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Adsorption of oxytetracycline from aquaculture wastewater by modified zeolites: kinetics, isotherm, and thermodynamics

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ABSTRACT

In this study, lanthanum modified zeolite (La-Z) was used as an adsorbent to adsorb oxytetracycline (OTC) from aquaculture wastewater. La-Z was characterized by scanning electron microscopy, transmission electron microscopy, energy-dispersive X-ray spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy, and Brunauer–Emmett–Teller. The effects of modification concentration of lanthanum on zeolites (0–0.06 mol/L), the dosage of La-Z (0.02–0.12 g), initial concentration of OTC (5–30 mL), solution pH (5–10) and reaction time (10–60 min) on the adsorption of OTC by La-Z were investigated. Orthogonal experiments were used to find the optimal adsorption conditions. The kinetics were studied by a quasi-first-order model, quasi-second-order model, Weber–Morris, Ritchie-second-order model, and Boyd models, and the isotherms were analyzed by Langmuir and Freundlich models. When the modified concentration of lanthanum was 0.02 mol/L, the dosage of adsorbent was 0.1 g, the initial concentration of OTC was 5 mg/L, the adsorption time was 40 min, pH was 7, and the removal rate was 99.18%. The initial concentration of OTC has maximum influence on the adsorption process. The kinetic results have shown that there was a significant linear correlation between the experimental results and the quasi-second-order kinetic model. By the internal diffusion model, it is found that the La-Z adsorption rate was controlled both internal diffusion and external diffusion in common, which was a multi-step process. The adsorption isotherm conforms to the Langmuir model, and the maximum adsorption quantity was 36.38 mg/g. The thermodynamic showed that the adsorption process was an endothermic process in which entropy was increased making it a spontaneous process.

Keywords: Adsorption; Antibiotics pollutants; Aquaculture wastewater; Kinetics

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