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Adsorption of anionic and cationic dyes from aqueous solution using gelatin-based magnetic nanocomposite beads comprising carboxylic acid functionalized carbon nanotube

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ABSTRACT

Significant efforts have been made to develop adsorbents capable of removing pollutant from aqueous solutions, making it possible to easily and rapidly separate from the treated solution via the magnetic field. In the current study, a novel magnetic adsorbent based on gelatin (Gel), which is entrapped carboxylic acid functionalized multi-walled carbon nanotube (CNT) and embedded magnetic nanoparticles of iron oxide (MNPs) was successfully synthesized. The synthesized magnetic nanocomposite beads were used as an adsorbent for removal of anionic direct red 80 (DR) dye and cationic methylene blue (MB) dye from aqueous solutions. To confirm the synthesis of the nanocomposite beads, the following studies were performed: Fourier transform infrared (FTIR) spectra and X-ray diffraction (XRD), differential scanning calorimetry (DSC), and scanning electron microscope (SEM) and transmission electron microscope (TEM) analyses. In addition, the magnetic properties of the nanocomposite beads were determined using vibrating sample magnetometer (VSM). The adsorption process, kinetics, isotherm, and thermodynamics of the adsorption were studied. Notably, the magnetic biosorbent removed 96.1% of DR and 76.3% of MB in a second order kinetic model. The high adsorption efficiency and strong magnetic properties of the nanocomposite beads suggest that they may be a promising adsorbent in the water treatment industry.

Keywords: Water treatment; Pollutant; Aqueous solutions; Nanocomposite; Iron oxide; CNT

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