



Adsorption of cationic dye from aqueous solution using molecularly imprinted polymers (MIPs)

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ABSTRACT

In this study, molecularly imprinted polymers (MIPs) were prepared using the microwave-assisted organic synthesis method for the adsorption of methylene blue (MB), a cationic dye, from aqueous solutions. The preparation of dye-MIP was carried using methacrylic acid (MAA) as monomers, divinyl benzene (DVB) as a cross-linker and acetonitrile as a porogen. The control polymer materials, i.e. the NIPs, were also prepared in a similar way to that of the MIPs preparation, but without the MB molecule as a template. The characterization of both the obtained NIPs and dye-MIPs was achieved by FTIR, SEM and Brunauer-Emmett-Teller (BET) method. Finally, both the obtained NIPs and dye-MIPs were used for the adsorption of MB from aqueous solutions using the batch adsorption technique. The effects of various experimental parameters, such as contact time, pH, adsorbent dosages, initial MB concentration and temperature on the adsorption capacity were investigated. The results showed that the adsorption behavior of both NIPs and dye-MIPs was greatly affected by the pH and initial concentration of MB. The experimental data were also analyzed by the Langmuir and Freundlich models of adsorption. The adsorption of MB onto both NIPs and dye-MIPs is in accordance with the Langmuir isotherm models with the adsorption capacity, which was found to be 33.11 and 40.82 mg/g, respectively. Thermodynamic parameter data indicated that the MB adsorption process onto dye-MIPs was non spontaneous and exothermic under the experimental conditions, with the values of Gibbs free energy (ΔG°) being in the range of 1.02 to 3.76 kJ mol⁻¹; as well as the values of enthalpy (ΔH°) and entropy (ΔS°) that were found to be -19.35 kJ mol⁻¹ and -68.39 J mol⁻¹, respectively. Moreover, pseudo-first-order, pseudo-second-order, intra-particle-diffusion, and Boyd kinetic models were considered to evaluate the rate parameters. The adsorption process could be described well by a pseudo-second-order model.

Keywords: Adsorption; Cationic dye; Kinetics; Methylene blue; Molecularly imprinted

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