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Preparation of NH_2-SH-GO/MWCNTs composite for simultaneous removal of Pb(II), Zn(II) and phenol from aqueous solution

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ABSTRACT

In the present work, NH_2-SH-GO/MWCNTs that graphene oxide (GO) and multiwalled carbon nanotubes (MWCNTs) were chemically modified with amino and sulfydryl groups, were synthesized by a simple process for simultaneous adsorption of pollutants, such as Pb^{2+}, Zn^{2+} and phenol in water solution. The structure of composite (NH_2-SH-GO/MWCNTs) was analyzed by transmission electron microscopy, scanning electron microscopy, Fourier transform infrared spectroscopy, thermogravimetric analysis, Raman spectrum, X-ray diffraction and X-ray photoelectron spectroscopy. Brunauer–Emmett–Teller surface areas and pore diameter were studied by nitrogen adsorption–desorption isotherms. Experimental conditions affecting adsorption process, such as pH, initial ion concentrations and adsorbent dosages, were studied. Adsorption process of metal ions and phenol was evaluated by Langmuir and Freundlich isotherm models. Pseudo-first-order and pseudo-second-order kinetic models were tested for fitting the adsorption data. The optimum conditions, specified as 25 mg/L of adsorbent, 10 mg/L of adsorbate at pH 5 and time of 60 min, led to the achievement of a high adsorption capacity. The maximum adsorption capacity of NH_2-SH-GO/MWCNTs was 125.8, 98.6 and 23.8 mg/g for Pb^{2+}, Zn^{2+} and phenol, respectively. The results of adsorption isotherm and kinetics showed a good fit to Freundlich isotherm model and pseudo-second-order kinetic model, respectively. Thermodynamic parameters, such as ΔG^{θ}, ΔH^{θ} and ΔS^{θ}, were calculated. The thermodynamics results indicated the adsorption process was spontaneous and endothermic. The adsorption performance of adsorbent indicated the feasibility of applying for industrial purposes.

Keywords: Adsorption; Graphene oxide; Metal ions; Phenol; MWCNTs

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