Utilization of bottom ash as a low-cost sorbent for the removal and recovery of a toxic halogen containing dye eosin yellow

Jyoti Mittala,*, Damodar Jharea, Harsh Vardhanb, Alok Mittalaa

aDepartment of Chemistry, Maulana Azad National Institute of Technology, Bhopal 462 051, India
Tel. +91 9893251369; Fax: +91 755 2670562; email: jyalmittal@yahoo.co.in
bDepartment of Chemistry, Mihir Bhoj (PG) College, GB Nagar, Dadri, UP, India

Received 20 April 2013; Accepted 26 April 2013

ABSTRACT

Removal and recovery of a hazardous halogen-containing dye Eosin Yellow were investigated using Bottom Ash as adsorbent. During the studies various essential factors influencing the adsorption, like sieve size of adsorbent, adsorbate concentration, amount of adsorbent, pH of the solution, contact time, and temperature have been monitored. Attempts have also been made to verify Langmuir, Freundlich, Tempkin, and D-R adsorption isotherm models. The feasibility of the ongoing adsorption has been ascertained on the basis of Langmuir adsorption isotherm. The free energy, entropy, and enthalpy of the ongoing adsorption process have been evaluated as about 26 kJ mol⁻¹, 22 kJ mol⁻¹, and 20 kJ mol⁻¹, respectively. Contact time studies reveal that the ongoing adsorption equilibrate within 3 h of contact. It is found that the adsorption of Eosin Yellow over Bottom Ash follows a pseudo-second-order kinetics. At all the temperatures rate constant of the process was calculated around 5 × 10⁻⁸ sec g mol⁻¹. During bulk removal through column operation about 97% percentage saturation of the dye is obtained. Desorption studies exhibit that the percentage recovery of Eosin Yellow dye on eluenting NaOH solution through exhausted column is about 90%.

Keywords: Eosin Yellow; Bottom Ash; Adsorption; Isotherms; Kinetics; Column Studies

*Corresponding author.

1944-3994/1944-3986 © 2013 Balaban Desalination Publications. All rights reserved.