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Efficient adsorption of nitrate and phosphate from wastewater by the cost-effective Mg/Ca bimetallic oxide composites functionalized peanut shell

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ABSTRACT

Large amounts of nitrogen and phosphorus elements were discharged into the environment. They would lead to severe eutrophication of water bodies. The development of economically efficient, green and ecological adsorbents is the current focus for adsorption technology. In this research, the cost-effective biochar modified by Mg/Ca bimetallic oxide composites (Mg/Ca@PS) for adsorption of NO_3^- and PO_4^{3-} ions in aqueous solution was investigated. Additionally, Mg/Ca@PS also was characterized by scanning electron microscopy, transmission electron microscopy, energy-dispersive X-ray analysis, X-ray diffraction, and Fourier-transform infrared spectroscopy, respectively. The experimental results showed that the adsorption process of NO_3^- ions in aqueous solution by Mg/Ca@PS could be described by pseudo-second-order kinetic model and Langmuir isotherm model, respectively. However, the adsorption process of PO_4^{3-} ions in solution by Mg/Ca@PS could be described by pseudo-second-order kinetic model and Freundlich isotherm model, respectively. Additionally, the adsorption capacity of NO_3^- and PO_4^{3-} ions in aqueous solution by Mg/Ca@PS were 18.52 and 47.85 mg/g, respectively. The adsorption mechanisms of NO_3^- ions and PO_4^{3-} ions in solution by Mg/Ca@PS mainly contain surface adsorption, intraparticle diffusion, electrostatic attraction, and ion exchange. Moreover, the adsorption mechanism of PO_4^{3-} ions in solution by Mg/Ca@PS also includes chemical precipitation. In the five recycle times, the removal rate of NO_3^- and PO_4^{3-} ions still reached 55.31% and 48.12%, respectively. It indicated that the chemical stability of Mg/Ca@PS was very well, and it was a good environmental friendly material.

Keywords: Adsorption; Nitrate and phosphate; Mg/Ca bimetallic oxide composites; Peanut shell

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