Assessment of the adsorptive color removal of methylene blue dye from water by activated carbon sorbent-immobilized-sodium decyl sulfate surfactant

Mohamed E. Mahmoud*, Gehan M. Nabil, Nabila M. El-Mallah, Shimaa B. Karar

Faculty of Sciences, Chemistry Department, Alexandria University, P.O. Box 426, Ibrimia 21321, Alexandria, Egypt, Tel. +20 1140933009; Fax: +20 3 3911794; email: memahmoud10@yahoo.com (M.E. Mahmoud), Tel. +20 1005298807; Fax: +20 3 3911794; email: gahan.nabil@gmail.com (G.M. Nabil), Tel. +20 1224706794; Fax: +20 3 3911794; email: dr.nabila elmallah@gmail.com (N.M. El-Mallah), Tel. +20 01002322911; Fax: +20 3 3911794; email: Chem.ShimaaKarar@yahoo.com (S.B. Karar)

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ABSTRACT

Sodium decyl sulfate (SDeS) as an anionic surfactant was used for the surface modification of activated carbon (AC). Micelle-like structure was formed on the surface of AC sorbent-modified surfactant (AC-SDeS). The modified sorbent was characterized by Fourier transform infrared spectroscopy, scanning electron microscopy and thermal gravimetric analysis. The AC-SDeS sorbent was proved to have high enhanced removal capability for methylene blue (MB), a cationic dye, from various water matrices. The adsorptive removal process of MB dye was investigated and monitored using the batch equilibrium technique. Adsorptive removal of MB dye by AC-SDeS sorbent was examined in presence of various controlling parameters such as pH, contact time, sorbent dosage, initial dye concentration, and different interfering substances. The results showed that the optimum pH range for removal of MB dye from aqueous solutions (120 mg L\(^{-1}\)) is pH 7.0–13.0 and the determined percentage values of removal were 92.25–94.50%. The percentage of dye removal decreased upon increasing the initial dye concentration and addition of interfering substances. The Langmuir, Freundlich, Temkin, and Dubinin–Radushkevich adsorption models were applied to describe the equilibrium isotherms, and the experimental data were found to agree with the Langmuir isotherm model. The pseudo first-order, pseudo-second-order, intraparticle diffusion and Elovich kinetic models were used to examine the kinetic data and determine the rate constants. The results were found to fit well with the pseudo-second-order kinetic model. The efficiency of AC-SDeS for adsorptive removal of MB dye from tap water and real wastewater was also studied and excellent results were obtained as 95.90–96.20 ± 2.0–4.0%.

Keywords: Activated carbon; Color removal; Methylene blue; Sodium decyl sulfate; Wastewater

*Corresponding author.

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