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Polypyrrole-coated halloysite nanotube clay nanocomposite: Synthesis, characterization and Cr(VI) adsorption behaviour

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Abstract

A polypyrrole-coated halloysite nanotube nanocomposite (PPy-HNTs NC) was prepared via in situ polymerization of pyrrole (Py) in the dispersion of HNTs and assessed for the removal of toxic Cr(VI) from aqueous solutions. ATR-FTIR and XRD results confirmed the formation of the nanocomposite. The FE-SEM and TEM images revealed the coating of PPy in the halloysite matrix and the surface morphology of the PPy-HNTs NC. Batch adsorption study showed that the adsorption process was very fast and kinetic data well fitted with pseudo-second-order kinetic model. Adsorption isotherms followed the Langmuir isotherm model and the maximum adsorption capacity was found to be 149.25 mg/g at pH 2.0 at 25 °C. The adsorption process was spontaneous and endothermic in nature. XPS study confirmed the adsorption of Cr(VI) onto the NC where some part of Cr(VI) reduced to Cr(III) by electron-rich PPy moiety. The desorption study suggested that the nanocomposite (NC) can be reused three times without loss of its original removal efficiency. Tests on contaminated groundwater and chrome mine water indicated the potential applicability of the adsorbents for the removal of Cr(VI) for actual field application.