Application of fly ash for adsorptive removal of malachite green from aqueous solutions

Shikha Dubey\textsuperscript{a}, Uma\textsuperscript{a}, Lavanchawee Sujarittanonta\textsuperscript{b}, Yogesh Chandra Sharma\textsuperscript{a,*}

\textsuperscript{a}Department of Chemistry, Indian Institute of Technology, Banaras Hindu University, Varanasi 221 005, India
Tel. +91 542 6701865; Fax: +91 542 2368428; email: ysharma.apc@itbhu.ac.in
\textsuperscript{b}Silpakorn University International College, Bangkok, Thailand

Received 29 June 2013; Accepted 12 August 2013

\textbf{ABSTRACT}

Present study investigates the adsorption of malachite green (MG) on fly ash. Batch adsorption experiments were performed to evaluate the influence of various experimental parameters like initial concentration and contact time, adsorbent dose, and pH of solution on the removal of MG. Adsorption of MG followed pseudo-second-order kinetics. Intra-particle diffusion seems to control the removal of MG. Isotherms for the adsorption of MG onto fly ash is also investigated. Adsorption of MG on fly ash is favorably influenced by an increase in the temperature. Values of the change in enthalpy ($\Delta H^\circ = 2.87 \text{ kcal mol}^{-1}$), and change in entropy ($\Delta S^\circ = 4.99 \text{ kcal mol}^{-1} \text{ K}^{-1}$) for MG adsorption on fly ash were positive. The high negative value of change in Gibbs free energy ($\Delta G^\circ = 1.76 \text{ kcal mol}^{-1}$) indicates the feasible and spontaneous adsorption of MG on fly ash. The surface physico-chemical characteristic of adsorbent fly ash was studied in an effort to establish a quantitative understanding of removal of the selected dye MG by adsorption. Results showed that the fly ash has a $\text{pH}_{\text{zpc}}$ value of 7.96.

\textit{Keywords:} Adsorption; Fly ash; Isotherm; Kinetics; Malachite green