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Recovery of phosphate from wastewater using alumina nanotubes

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ABSTRACT

Phosphorus is an essential nutrient for every plant and animal. Excess of phosphorus stimulates algal growth in water bodies, resulting in eutrophication of the surface water. In this work, self-organized hexagonal nanotubes were fabricated on the surface of aluminum foil via a two-step electrochemical anodization, and the adsorption performance of the alumina nanotubes (ANT) for phosphate removal from wastewater was evaluated. The morphology of the ANT film was characterized by field emission scanning electron microscopy, X-ray diffraction, energy dispersive X-ray spectroscopy, and Fourier transform infrared spectroscopy. The different parameters that affect the adsorption, such as the initial PO_4^{3-} concentration, pH, contact time, temperature, and coexisting anions, were investigated. The adsorption isotherm results illustrated that the Langmuir model was more suitable than the Freundlich model. Thermodynamic studies showed that the adsorption of phosphate was endothermic and spontaneous in nature. The adsorption capacity of ANT was more effective at acidic pH because of the increase in attractive forces between the phosphate anions and charges on the ANT surface. Kinetic modeling studies showed that the adsorption process obeyed the pseudo-second order. The adsorbed phosphate was successfully detached using NaOH. Thus, it was concluded that ANT is a highly efficient adsorbent material for phosphate recovery from wastewater.

Keywords: Anodization; Alumina nanotubes; Adsorption; Phosphate; Reusability

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