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REMEDIATION OF CHROMIUM-CONTAMINATED WASTEWATER USING SISAL-BASED HYDROGEL BEADS

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Chromium may be the sole or primary contaminant in leather tanning, stainless steel, and wood industries [1]. Aiming to produce hydrogel beads for the sorption of Cr(VI) from aqueous media, sisal fibers were deconstructed by bis(ethylenediamine)copper(II) hydroxide (CUEN), and the suspension was dropped into a $CaCl_2$ solution. The hydrogels were freeze-dried (Lyoph), placed in a citric acid (CA) solution, and heated in an oven at 120 ºC to enable the crosslinking (Lyoph_CA_120). A control sample (Lyoph_120) was also prepared. The viscosity average molar mass (M_v) of the beads redissolved in CUEN [2] was assessed to evaluate the role of CA in the cellulose chains' hydrolysis. The beads were characterized by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), water absorption, and compressive mechanical resistance. The beads were mixed with a Cr(VI) solution (1 mmol/L, pH 4.0) for 24 h. Cr(VI) was measured by UV-VIS spectroscopy. FTIR spectra confirm the esterification of –OH groups by CA. The hydrogels' M_v ranged between 86,296 g/mol (Lyoph_120) to 3,464 g/mol (Lyoph_CA_120), which means CA hydrolyzed largely the cellulose chains. The SEM images displayed the beads's high porosity. The water absorption of Lyoph_CA_120 was 1.2 times higher than Lyoph_120, which may be due to the leaching of Ca^{2+} and due to unreacted –COOH (more hydrophilic than –OH). On the contrary, the CA crosslinking of the chains raised Young's modulus of the beads, varying from 91.3 MPa for Lyoph_120 to 113.3 MPa for Lyoph_CA_120. Also, –COOH groups on Lyoph_CA_120 improved the sorption capacity of Cr(VI), achieving 5.25 mg/g (30% > Lyoph_120), because they reduce Cr(VI) to Cr(III) and complexes Cr(III) [3]. Also, the Ca^{2+} and CA crosslinking improved 3.4 times the Cr(VI) sorption capacity compared to the sisal-based hydrogel made by water coagulation. Thus, this study showed the potential of the CA crosslinked sisal-based beads to treat Cr(VI)-tainted wastewater.

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