Synthesis OfTiO_2/CuO Nanoparticles and Its Application in Simulated Wastewater Treatment

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ABSTRACT

Introduction: Water is essential tool for life in all forms, but this precious gift of nature is going to be contaminated due to advancement in technology and rapid industrialization. The use of hazardous chemicals for industrial purposes mainly colorants (dyes and pigments) pollute water badly. Dyes not only increase water pollution, but they also interfere in photosynthesis and normal biological processes. Therefore, the removal of such colored compounds from wastewater stream becomes environmentally important. The current water pollution problem can be resolved by nanomaterials which have unique properties for wastewater management. In the present research work, TiO_2/CuO nanoparticles were successfully synthesized by employing chemical method. The morphological, structural and chemical studies were performed by using Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray Spectrometry (EDS) and Fourier Transform Infrared Spectroscopy (FTIR).

Objective: Removal of dyes from wastewater by using synthesized nanoparticles.

Methodology: The synthesized nanoparticles were efficiently utilized as adsorbent for the Malachite Green dye by Ultrasonication assisted adsorption process. Central composite design with 5 factors was employed to design the adsorption experiment. Factors of Time, pH, amount of adsorbent, concentrations of Malachite Green dye were studied. Optimum operating parameters were evaluated by RSM. The OOP for the removal of MG were observed to be 7.6 min, pH of 6.9, 0.023 g of adsorbent, 12.57mgL-1 concentration of MG, the removal of MG was observed to be 84.83%. Adsorption equilibrium was studied by Freundlich, Langmuir, Dubinin- Radushkevich, and Temkin isotherm model.

Conclusion: The Freundlich model was observed to be well followed by MG-systemat temperature. Removal of dyes followed pseudo second order kinetics. Desorption performed in different solvents. The urodynamic Studies were performed to assess the feasibility of the adsorption process and it was observed that dye adsorption was spontaneous in nature as indicated by the negative ΔGo and positive ΔSovalues.

Keywords: Adsorption; Central Composite Design; Nanoparticles; Response Surface Methodology; Ultrasonication; Waste water treatment.