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DEVELOPMENT OF Fe@MgO NANOPARTICLES FOR ENHANCING THE ADSORPTION OF METHYLENE BLUE DYE

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Abstract

Industrial dye effluents are a significant concern and require to be treated before being discharged into the environment. Magnesium oxide (MgO) has been known as an excellent adsorbent for a variety of environmentally polluted compounds. This study synthesizes Fe@MgO nanocomposites via facile precipitation-calcination approach by using tetraethyl orthosilicate (TEOS) as a protective and coupling agent to remove the methylene blue in the wastewater. Powder X-ray diffraction analyses (XRD) were performed to characterize the physical properties of synthesized Fe@MgO nanocomposites and scanning electron microscopy (SEM) was used to observe their morphology and particle size, and the X-ray photoelectron spectroscopy (XPS) method was used to obtain the elemental composition as well as the chemical and electronic state of the atoms within a material. The adsorption performance was studied by batch experiments using a UV- vis spectrometer for methylene blue dye (MBD) removal. The results showed that as-prepared Fe@MgO nanocomposites are composed of cubic structures of Fe, Fe_3O_4, and MgO with granular morphology. Fe_3O_4 shows magnetic properties while, Mg, Fe, and O are in the electronic configuration of 1s, 2p, and 1s with 1302.2 eV, 710 eV, and 530 eV respectively. The contact time of the as-prepared Fe@MgO for methylene blue dye was 120 min. Langmuir model fitted better with the experimental data of methylene blue adsorption with higher correlation coefficients (R^2>0.9911), suggesting the methylene blue adsorption onto Fe@MgO is monolayer chemisorption. Furthermore, the maximum adsorption capacity (q_m) calculated by the Langmuir model was 1857.0 mg g^{-1} which was close to the experimental value of 1440.0 mg g^{-1}. It was found that the adsorption process was very fast, and the adsorption capacity of Fe@MgO was higher compared to Fe_3O_4/carboxymethyl-β-cyclodextrin (CM-β-CD), $MgFe_2O_3$@SiO_2, and Cobalt zinc ferrite.

Keywords: *adsorption, magnetic MgO, methylene blue dye, precipitation-calcination*