Removal of cefixime from aqueous solutions by the biosorbent prepared from pine cones: kinetic and isotherm studies

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A B S T R A C T

The bio-char prepared from pine cones was used to remove cefixime (CFX) from aqueous solutions. The influence of some parameters including pH (2–12), contact time (0 to 120 min), initial concentration of CFX (10, 50, and 100 mg L⁻¹), adsorbent dose (0.1 to 2.5 g L⁻¹), temperature (10°C to 50°C) was evaluated. The pine cones pieces were washed with the distilled water, dried, crushed, and sieved to provide a particle size of 100–250 nm. For carbonization, the dried raw material was put into a stainless steel reactor and heated in an electrical furnace at 20°C per min and maintained at 460°C for 2 h. After carbonization, the samples were washed with distilled water and then dried at 105°C for 12 h, and were used as adsorbent. The specific surface area, total pore volume, and mean pore diameter of the biosorbent were determined to be 789 m² g⁻¹, 0.373 cm³ g⁻¹, and 1.89 nm, respectively. In the optimum conditions (pH = 6.3, initial concentration of CFX = 50 mg L⁻¹, contact time = 90 min, and adsorbent dose = 2 g L⁻¹), the removal efficiency was 92%. The adsorption isotherm of CFX follows the Langmuir model. The kinetic study confirmed that the adsorption process fits with the pseudo-second-order reaction. The thermodynamic study indicated that the adsorption of CFX by the bio-char is feasible, spontaneous, and exothermic. This study represents that the biosorbent prepared from the pine cones can be used as an appropriate and cost-effective adsorbent for the removal of CFX from aqueous solutions and hospital wastewater.

Keywords: Cefixime; Adsorption; Pine cones; Bio-char; Kinetics; Isotherms