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ORIGINAL PAPER

Evaluation of peanut husk as a novel, low cost biosorbent for the removal of Indosol Orange RSN dye from aqueous solutions: batch and fixed bed studies

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Abstract The feasibility of using peanut husk biomass for the removal of Indosol Orange RSN dye was explored during this study. Batch experiments were conducted with native, polyethyleneimine (PEI) treated and Na-alginate immobilized biomass. Different important process parameters like pH, contact time, biosorbent dose, initial dye concentration, and temperature were optimized during batch study. Low pH and low biosorbent dose were found to be the feasible conditions for the maximum biosorption of dye. PEI-treated biomass exhibited maximum biosorption capacity (79.5 mg g^{-1}) for Indosol Orange RSN dye. Pseudo-second-order equation generated the best agreement with experimental data. Different equilibrium isotherm models were applied to the experimental data. Langmuir adsorption isotherm model showed better fitness to the experimental results. Biosorption process was found to be exothermic in nature and thermodynamic study was carried out to check out the feasibility of process. Continuous mode study was performed with native peanut husk biomass to optimize the bed height, flow rate, and initial dye concentration for maximum dye removal. The results indicate that maximum dye removal (8.8 mg L^{-1}) was obtained with 3 cm bed height and 1.8 mL min^{-1} flow rate by using 70 mg L^{-1} initial dye concentration. Characterization of biosorbent was carried out by determination of point of zero charge, scanning electron microscopy, and Fourier transform infrared spectroscopy. The findings revealed that peanut husk biomass has a high biosorption potential, and it can be exploited for the treatment of dye containing waste water.

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Introduction

Over the years, rapid population growth, urbanization, industrialization, and increased farming has resulted in the depletion of natural water resources worldwide. The environmental degradation and climatic changes have worsened the global water shortage problems. Water scarcity has also been resulted due to pollution of water resources (Lu et al. 2010). Industrial growth has resulted in an increased water demand, which is being used in various production processes, and much of the water being used is not being reclaimed. Recycling of the wastewater is a starting point in conserving the limited water supply (Lu and Leung 2003; Gupta et al. 2007).

An important source of water pollution is dyes which are being released from textile industries (Mittal et al. 2009a, b; Fu et al. 2010). Approximately 70 % of the synthetic dyes belong to the azo group which contains N=N bond in there molecular structure (Hsueh et al. 2005; Mittal et al. 2008). These dyes may undergo oxidation, hydrolysis, and many other chemical reactions which may result in the production of toxic by-products which are harmful to the environment (Juang et al. 2008; Mittal et al. 2010a, b, c). These dyes should be eliminated prior to their discharge into the environment. Purification of dye-containing wastewater is becoming a matter of great concern, and it is vital to develop novel and cost-effective technologies for the treatment of dye wastewater (Daud and Hameed 2010).

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