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Facile synthesis and characterization of a novel 1,2,4,5-benzene tetracarboxylic acid doped polyaniline@zinc phosphate nanocomposite for highly efficient removal of hazardous hexavalent chromium ions from water

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The present study describes the development of a novel 1,2,4,5-benzene tetracarboxylic acid doped polyaniline@zinc phosphate (BTCA-PANI@ZnP) nanocomposite via a facile two-step procedure. Thereafter, as-prepared composite material adsorption characteristics for Cr(VI) ions removal were evaluated under batch adsorption. Removal kinetic and equilibrium approaches clearly demonstrate the well simulation of adsorption data via pseudo second order and Langmuir models. The thermodynamic study indicated a spontaneous, endothermic and increasing randomness surface sites availability of BTCA-PANI@ZnP material for Cr(VI) ions adsorption. Furthermore, higher monolayer adsorption of about 933.88 mg.g-1. In addition, the capability study of the Cr(VI) ions adsorption process over nanocomposite has revealed that our method is suitable and capable to be applied on a large scale. The XPS analysis showed Cr(VI) ions with a peak Cr 2p1/2 (586.5 eV) reduction into Cr(III) species as witnessed by the appearance of Cr 2p3/2 (576.9 eV) peaks during adsorption process. Thus, the occurrence of external mass transfer, electrostatic attraction and reduction phenomenon were considered as main mechanistic pathways of Cr(VI) ions removal. In conclusion, the material superior adsorption performance, multi-dimensional surface characteristics and multiple removal mechanism involvements clearly suggest the potential applicability of that BTCA-PANI@ZnP material as an effective alternative for Cr(VI) ions wastewaters treatment.

Keywords: Adsorption; Computational formulation; Hexavalent chromium ions; Polyaniline@zinc phosphate nanocomposite.