Using Raw Bamboo Waste to Sustainably Purify Water

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Anionic dyes are commonly used in the paper, dyeing, petroleum, and textile industries, contributing to global water pollution that harms microbial populations and can be carcinogenic to mammals. However, current techniques of dye removal are largely inefficient and expensive, making them infeasible for large-scale use in developing countries. The goal of this research was to develop an eco-friendly, affordable, and sustainable technique for wastewater purification. The methodology developed in this study utilizes the reaction between the aldehyde groups of dialdehyde cellulose (DAC) and cationic Girard's Reagent T ((2-hydrazinyl-2-oxoethyl)- trimethylazaium chloride, GT) to synthesize a positively charged cellulose derivative called cationized dialdehyde cellulose (cDAC). The use of cDAC as a cheap and sustainable adsorbent is considered for the removal of negatively charged dyes such as Congo Red (CR). The influences of a variety of parameters were tested, including pH, dye concentration, contact time, and cDAC concentration. The adsorption kinetics were modeled by pseudo-first-order kinetics and pseudo-second-order kinetics. Additionally, the adsorption equilibrium data conformed to the Langmuir and Freundlich isotherm models. Promising results were obtained for the use of cDAC as a new adsorption agent for CR, with a high adsorption capacity (Qm) of 909.09 mg/g and the ability to remove 99.9% of dye from wastewater in just 15 minutes. This adsorbent opens numerous applications for sustainable and effective wastewater purification.

Awards Won:
U.S. Agency for International Development: USAID Science for Development Third Place Award of $2,000.
Fourth Award of $500