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Design and optimization of titania-doped carbon nanocomposites for efficient cadmium removal from aqueous solutions

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Abstract	This research aimed to develop and optimize a titania-doped carbon nano-adsorbent composite (CNAs/TiO₂) for the removal of cadmium (Cd²⁺) from aqueous solutions. Carbon nanotubes and nanofibers were acid-treated and combined with varying ratios of TiO₂ using a controlled impregnation-calcination method. Optimization of synthesis parameters, including titania loading, sonication time, and calcination temperature, was conducted using Response Surface Methodology (RSM) with a Central Composite Design (CCD). Characterization via BET, SEM, TGA, FTIR, and XRD revealed enhanced surface area (increased from 92 to 184 m²/g), improved morphology, thermal stability, and the presence of oxygen-rich functional groups favorable for Cd²⁺ adsorption. Batch adsorption experiments showed maximum adsorption capacities reaching 52.81 mg g⁻¹ under optimal conditions. The Langmuir model (R² = 0.994) best described the adsorption isotherm, while the pseudo-first-order model showed the highest correlation coefficient (R² = 0.978) among kinetic models. This study fills a gap in the literature by demonstrating how RSM-optimized TiO₂ doping can significantly enhance the performance of carbon nanomaterials for heavy metal remediation, offering a scalable and cost-effective solution for wastewater treatment.
Keywords	Author Keywords: Cadmium; Multiwall carbon nanotubes; Conical carbon nanofiber; Carbon Nano adsorbent; Titanium oxide; And RSM Keywords Plus: HEAVY-METAL IONS; ADSORPTION; NANOTUBES; WATER
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