Removal of Cr(VI) from wastewater using activated neem bark in a fixed-bed column: interference of other ions and kinetic modelling studies

Utkarsh Maheshwari, Suresh Gupta*

Department of Chemical Engineering, Birla Institute of Technology and Science (BITS), Pilani 333031, Rajasthan, India, emails: utkarsh@pilani.bits-pilani.ac.in, utkarshmaheshwari13@gmail.com (U. Maheshwari), Tel. +91 1596 515224; Fax: +91 1596 244183; email: sureshg@pilani.bits-pilani.ac.in (S. Gupta)

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ABSTRACT

Continuous adsorption experiments are carried out in a fixed-bed to evaluate the performance of a newly developed low-cost adsorbent (activated neem bark, ANB) for the removal of Cr(VI) along with other metal ions (Cu & Zn) from aqueous solutions. The effect of initial Cr(VI) concentration, mass of adsorbent and flow rate on the breakthrough curve are studied. It is observed that as there is an increase in the initial concentration of Cr(VI) from 50 to 100 mg L$^{-1}$, the mass of the adsorbent from 25 to 175 g, and flow rate from 5 to 15 mg L$^{-1}$, the breakthrough time decreases from 24.78 to 13.875 h, increase from 9.25 to 111.66 h and decrease from 35.09 to 8.26 h, respectively. The effect on the performance of the ANB for Cr(VI) adsorption is also studied in the presence of Cu and Zn. The breakthrough time is achieved earlier in the presence of Cu and Zn in the feed stream. The fixed-bed adsorption process parameters such as saturation loading capacity, breakthrough time, total percentage removal of Cr(VI), the fraction of unused bed length, adsorption exhaustion rate and empty bed residence time are calculated for different experimental runs. The experimental results are likewise applied to the Yoon–Nelson and the Yan kinetic models. The kinetic parameters for both the models are calculated and reported in this study.

Keywords: Adsorption; Multiple metal ions; Continuous studies; Breakthrough curve parameters; Yoon & Nelson model; Yan model

*Corresponding author.

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