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Adsorption potential of 2,4-dichlorophenol onto cationic surfactant-modified phoenix tree leaf in batch mode

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ABSTRACT

It is essential and important to remove chlorophenols from solution. The natural phoenix tree leaf (NTL) was modified by a cationic surfactant, hexadecylpyridinium chloride monohydrate (CPC), and applied as an adsorbent (modified phoenix trees' leaf (MTL)) to enhance the capability to remove 2,4-dichlorophenol in aqueous solutions. Analysis of elemental composition, SEM and FTIR indicated that CPC was adsorbed on the surface of NTL. 2,4-dichlorophenol (2,4-DCP) was selected as adsorbate and the adsorption experiments were carried out in batch mode. Effects of physical–chemical parameters such as solution pH, coexisted salt, and contact temperature were investigated. The optimum pH was 6.3 and the effect of salt concentration is not significant. The adsorption quantity was up to 188.8 mg g^{-1} at experimental condition. The equilibrium adsorption data were fitted adequately to Freundlich and Henry isotherms, and the corresponding constants were calculated for these models. In addition, the adsorption kinetic data were analyzed using the pseudo-first-order and pseudo-second-order kinetic equations. The results showed that the pseudo-second-order model was better to fit the experimental data, which indicated that the adsorption of 2,4-DCP was controlled predominantly by a chemical adsorption process. Thermodynamic study suggested that the adsorption of 2,4-DCP on CPC–MTL was an endothermic process. Furthermore, the adsorbed 2,4-DCP was desorbed effectively up to 83% and the exhausted adsorbent could be regenerated and reused, making the adsorption process more feasible and economical. The results indicated that MTL can be used as an efficient adsorbent for the removal of 2,4-DCP from aqueous solutions.

Keywords: Modified phoenix tree leaf; 2,4-dichlorophenol; Adsorption; Regeneration

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