

Preparation and Characterization of Biosorbent from Cactus (*Opuntia ficus-indica*) cladodes and its Application for Dye Removal from Aqueous Solution

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Abstract : Malachite green (MG), an organic basic dye, has been widely used for the dyeing purpose, as well as a fungicide and antiseptic in aquaculture industry to control fish parasites and disease. However, MG has now turned out to be an extremely controversial compound due to its adverse impact on living beings. Due to high toxicity, proper treatment of wastewater containing MG is utmost important. Among different available technologies, adsorption process is one of the most efficient and cost-effective treatment method due to its simplicity of design, ease of operation and regeneration of used materials. Nonetheless, commercial activated carbon is expensive leading the researchers to focus on utilizing natural resources. In the present work, a species of cactus, *Opuntia ficus-indica* (OFI), was used to develop a highly efficient, low-cost powdered activated carbon by chemical activation using NaOH. The biosorbent was characterized by Fourier-transform infrared spectroscopy, field emission scanning electron microscope, energy-dispersive X-ray spectroscopy, Brunauer-Emmett-Teller (BET) and X-ray diffraction analysis. Batch adsorption studies were performed to remove MG from an aqueous solution as a function of contact time, initial solution pH, initial dye concentration, biosorbent dosages, the presence of salt and temperature. By increasing the initial dye concentration from 100 to 500 mg/l, adsorption capacity increased from 165.45 to 831.58 mg/g. The adsorption kinetics followed the pseudo-second-order model and the chemisorption mechanisms were revealed. The electrostatic attractions and chemical interactions were observed between amino and hydroxyl groups of the biosorbent and amine groups of the dye. The adsorption was solely controlled by film diffusion. Different isotherm models were used to fit the adsorption data. The excellent recovery of adsorption efficiency after the regeneration of biosorbent indicated the high potential of this adsorbent to remove MG from aqueous solution and an excellent cost-effective biosorbent for wide application in wastewater treatment.

Keywords : adsorption, biosorbent, cactus, malachite green

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