ABSTRACT

The present investigation was undertaken to ratify the adsorption capacity of leather shoe waste to abolish hazardous cationic (Crystal violet and Methylene blue) dyes and Cr (VI) metal. Leather waste was characterized by using Fourier transform infrared (FT-IR) spectroscopy, X-ray diffraction (XRD), differential thermal analysis (DTA), thermogravimetric analysis (TGA), and scanning electron microscopy (SEM). Response surface methodology based on central composite design has been opted to investigate the cumulative effect of operating parameters, to model data statistically and to optimize operating variables for the removal of CV, MB, and Cr(VI) employing design expert software. Analysis of variance (ANOVA) showed a high coefficient of determination value for CV and MB (R^2 = 0.9731and 0.9839 respectively) and a lower value (0.8805) for Cr (VI). To obtain optimum conditions for the removal of aforementioned dyes and metal, five operating parameters; Amount of adsorbent, initial dye concentration, contact time, temperature and pH have been varied according to experimental design suggested by software while adsorption capacity q_e taken as output response. Equilibrium data were analyzed by Freundlich, Langmuir, Temkin, Generalized, and Dubbinin-Redushkehich isotherms; and were best modeled by Freundlich adsorption isotherm at all studied temperatures. Five non-linear error analysis (ARE, ERRSQ, HYBRID, EABS, MPSD) were performed to get adsorption isotherm parameters by reducing error function and to predict that which isotherm provide best fit to the equilibrium data. Adsorption mechanism was prevailed by pseudo second order kinetic model with linear regression coefficient (R^2 =1 and R^2 > 0.99) for CV and MB. Rate of adsorption was determined by film layer diffusion. Negative values of ΔG confirmed the spontaneity of adsorption. Results of ΔH showed that adsorption of CV and MB on Leather waste were endothermic and exothermic processes respectively.