Highly Adsorptive Filter Based On Iron Oxide Nanoparticles for Dye Removal from Aqueous Solutions

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Dyes are major contaminants in the industrial effluents which cause adverse effects to living beings. Today, the removal of these dyes plays a major role in water purification processes. The nanoscale iron oxides as a high adsorptive filter material can be identified as a versatile dye removal method. Due to high abundance and low cost, ferruginous laterite can be considered as an alternative iron source for the synthesis of iron oxide nanoparticles. This work was performed to synthesis iron oxide nanoparticles using laterite through an obvious and innovative route and to evaluate their potential dye adsorptive removal behavior. First, powdered laterite was reacted with HCl to extract Fe' ions as we have studied previously. The digested solution separated by centrifugation was mixed with urea and heated in reflux condition for 5 h. Then the resultant precipitate was separated, dried and calcined for 2 h at 650 ℃ to obtain iron oxide nanoparticles (IONPs). Synthesized nanoparticles were characterized by Scanning Electron Microscope (SEM), Thermo Gravimetric Analysis (TGA), Fourier Transform Infrared (FT-IR) spectrometer and X-ray Diffractometer (XRD). SEM images revealed the spherical morphology of particles with 50 nm average particle sizes of the iron oxide nanoparticles, while FTIR and XRD data confirmed the presence of hematite crystalline phase. IONPs were used as an absorbent in a specially designed laboratory scale filter apparatus and several aqueous solutions of acid dyes were used as an adsorbates. The adsorption behavior was evaluated by varying the dye concentration and inlet flow rate of the filter and analyzing the filtrate by UV-VIS spectrophotometer. The filter proved to be effective in removing these dyes fully when the dye concentration is as high as 1000 ppm.

Keywords: Laterite, Hematite, Nanoparticles, Adsorption, Filter

Financial assistance by the National Research Council Grant no. NRC 16-123 is highly acknowledged.