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Iodide adsorption from aqueous solutions by bis(trimethoxysilylpropyl)amine polycondensate/silver chloride composites

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ABSTRACT

Composite adsorbents for iodide were prepared with AgCl as an adsorption active component and bis(trimethoxysilylpropyl)amine (TSPA) as a gel precursor. The prepared composite adsorbents were used to adsorb iodide from aqueous solutions by considering the effects of initial iodide concentration, temperature, initial solution pH, and coexisting NaCl. The loading of AgCl in the prepared composite adsorbents was 5.5 mmol/g, much higher than that in the reported silver or silver chloride-impregnated activated carbon (around 0.097 mmol/g). The high AgCl loading ensures that the prepared composite adsorbents have a high adsorption capacity. At the initial adsorption stage of 0–12 h, the adsorption rate increases with increasing initial iodide concentration from 2 to 8 mmol/L. When the initial iodide concentration further increases from 8 to 14 mmol/L, the adsorption rate does not have an obvious increase. Pseudo-second-order model fits the experimental kinetic data quite well. The initial adsorption rate increases greatly from 1.97 to 7.32 mmol g^{-1} h^{-1} as adsorption temperature rises from 25 to 55°C. The equilibrium adsorption amount is insensitive to solution pH and coexisting NaCl, but it increases slightly with the increasing adsorption temperature. The adsorption isotherms are of H2 type, indicating that the adsorption is chemical adsorption. The comparison of the energy dispersive spectroscopy (EDS) spectra and X-ray diffraction (XRD) patterns of the composite adsorbents before and after adsorption shows that after adsorption, all AgCl in the original adsorbents changes into AgI, confirming the chemical nature of the adsorption. The composite adsorbents prepared in this work have a high adsorption capacity, a good selectivity, and good chemical and mechanical stabilities. They are very suitable for the adsorption of iodide form aqueous solutions.

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