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Adsorption of tetrakis(hydroxymethyl)phosphonium chloride on pomelo peel biochar and its antimicrobial ability

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ABSTRACT

In this study, potassium hydroxide (KOH), aluminum chloride ($AlCl_3$), and zinc chloride ($ZnCl_2$) were co-pyrolyzed with pomelo peel biomass (according to different pyrolysis conditions, abbreviated in order as KOH-BC, $AlCl_3$-BC, and $ZnCl_2$-BC) to enhance the original biochar (BC) adsorption performance of an emerging contaminant tetrakis(hydroxymethyl)phosphonium chloride (THPC). The adsorption experiments indicated that the adsorption capacity for THPC of KOH-BC reached 438 mg·g^{-1}, which showed much higher adsorption properties than those of BC (239.6 mg·g^{-1}), $AlCl_3$-BC (301.6 mg·g^{-1}) and $ZnCl_2$-BC (278.9 mg·g^{-1}) due to its better developed pore structures. The adsorption process of THPC by BC, KOH-BC, $AlCl_3$-BC, and $ZnCl_2$-BC, a spontaneous endothermic process that had been analyzed, according with the second-order kinetic model and Langmuir isotherm model. And the adsorption mechanisms of THPC removal (i.e., pore filling, cation-π interaction, hydrogen bonding, and ion exchange) were summarized. Targeting *Escherichia coli*, the antibacterial activity of BC (THPC-BC) and KOH-BC (THPC-KOH-BC) of THPC after adsorption was explored. Antibacterial activity experiments have shown that THPC-BC and THPC-KOH-BC could effectively inhibit the growth of *E. coli*. Therefore, BC and modified BC can not only be used to remove THPC but also be recycled for secondary utilization, which provides a novel idea for the emission reduction and resource recycling of THPC with great practical value.

Keywords: Adsorption; Biochar activation; Tetrakis(hydroxymethyl)phosphonium chloride; *Escherichia coli*; Sterilization; Water treatment

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