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Optimization of heavy metals removal from wastewater by magnetic nano-zeolite using response surface methodology

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ABSTRACT

Response surface methodology (RSM) has been utilized to analyze and optimize sensitive parameters that can affect the reliability of removal processes. This paper aimed to utilize magnetic nano-zeolite (MNZ) as an adsorbent to remove heavy metals, mainly cadmium (Cd(II)) and copper (Cu(II)) ions, from wastewater. Field-emission scanning electron microscopy, zeta potential, and energy-dispersive X-ray spectroscopy were used to characterize the MNZ. The results showed that the maximum removal ratio for cadmium (Cd(II)) was 93%, and for copper (Cu(II)) was 94.5% at optimal conditions of a 68-min run time, pH of 6.5, MNZ of 0.3 mg/L, Cd(II) and Cu(II) concentrations of 50 ppm, and shaking speed of 233 rpm. The model-predicted responses also showed good agreement with actual data (R^2 = 0.9986 for Cd(II), 0.9976 for Cu(II)), demonstrating the effectiveness of this approach for making precise predictions. The adsorption using MNZ was better than that using natural zeolite due to its high cation exchange capacity and large surface area.

Keywords: Magnetic nano-zeolite; Cd(II) removal; Cu(II) removal; RSM; Treatment; Wastewater

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