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Adsorptive removal of ciprofloxacin from aqueous medium by magnetic guar gum grafted graphene oxide nano composite

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ABSTRACT

In view of the huge quantum of harmful pharmaceuticals being released into the water stream from various sources, eradication or reduction of these harmful chemicals to a minimum permissible limit is of primary importance. The current work reports a two-step fabrication of magnetic guar gum graphene oxide nanocomposite, mGG/GO NC, a bio nanocomposite based on guar gum polymer blended with Graphene oxide decorated with magnetic nanoparticles. It was subsequently examined for its adsorption ability for the sequestration of ciprofloxacin form wastewater. Various techniques including XRD, Raman and FTIR spectroscopy, HRTEM, EDX, FESEM, VSM, pH_{ZPC}, and TGA have been employed for the characterization of guar gum as well the nanocomposite. Experimental kinetic and isotherm data obtained from batch adsorption studies when fitted into known models reveals that pseudo second order model and Langmuir isotherm model can best illustrate the behavior of the adsorption process. Thermodynamic studies carried out at varying temperatures confirm the spontaneity and exothermic nature of the adsorption phenomenon. Moreover, a significant extent of recyclability of the nanocomposite is predicted with a retention of adsorption efficiency up to several cycles of adsorption-desorption studies. The novel natural polysaccharide-based nanocomposite can prove to be an excellent adsorbent as evident from a considerably high maximum adsorption capacity value of 555.56 mg g^{-1}. Numerous interactions such as hydrogen bonding, electrostatic, electron-donor acceptor (EDA) or $\pi - \pi$ interactions, and hydrophobic interactions act as driving forces in the adsorption mechanism; a synergistic effect of all these interactions may have plausibly resulted in such an excellent adsorption capacity exhibited by mGG/GO NC.