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Magnetized Cellulose Nanofiber Extracted from Natural Resources for the Application of Hexavalent Chromium Removal Using the Adsorption Method

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Abstract : Water pollution is one of the most serious worldwide issues today. Among water pollution, heavy metals are becoming a concern to the environment and human health due to their non-biodegradability and bioaccumulation. In this study, a magnetite-cellulose nanocomposite derived from renewable resources is employed for hexavalent chromium elimination by adsorption. Magnetite nanoparticles were synthesized directly from iron ore using solvent extraction and co-precipitation technique. Cellulose nanofiber was extracted from sugarcane bagasse using the alkaline treatment and acid hydrolysis method. Before and after the adsorption process, the MNPs-CNF composites were evaluated using X-ray diffraction (XRD), Scanning electron microscope (SEM), Fourier transform infrared (FTIR), and Vibrator sample magnetometer (VSM), and Thermogravimetric analysis (TGA). The impacts of several parameters such as pH, contact time, initial pollutant concentration, and adsorbent dose on adsorption efficiency and capacity were examined. The kinetic and isotherm adsorption of Cr (VI) was also studied. The highest removal was obtained at pH 3, and it took 80 minutes to establish adsorption equilibrium. The Langmuir and Freundlich isotherm models were used, and the experimental data fit well with the Langmuir model, which has a maximum adsorption capacity of 8.27 mg/g. The kinetic study of the adsorption process using pseudo-first-order and pseudo-second-order equations revealed that the pseudo-second-order equation was more suited for representing the adsorption kinetic data. Based on the findings, pure MNPs and MNPs-CNF nanocomposites could be used as effective adsorbents for the removal of Cr (VI) from wastewater.

Keywords : magnetite-cellulose nanocomposite, hexavalent chromium, adsorption, sugarcane bagasse
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