = 10 min). The adsorption capacities for other heavy metal ions such as Fe^{3+}, Cr^{3+}, Co^{3+} and Ni^{2+} were also good, being 242, 219, 201 and 195 mg g^{-1}, respectively, at pH 6. The heavy metal ions removal efficiency from water was 98% at low concentration. The data proved that the heavy metal ions adsorption onto the polymer ligands were well fitted with the Langmuir isotherm model (R^2>0.99), which suggests that the cellulose-based adsorbent surface namely the poly(amidoxime) ligand, was homogenous and a monolayer. The reusability was examined by a sorption/desorption process for six cycles and the extraction efficiency was determined. This new adsorbent could be reused for 6 cycles without any significant loss in its original removal function.