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Modeling mercury (II) removal at ultra-low levels from aqueous solution using graphene oxide functionalized with magnetic nanoparticles: optimization, kinetics, and isotherm studies

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ABSTRACT

Magnetic graphene oxide (Fe_3O_4@SiO_2-GO) nanocomposite was fabricated through a facile process and its application was found to be an excellent adsorbent for capturing low concentrations of mercury (II) from water. The effects of four independent factors, including nanocomposite dosage, contact time, pH, and initial mercury ion concentration on the mercury (II) removal were studied, and the process was optimized using response surface methodology (RSM). The optimum values of the variables adsorbent dosage, contact time, pH, and mercury (II) initial concentration were found to be 23 mg L^{-1}, 21 min, 5.5, and 550 ppb, respectively. The adsorbent equilibrium capacity was 328.3 mg g^{-1} after 21 min. By using goodness-of-fit measures (GoFMs), the Sips isotherm was found to provide a good fit with the adsorption data (K_S = 0.388 L mg^{-1}, n_S = 0.44, q_m = 569.3 mg g^{-1}, and R^2 = 0.989). The mean free energy E_{ads} was 11.901 kJ/mol, confirmed chemisorption mechanisms. The kinetic study determined good compliance of experimental data with the double exponential kinetic model (R^2 = 0.997).

Keywords: Graphene oxide; Adsorption; Mercury (II); Response surface methodology; Central composite design; Model

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