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The wheat straw biochar research on the adsorption/desorption behaviour of mercury in wastewater

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ABSTRACT

The adsorption/desorption behaviour and varying adsorption mechanisms of Hg(II) in simulated wastewater were evaluated using wheat straw biochars (WBCs) prepared under three different slow pyrolysis temperatures (300°C, 400°C, and 600°C, referred as WBC300, WBC400, and WBC600, respectively). The adsorption isotherm characteristics for these biochars were extensively described by the Langmuir isotherm ($R^2 > 0.9782$) and pseudo-second-order kinetics ($R^2 > 0.9421$) models, with the maximum theoretical adsorbing capacity measured at 5.85, 4.13, and 3.56 mg/g, respectively, in the following order: WBC300 > WBC400 > WBC600. The experimental results showed that there was a direct competitive adsorption in Pb(II) and Hg(II) binary system, whereas not in Cd(II) and Hg(II) system. The Hg(II) desorption behaviour on the surface of these biochars, confirmed by the FTIR results and water-soluble cations test, which indicated that the low temperature biochars (WBC300 and WBC400) adsorbed Hg(II) mainly relied on complexation reactions with oxygen-containing functional groups such as carboxyl, alcoholic and phenolic hydroxyl, while high temperature biochars (WBC600) mainly relied on ion-exchange interactions. This research proposes an efficient, environmentally friendly, and economical method for mercury-containing wastewater remediation and simultaneous agriculture residue treatment.

Keywords: Wheat straw; Biochar; Mercury-containing wastewater; Adsorption; Desorption

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