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Phosphate removal using aluminum-doped magnetic nanoparticles

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ABSTRACT

Modern industrial waste waters often contain high concentrations of phosphate, and many methods have been explored to aid in its removal. This study investigates the use of magnetic nanoparticles as an adsorbent for phosphate removal. Aluminum-doped magnetic nanoparticles were synthesized using a co-precipitation method. Structure and composition analysis of the prepared magnetic nanoparticles indicated an inverse spinal structure with a composition of $FeAl_{0.75}Fe_{1.25}O_4$. These nanoparticles were tested for their phosphate removal properties, including adsorption capacity, selectivity, and kinetic models. They showed great affinity to phosphate with a maximum adsorption capacity of 102 mg/g. Additionally, the adsorption was selective, and the presence of other common anions and organic matters did not interfere with the phosphate adsorption efficacy. The kinetic analysis of phosphate adsorption suggested a pseudo-second-order adsorption behavior, and the adsorption isotherm studies indicated a Langmuir type adsorption. The phosphate removal capabilities of the nanoparticles were also tested in poultry rinsing water, tap water, and municipal wastewaters, all with high phosphate removal efficiency. The overall results from these experiments showed promising results for the phosphate removal efficacy of these nanoparticles.

Keywords: Phosphate; Adsorption; Magnetic nanoparticle; Wastewater treatment

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