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Adsorption and Photocatalytic Degradation of Textile Wastewater Using Green Synthesized Sequesters

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Abstract : This study carried out the physicochemical analysis of the Textile WasteWater (TWW) before and after the adsorption and photocatalytic processes. The adsorbents and catalysts that were used for this study were prepared from C. albidum seed shell activated with steam and then loaded with Titanium Dioxide Nanoparticles (TiO2NPs) and Copper Nanoparticles (Cu NPs), which were synthesized from green tea leaf extract and Citrus limon fruits extract, respectively. The photocatalytic activity was carried out under sunlight irradiation, and the effect of various parameters, such as catalyst dose, pH, contact time, and initial dye concentration, on the removal efficiency, were studied. The reusability of the catalyst was also observed to determine its stability and long-term efficacy. Ultra-violet visible spectroscopy (UV-Vis spectroscopy) was used to determine the dye concentration after each experiment. The adsorbents, nanoparticles, and photocatalysts were appropriately characterized for morphological, functional group, structural, and surface area using Scanning Electron Microscopy (SEM), Fourier-Transform Infrared Spectroscopy (FTIR), X-ray diffraction (XRD) analysis, and Brunauer–Emmett–Teller (BET) analysis respectively. Batch adsorption studies were carried out on the wastewater, using the composite adsorbents, to determine the effects of pH, adsorbent dose, initial dye concentration, and contact time. The batch adsorption studies were conducted based on the runs generated from the Definitive Screen Design (DSD) of the Response Surface Methodology (RSM). The obtained data were subjected to the pseudo-first-order, pseudo-second-order, and intra-particle diffusion kinetic models, the Langmuir and Freundlich isotherm models, and thermodynamic parameters. The findings of this study contribute to the existing knowledge by providing more insights into the identification of efficient, low-cost, and environmentally-friendly approach to textile wastewater treatment. This approach enhances the reduction of potential toxicity from the discharged textile wastewater into the environment and, thus, conforms to Sustainable Development Goal 6 (SDG 6), which ensures the sustainability of the water resources, wastewater, and ecosystems.

Keywords : adsorption, photocatalytic, textile wastewater, green synthesized sequesters, degradation
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