Design and model parameters estimation for fixed–bed column adsorption of Cu(II) and Ni(II) ions using magnetized saw dust

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ABSTRACT

Fixed-bed column studies were performed using magnetized sawdust (Fe₃O₄–SD) as adsorbent for removal of Cu(II) and Ni(II) ions from aqueous solutions. Breakthrough curves were obtained by performing experiments in order to evaluate the influence of adsorbent bed height (2, 4, 8 cm), metal ion concentration in feed solution (10, 20, 30 mg/L), and feed flow rate (15, 20, 25 mL/min) for adsorption of Cu(II) and Ni(II) ions onto Fe₃O₄–SD adsorbent. Adsorption kinetics was analyzed using Bohart–Adams, Thomas, and Yoon–Nelson models. Kinetic data correlated well with both Thomas and Yoon–Nelson models, while Bohart–Adams model poorly predicted the model operation. Saturation loading capacity of adsorbent bed decreased with increase in adsorbent bed height, metal concentration in feed, and feed flow rate. Both mass transfer zone (MTZ) height and height of unused bed ($H_{UNB}$) noticeably increased with increase in the values of the parameter studied. The results showed that reduced MTZ height and lowest $H_{UNB}$ are suitable for operating the column satisfactorily.

Keywords: Fixed-bed adsorption; Cu(II) and Ni(II); Fe₃O₄–SD; Saturation loading capacity; $H_{UNB}$ and MTZ