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Metronidazole adsorption on $CoFe_2O_4$/activated carbon@chitosan as a new magnetic biocomposite: modelling, analysis, and optimization by response surface methodology

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ABSTRACT

A novel magnetic biocomposite adsorbent $CoFe_2O_4$/Activated Carbon@Chitosan (CF/AC@Ch) was synthesized and applied for metronidazole (MNZ) adsorption from aqueous solutions. The magnetic biocomposite adsorbent was characterized by field emission scanning electron microscopy (FESEM), the Brunauer–Emmett–Teller (S_{BET}), Fourier transform infrared spectroscopy (FTIR), X-ray powder diffraction (XRD), and vibrating sample magnetometer (VSM). Powder XRD analysis confirmed the formation of phase spinel ferrites. FESEM analysis confirmed the morphology of the samples with a smaller agglomeration. VSM analysis clearly showed the ferromagnetic nature of the adsorbent. The Ms value was 22.03 emu/g for simple separation by external magnetic fields. The influence of parameters such as the adsorbent dose, pH, MNZ initial concentration, and contact time was examined and evaluated by central composite design (CCD) with response surface methodology (RSM). The predicted optimal adsorption capacity (q_e) of 36.897 mg/g was obtained under optimal conditions as follows; adsorbent dose: 450 mg/L, pH: 5.02, MNZ initial concentration: 22.35 mg/L and contact time: 46.25 min. The quadratic model was obtained with a high degree of fit. The experimental equilibrium data fitting to Langmuir and Freundlich models show that the Freundlich model is a good and suitable model for evaluation and the actual behavior of adsorption. The equilibrium adsorption capacity of MNZ declined from 35.90 mg/g in the pure solution of MNZ to 21.5 mg/g in the wastewater sample.

Keywords: Metronidazole; Optimization; Magnetic biocomposite; Response surface methodology

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