Synthesis of Calcium Carbonate Nano Particles using Citrate Method to Remove Dyes from Textile Waste Water

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Dye removal is an important aspect as textile industries produce waste water containing high amounts of textile dyes at high temperatures. Therefore purification of the textile waste water is of great importance as the treated water would be discharged into natural water streams. Using nanomaterials, dye removal has been studied and have yielded promising results. In this study, nano-sized calcium carbonate were synthesized using *Sol-gel hydrothermal citrate* method. Calcium nitrate, citric acid and sodium hydroxide were used as precursors for the method. Using different concentration of citric acid solution, selected as 0.5, 1, 1.25 and 2.5 times of the calcium nitrate solution, calcium carbonate nanoparticles were synthesized. X-ray diffraction (XRD), Scanning Electron Microscope (SEM), Fourier Transformed Infrared Spectroscopy (FT-IR), Thermo gravimetric analysis (TGA) and N_2 adsorption-desorption analysis were conducted (to characterize the synthesized nanoparticles qualitatively and quantitatively). For testing adsorption of the synthesized nanoparticles, standard methylene blue dye solutions were prepared and used. The effect of initial dye concentration, pH (7-12), temperature (35 °C, 45 °C, 55 °C) were conducted in this study. Optimum pH value and temperature for maximum dye adsorption were obtained. With increasing pH and temperature, adsorption capabilities increased significantly. Equilibrium data was well fitted with Langmuir isotherm for the effect of initial dye concentration. Adsorption data were used for kinetic studies using pseudo first order and second order rate equations. Kinetic studies conducted for pH was well fitted with pseudo second order rate equation, while the kinetic studies conducted for temperature was well fitted with pseudo first order rate equation. Considering the results, synthesized calcium carbonate nanoparticles could be used as an alternative for dye adsorption.

Keywords: Nanomaterials, Calcium carbonate, Citrate method, Adsorption