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FAST REMOVAL OF MALACHITE GREEN FROM AQUEOUS SOLUTIONS USING HIGHLY HYDROPHOBIC WATER–DISPERSIBLE MAGNETIC NANOCOMPOSITE

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Abstract

Release of dyes without performing adequate treatment into the water can lead to environmental risk and serious health problems. The development of effective and economic adsorbent materials for the removal of dyes from industrial wastewaters has gained great consideration in recent years. In the present study, a novel bio-based nanocomposite has been developed for ultrasound-assisted adsorption of malachite green (MG) from aqueous solutions. The synthesized adsorbent consisting of both hydrophobic surface and hydrophilic polar functional groups was prepared by covalent binding of epoxidized sunflower oil (ESFO) on the surface of silica-coated magnetite nanoparticles. The synthesized sorbent was characterized by FE-SEM, EDS, FT-IR, XRD, VSM and thermal analysis. The effects of experimental parameters including pH, amount of sorbent, temperature and uptake time were investigated for MG adsorption on Fe_3O_4@SiO_2-ESFO sorbent using Box-Behnken design. At the optimized conditions, the adsorption capacity of the magnetic nanocomposite for MG was found to be 4.97 mg g^{-1} according to the removal yield of 90.0%, while 88% of the adsorption occurred at the first 1 min, and the adsorption equilibrium was achieved in few minutes. The results showed that the proposed Fe_3O_4@SiO_2-ESFO sorbent exhibits a strong adsorption affinity to MG, and the adsorption isotherms are well described by Freundlich model. A thermodynamic study of the adsorption indicated that MG adsorption on sorbent was an endothermic and spontaneous phenomenon.

Keywords: epoxidation, magnetic nanosorbent, malachite green, sunflower oil, wastewater treatment

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