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Study of Cu^{2+}, Ni^{2+}, and Zn^{2+} competitive adsorption on synthetic zeolite: an experimental and theoretical approach

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ABSTRACT

In this study, isotherm models were used to describe the interactions between adsorbent (zeolite 4A) and adsorbate (Cu^{2+}, Ni^{2+}, and Zn^{2+}) at different concentrations in both simple and multicomponent systems. To assess the effect of the mass transfer parameters on the adsorption kinetics, the pore diffusivity model was also applied. The adsorption selectivity of the adsorbent material was evaluated as a function of the initial concentration in binary and ternary systems, as well as the competitive adsorption between the metallic ions in synthetic zeolite 4A. The synthesized zeolite was characterized by different techniques such as powder X-ray diffraction, infrared vibrational spectroscopy, and scanning electron microscopy. Langmuir, Freundlich and Sips isotherm models fitted the experimental data of Cu^{2+} and Ni^{2+}, whereas Langmuir and Freundlich models fitted the experimental data of Zn^{2+}. The adsorption kinetics was fast for Cu^{2+} and Zn^{2+}, and slow for Ni^{2+}, which is consistent with the pore diffusivity results, in which higher diffusion values for Cu^{2+} and Zn^{2+} were obtained, and indicates a higher selectivity of the synthesized zeolite 4A for Cu^{2+} and Zn^{2+}.

Keywords: Zeolite; Metals; Selective adsorption; Isotherm models; Kinetic models

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