Biogenic Synthesis and Characterization of ZnO Nanoparticles for Degradation of Synthetic Dyes: A Sustainable Environmental Cleaner Approach

Shumaila Kirana*, Atizaz Rasoola
Department of Applied Chemistry, Government College University, Faisalabad-38000, Pakistan
*E-mail: shumaila.asimch@gmail.com

ABSTRACT

Agro-wastes including leaves, manure, plant parts, and vegetables, etc. are usually unusable, therefore discarded in agricultural activities which may lead to different environmental and health issues. This study is focused on the use of agro-waste to synthesize ZnO nanoparticles which are applied for the degradation of two synthetic dyes. Zinc oxide nanoparticles (ZnO-NPs) are synthesized from the fruit peel extract of *Citrus limetta* (*C. limetta*). The optimized conditions to synthesize ZnO-NPs were 80 °C temperature, 9 pH, 1:4 reactant ratio and 80 minutes' contact time. ZnO-NPs were characterized by UV-Visible spectroscopy showing a λ_{max} at 350 nm. Scanning Electron Microscopy (SEM) was used to characterize the shape and size of synthesized ZnO nanoparticles. The nanoparticles' size varied from 40 to 42 nm. ZnO-NPs were then applied for the remediation of two dyes Basic Brilliant Flavine Y-40 (dye A), and Direct Fast Rose FR Red 227 (dye B) following the optimization of experimental factors like dye concentration, nanoparticles concentration, pH, H_2O_2 level and temperature. The synthetic dyes were decolorized 30 % at 0.02 %, and 49 % at 0.04% with dye concentration, 43 % at 5 mg and 56 % at 4 % NPs, 58 % and 63 % at 7 pH, 71 % at 0.4 M, and 76 % at 0.5 M H_2O_2 and 85% and 89 % at 50 °C for dye A and dye B. The experimental results exhibited that COD, TOC and toxicity assessments were 74.56 & 73.24% and 92 & 91% for dye A and dye B, respectively. The UV-Visible and FTIR studies also confirmed the degradation of the targeted dyes. The current study suggested a greener approach towards environmental remediation for a neat and clean environment.