

Kinetics, isotherms and thermodynamics of Cu(II) metal ions adsorption: an insight into chitosan and bentonite

Sarita Joshi^{1,3,*}, Bhupender Singh² and R. K. Srivastava¹

¹Department of Environmental Science, College of Basic Science and Humanities, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145, India

²Central Research Facility, Indian Institute of Technology, Delhi 110 016, India

³School of Business Management, Maharishi University of Information and Technology, Noida 201 304, India

Chitosan + bentonite modified composite was synthesized to analyse its removal efficiency for Cu(II) metal ions. FTIR analysis done for chitosan, bentonite and the prepared biocomposite of chitosan + bentonite gave detailed information about the active functional group present on the site of adsorbent. SEM-EDS micrographs reflected the distribution and weight percent of elements in the prepared bio-composite with prominent porosity and roughness but after the adsorption of Cu(II), the porosity and roughness of the adsorbent decreased. Freundlich isotherm best fitted to Cu(II) metal ions indicates that the adsorbent surface is heterogeneous. The value of the regression coefficient for the Lagergren kinetic model for the adsorption of Cu(II) metal ions was 1 and hence, it has the highest conformity towards the pseudo-first-order kinetic model. Adsorption thermodynamics revealed that it was a spontaneous and exothermic adsorption.

Keywords: Adsorption isotherm model, adsorption kinetic model, adsorption thermodynamics, bentonite, chitosan, FTIR.

cheap and impressive in the elimination of a broad range of pollutants^{4,5}.

Chitosan (Ch) and chitin have been widely used because they contain the desired amount of nitrogen (6.89%) and it also contains cellulose (1.25% of nitrogen). Furthermore, chitosan and chitin have properties like biodegradability, non-toxicity, hydrophilicity, biocompatibility and they have a phenomenal affinity for macromolecules of biological origin. Chitosan can agglomerate in various solutions. It is a good material for immobilization as support; it raises the approachability of its sites which are responsible for blindness and mechanical durability⁶. With these properties, chitosan can be considered a competent adsorbent and has the quality of heavy metal ions absorption. It absorbs many metal ions, as the amino groups in them act as sites for chelation. Due to its nitrogen content, chitosan exhibits a high affinity for adsorption. Clay minerals found in nature show varied mechanical and chemical stability, due to this, clay-containing materials are most promising as they are made up of alumina silicates, with extensive surface area and impressive cation exchange capacity. Bentonite (Ben) is one of the well-known clay materials which contains montmorillonite, considered a crystalline and lamellar silicate.