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Modeling of Cu(II) adsorption from an aqueous solution using an Artificial Neural Network (ANN) (Article) (Open Access)

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Abstract

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This research optimized the adsorption performance of rice husk char (RHC4) for copper (Cu(II)) from an aqueous solution. Various physicochemical analyses such as Fourier transform infrared spectroscopy (FTIR), field-emission scanning electron microscopy (FESEM), carbon, hydrogen, nitrogen, and sulfur (CHNS) analysis, Brunauer-Emmett-Teller (BET) surface area analysis, bulk density (g/mL), ash content (%), pH, and pHZPC were performed to determine the characteristics of RHC4. The effects of operating variables such as the influences of aqueous pH, contact time, Cu(II) concentration, and doses of RHC4 on adsorption were studied. The maximum adsorption was achieved at 120 min of contact time, pH 6, and at 8 g/L of RHC4 dose. The prediction of percentage Cu(II) adsorption was investigated via an artificial neural network (ANN). The Fletcher-Reeves conjugate gradient backpropagation (BP) algorithm was the best fit among all of the tested algorithms (mean squared error (MSE) of 3.84 and R2 of 0.989). The pseudo-second-order kinetic model fitted well with the experimental data, thus indicating chemical adsorption. The intraparticle analysis showed that the adsorption process proceeded by boundary layer adsorption initially and by intraparticle diffusion at the later stage. The Langmuir and Freundlich isotherm models interpreted well the adsorption capacity and intensity. The thermodynamic parameters indicated that the adsorption of Cu(II) by RHC4 was spontaneous. The RHC4 adsorption capacity is comparable to other agricultural material-based adsorbents, making RHC4 competent for Cu(II) removal from wastewater. © 2020 by the authors.

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Adsorption | Artificial neural network | Heavy metal removal | Rice husk char

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