



Synthesis of nickel nanoparticles using Plant Leaves and their application in the degradation of Pollutants

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Abstract : Nickel nanoparticles as an eco-friendly adsorbent was biosynthesized using *Raphanus sativus* (Radish) leaf extract. The physiochemical properties of green synthesized nickel nanoparticles (NiGs) were characterized by UV-Vis spectroscopy (UV-Vis), Fourier Transform Infrared Spectroscopy (FTIR), X-ray diffraction (XRD), Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). NiGs were used as adsorbent for the removal of dyes such as crystal violet (CV), eosin Y (EY), orange II (OR) and anionic pollutants nitrate (NO_3^-), sulfate (SO_4^{2-}) from aqueous solution. Adsorption capacity of NiGs was examined in batch modes at different pH, contact time, NiGs dosage, initial dye and pollutant concentration. The adsorption process was pH dependent and the adsorption capacity increased with increase in contact time and with that of NiGs dosage, whereas the adsorption capacity decreased at higher concentrations of dyes and pollutants. Maximum percentage removal of dyes and pollutants were observed at 40, 20, 30, 10 and 10 $\text{mg}\cdot\text{L}^{-1}$ initial concentration of CV, EY, OR, NO_3^- and SO_4^{2-} respectively. The maximum adsorption capacities in Langmuir isotherm were found to be 0.454, 0.615, 0.273, 0.795 and 0.645 $\text{mg}\cdot\text{g}^{-1}$ at pH 8, 3, 3, 7 and 7 for CV, EY, OR, NO_3^- and SO_4^{2-} respectively. The higher coefficients of correlation in Langmuir isotherm suggested monolayer adsorption. The mean energies (E), 2.23, 3.53, 2.50, 5.00 and 3.16 $\text{kJ}\cdot\text{mol}^{-1}$ for CV, EY, OR, NO_3^- and SO_4^{2-} respectively, calculated from Dubinin-Radushkevich isotherm showed physical adsorption of adsorbate onto NiGs. Adsorption kinetics data was better fitted to pseudo-second-order kinetics with $R^2 > 0.870$ for all dyes and pollutants. NiGs were found to be an effective adsorbent for the removal of dyes and pollutants from aqueous solution and can be applied to treat textile and tannery effluents.

Keywords : *Raphanus Sativus*, Nickel nanoparticles, Adsorption, Adsorbents, Dyes, Pollutants.

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