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Equilibrium, Kinetic and Thermodynamic Studies of the Biosorption of Textile Dye (Yellow Bemacid) onto Brahea edulis

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Abstract : Environmental contamination is a major problem being faced by the society today. Industrial, agricultural, and domestic wastes, due to the rapid development in the technology, are discharged in the several receivers. Generally, this discharge is directed to the nearest water sources such as rivers, lakes, and seas. While the rates of development and waste production are not likely to diminish, efforts to control and dispose of wastes are appropriately rising. Wastewaters from textile industries represent a serious problem all over the world. They contain different types of synthetic dyes which are known to be a major source of environmental pollution in terms of both the volume of dye discharged and the effluent composition. From an environmental point of view, the removal of synthetic dyes is of great concern. Among several chemical and physical methods, adsorption is a promising technique due to the ease of use and low cost compared to other applications in the process of discoloration, especially if the adsorbent is inexpensive and readily available. The focus of the present study was to assess the potentiality of Brahea edulis (BE) for the removal of synthetic dye Yellow bemacid (YB) from aqueous solutions. The results obtained here may transfer to other dyes with a similar chemical structure. Biosorption studies were carried out under various parameters such as mass adsorbent particle, pH, contact time, initial dye concentration, and temperature. The biosorption kinetic data of the material (BE) was tested by the pseudo first-order and the pseudo-second-order kinetic models. Thermodynamic parameters including the Gibbs free energy ΔG, enthalpy ΔH, and entropy ΔS have revealed that the adsorption of YB on the BE is feasible, spontaneous, and endothermic. The equilibrium data were analyzed by using Langmuir, Freundlich, Elovich, and Temkin isotherm models. The experimental results show that the percentage of biosorption increases with an increase in the biosorbent mass (0.25 g: 12 mg/g; 1.5 g: 47.44 mg/g). The maximum biosorption occurred at around pH value of 2 for the YB. The equilibrium uptake was increased with an increase in the initial dye concentration in solution (C_o = 120 mg/l; q = 35.97 mg/g). Biosorption kinetic data were properly fitted with the pseudo-second-order kinetic model. The best fit was obtained by the Langmuir model with high correlation coefficient (R² > 0.998) and a maximum monolayer adsorption capacity of 35.97 mg/g for YB.

Keywords : adsorption, Brahea edulis, isotherm, yellow Bemacid
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