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Guar gum-coated iron oxide nanocomposite as an efficient adsorbent for Congo red dye

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ABSTRACT

Functionalized Guar gum (GG) on the surface of iron oxide (Fe_3O_4) nanoparticles was synthesized via conventional co-precipitation method. The nanocomposite was characterized by Fourier transform infrared, X-ray diffraction, field emission scanning electron microscopy, transmission electron microscopy, BET, vibrating sample magnetometer and zeta potential measurement. The efficiency of the nanocomposite was investigated towards the adsorption of different dyes such Congo red (CR), malachite green, methylene blue, methyl orange, Eriochrome Black T, methyl blue and Rhodamine B. Among which CR dye shows adsorption efficiency of 97% using the prepared nanocomposite. The presence of $–NH_2$ in the CR dye was responsible for the efficient adsorption, as it easily forms hydrogen bonding with the surface hydroxyl group of Fe_3O_4-GG. The optimum condition for dye removal efficiency using Fe_3O_4-GG was investigated by varying different factors such as the influence of pH, the initial concentration of dye, adsorbent dose and influence of contact time. Moreover, the adsorption procedure was studied with various adsorption isotherms (Langmuir, Freundlich, Temkin, Dubinin–Radushkevich and Elovich) and Langmuir isotherm was best fitted to the experimental data for CR removal with maximum adsorption capacity of 60.24 mg/g. The CR adsorption rate follows the pseudo-second order and within just 5 min maximum adsorption occurred. This material can be effectively used up to five consecutive runs. Hence, the synthesized Fe_3O_4-GG can be used as a good adsorbent for CR removal and reduce the pollution load in waste water.

Keywords: Guar gum; Magnetic iron oxide; Adsorption; Congo red dye

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