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Central Composite design (CCD) optimization and characterization of removal of Entacapone drug using copper zinc cobalt ferrite nanoparticles modified by cetyltrimethylammonium bromide ($Cu_{0.3}Zn_{0.3}Co_{0.4}Fe_2O_4$@CTAB) nanoparticles and Adsorption Characterization

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Abstract: Copper zinc cobalt ferrite nanoparticles modified by cetyltrimethylammonium bromide ($Cu_{0.3}Zn_{0.3}Co_{0.4}Fe_2O_4$@CTAB NPs) are used as an efficient adsorbent to remove Entacapone (En) drug from aqueous solutions. The characterization of adsorbent is investigated by field emission scanning electron microscopy (FE-SEM), X-ray diffraction (XRD), Fourier transform infrared (FT-IR) spectroscopy, energy dispersive X-ray spectroscopy (EDX), and the vibrating sample magnetometer (VSM) technique. To optimize the effective factors, response surface methodology (RSM) through using Central Composite design (CCD) is applied. By proper running of the Desirability function option in MINITAB software, the optimum conditions were found as pH 3.0, adsorbent mass (m) 10 mg, and initial dye concentration (C_d) of 77 mg L^{-1}. Isotherm studies of the adsorption process are carried out where the Langmuir isotherm shows the maximum monolayer capacity (q_{max}) is 224 mg g^{-1}. The kinetic studies including pseudo-first-order, pseudo-second-order and intra-particle diffusion models indicate that the pseudo-second-order kinetic model describes better the adsorption kinetic behavior. This study shows that $Cu_{0.3}Zn_{0.3}Co_{0.4}Fe_2O_4$@CTAB NPs have excellent potential for the removal of Entacapone (En) drug from an aqueous solution.

Keywords: Adsorption; mixed magnetic oxides nanoparticles; removal; drug; Response surface methodology

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