Synthesis of mesoporous akaganeite functionalized maize cob biochar for adsorptive abatement of carbamazepine: Kinetics, isotherms, and thermodynamics.

Abstract

In this work, akaganeite (β-FeO(OH)) impregnated maize cob biochar (Fe-MCB) was prepared by direct hydrolysis, and its adsorptive potential was tested against aqueous solutions of carbamazepine (CBZ), an emerging contaminant. The adsorbent was characterized by standard methods, namely XRD, SEM-EDX, FT-IR, BET surface area analysis, and VSM. Fe-MCB exhibited mesoporous textural structure with paramagnetic behavior at room temperature. The equilibrium data were modeled using the Langmuir, Freundlich, Fowler-Guggenheim and Sips isotherm models. The adsorption data were best described by Fowler-Guggenheim with an estimated maximum adsorption capacity of 81.80 mg g^{-1}. The adsorption rate was described by the pseudo-first-order (PFO) model. The thermodynamic functions, namely enthalpy (ΔH = -6.88 kJ mol^{-1}), negative Gibbs free energy (ΔG) values, entropy (ΔS = 26.33 J mol^{-1}), indicated that the adsorption was exothermic, spontaneous, with the increased disorder at the solid-liquid interphase. The adsorption mechanism is thought to entail dispersive interactions. Modified maize cob biochar is a potentially techno-economic sorbent for CBZ adsorption.

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