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Fitting Column Study Data of Commercial Activated Charcoal for Cu (II) Adsorption in Different Kinetic Models

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The presence of heavy metals (HMs) in the environment is of major concern and to address this issue, the adsorption process using activated charcoal (AC) stands out as one of the most efficient and economical methods. Among HMs, Cu pollution in water resources poses a serious threat and effective removal of Cu is of prime importance. This study aimed to evaluate the effectiveness of commercially available AC under various experimental conditions for removing Cu (II) from aqueous solutions using a column study. The breakthrough curves and associated parameters were detected by altering the bed depths (2, 4, and 6 cm), maintaining an initial metal concentration of 100 mg/L, and using a flow rate of 2.5 mL/min. During the process of Cu (II) removal using AC, the breakthrough points for bed depths of 2, 4, and 6 cm were achieved at 15, 25, and 40 min, and the exhaustion points at 210, 330, and 840 min, respectively. Three kinetics models were utilized to analyze the adsorption kinetics. Only the first part of breakthrough curves was described by the Adams–Bohart model. The adsorption process is represented by the Yoon-Nelson and Thomas models, which have coefficients of determination (R^2) that range from 0.92 to 0.95. The good fit of two models, implies that the rate-controlling mechanisms are well captured by these models. Maximum Thomas uptake capacity was achieved up to 951.4, 386.9, and 480.4 mg/g, for bed depths of 2, 4, and 6 cm, respectively. This study demonstrated that using AC contributes to achieving the objectives of sustainable development. The good fit can be used to optimize the design and operation of adsorption columns. Future work could focus on extending the current study by preparing activated charcoal from low-cost, environmentally friendly materials, thereby contributing to sustainable environmental practices.

Keywords: *heavy metals, copper, activated charcoal, adsorption, kinetic models*