RESCON 2025 PS 39

DYE DEGRADATION CAPACITY OF GREEN SYNTHESISED IRON OXIDE NANOPARTICLES

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Synthetic dyes, once released as waste, pose a huge threat to the environment and the living organisms. Nanoparticles offer a cheaper, environmentally friendly and less energy consuming way to remove synthetic dyes by degrading these organic molecules. This research utilised papaya peel extract to green synthesise iron oxide nanoparticles (IONP) and to study their possible degrading capacity of methyl orange (MO) and methylene blue (MB) dyes. Papaya peel, a waste material available throughout the year, consists of antioxidants that can reduce and act as capping agents during the formation of nanoparticles. IONP were synthesised by adding the papaya peel extract to a heated solution of $FeCl_3$ while stirring. Effect of $FeCl_3$ concentration on nanoparticle formation and their corresponding dye degradation capacity were studied using $FeCl_3$ solutions of 10 mM, 20 mM and 30 mM concentrations. Powder X-ray diffraction data confirmed the presence of α-Fe_2O_3, high crystallinity of the calcined, synthesised samples, and the presence of small amounts γ-Fe_2O_3 and Fe_3O_4 as well. The scanning electron microscopic images revealed that the particles were in nanoscale, and their shapes were roughly spherical. The Fourier transform infrared bands appearing at 428, 524 and 628 cm^{-1} confirmed the formation of Fe-O bonds. The ability of IONP to decolorise both MO and MB were studied by UV-visible spectrophotometry. The intensities of the MO bands decreased over 1.5 h of stirring and that of MB bands decreased over 4 h of stirring when the solutions were exposed to sunlight. The study revealed that the synthesised IONPs remove 92.0% of MO and 74.7% of MB. The dye removal process may include degradation of dye molecules and adsorption of dye onto the IONP. The net reduction in color intensity, either due to degradation, adsorption or both, is higher for the synthesised IONP than with the commercially available iron oxide powder.

Keywords: Degradation, Green synthesis, Iron oxide nanoparticles, Methyl orange, Methylene blue