Republic of Iraq Ministry of Higher Education & Scientific Research AL-Muthanna University College of Science Department of Chemistry



Removal of some organic compounds from aqueous solution by Binary and Ternary zinc-ferrite oxide nanocomposites as surface adsorbent: kinetic and Thermodynamic study

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By

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Abstract

In this study, ZnO-Fe₂O₃ nanoparticles were synthesized using a Co-precipitation method and then Nanocomposites were prepared by different methods. Firstly, impregnating ZnO-Fe₂O₃ nanoparticles onto polyaniline by in-situ polymerization under ultrasonic wave fields to form ZnFe2O4-PANI nanocomposites. Secondly, by using an in-situ polymerization method, ZnFe2O4 is coated with PANI in presence of graphene oxide to form a ternary nanocomposites of ZnFe2O4-PANI-GO. X-ray diffraction (XRD), Field Emission Scanning Electron Microscope (FE-SEM), Surface area analysis (BET, BJH), Fourier Transform Infrared Spectroscopy (FTER), Atomic Force Microscope (AFM), and Thermal Gravimetric Analysis (TGA) were used to characterize the nanocomposites. The FTER spectroscopy exhibits the emergence and shifts in the main band of ZnO-Fe₂O₃, PANI, and GO. Besides that, the XRD data demonstrate a shifting of the main band and average crystal sizes of nanocomposite materials for ZnFe2O4-PANI and ZnFe2O4-PANI-GO different from ZnO-Fe2O3 (36.88 nm). Additionally, the ZnO-Fe2O3 nanoparticles are homogeneously dispersed throughout the PANI matrix of ZnFe₂O₄-PANI nanocomposite, according to the AFM and FE-SEM images. While PANI, GO, and ZF nanomaterials are wrapped together to form ZnFe2O4-PANI-GO ternary nanocomposite. The resultant nanocomposites were used to remove Orange G dye and Malachite green dye from an aqueous solution. Using batch adsorption, the effects of different parameters on the removal of the two dyes can be studied, including contact time (5-120 min), adsorbent dose (0.005-0.05 g), and pH (2-10). The thermodynamic study concluded that the adsorption of both dyes was spontaneous in nature according to negative values of (ΔG°) and exothermic according to negative values of (ΔH°) . Besides, the adsorption pursued pseudo-second-order kinetics. In addition, the isotherm models Freundlich, Langmuir, and Temkin were used to model the

experimental adsorption data. The results showed Freundlich isotherm was the most suitable with experimental data.