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PHOSPHORUS REMOVAL FROM MUNICIPAL WASTEWATER WITH A MAGNETIZED COCONUT WASTE BIOCARBON ADSORBENT

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Abstract

The discharge of phosphorus-rich effluents is a major driver of eutrophication in aquatic systems, leading to substantial ecological impacts. In this study, a magnetized biocarbon derived from coconut waste was developed as an environmentally friendly and cost-effective adsorbent for phosphorus removal from municipal wastewater. The biocarbon was produced via torrefaction and subsequently magnetized in hematite solutions. The resulting materials were characterized using chemical analyses, TGA, DTA, XRD, and FTIR. Adsorption tests were conducted with effluents from a municipal wastewater treatment plant in the Amazonas region of Peru, employing a 2^2 factorial design to evaluate the effects of adsorbent dosage and contact time. Adsorption kinetics were analyzed using kinetic, intraparticle diffusion, and film and pore diffusion models. Magnetization results indicated limited significance, as magnetization time did not emerge as a major factor in phosphorus removal, suggesting that optimization of magnetization parameters remains necessary. In contrast, adsorption tests revealed high phosphorus removal efficiency, with dosage and contact time identified as critical variables. Pourbaix diagrams provided insight into the electrochemical stability and phase behavior of iron and phosphorus compounds, while kinetic studies indicated that the process followed a PSO model, with chemisorption and intraparticle diffusion as the predominant mechanisms. Overall, coconut waste-derived magnetized biocarbon proved to be an effective adsorbent for phosphorus removal, offering a practical and sustainable solution for wastewater treatment and resource recovery in developing countries.

Key words: adsorption kinetics, biowaste, magnetized biocarbon, wastewater treatment

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