A comparative study of 2-chlorophenol, 2,4-dichlorophenol, and 2,4,6-trichlorophenol adsorption onto polymeric, commercial, and carbonaceous adsorbents

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ABSTRACT

In this study, polymeric and carbonaceous type of adsorbents were synthesized and their 2-chlorophenol (2-CP), 2,4-dichlorophenol (2,4-DCP), and 2,4,6-trichlorophenol (2,4,6-TCP) adsorption performances were compared with commercial available XAD-4 resin. Peach stone-based activated carbon (AC) was fabricated by steam activation and porous copolymer of cyamomethyl styrene–divinylbenzene was synthesized by suspension polymerization method. A comparative examination of chlorophenols (CPs) adsorption onto AC, polymeric, and XAD-4 resin was conducted in batch and continuous systems. Zeta potential and potentiometric titration data were analyzed for three adsorbents. The equilibrium data were fitted to the common types of adsorption isotherm and kinetic models. Freundlich model illustrated best fit to the experimental data. The adsorption kinetic obeys the pseudo-second-order model indicating that the chemical sorption is the rate-controlling parameter for chlorophenolic pollutants. The kinetic results also revealed that the rate of uptake is dependent on the acidity and hydrophobicity of CPs and the adsorbents showed excellent removal efficiency toward 2,4,6-TCP. The positive $\Delta H^\circ$ and $\Delta S^\circ$ values indicated endothermic nature and the increasing randomness at the solid–liquid interface during sorption process. Breakthrough curves obtained from column study revealed that the order of longer column saturation time was obtained as: 2,4,6-TCP > 2,4-DCP > 2-CP.

Keywords: Adsorption; Amberlite XAD-4; Activated carbon; Chlorophenols; Polymer