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Composite cation-exchange resins containing zirconium hydrophosphate for purification of water from U(VI) cations

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ABSTRACT

Organic-inorganic ion exchangers based on strongly acidic gel-like cation exchange resin were obtained by precipitation of zirconium hydrophosphate from a $ZrOCl_2$ solution with phosphoric acid. When additionally sorbed electrolyte ($ZrOCl_2$) had been removed from the polymer before the deposition, non-aggregated particles (20–50 nm) and their aggregates (70–300 nm) were formed in voids between gel regions of the polymer. Particles of micron size were precipitated from additionally sorbed electrolyte in structure defects. The inorganic constituent in these pores is characterized by the highest content of phosphorus. As it was found with a method of standard contact porosimetry, the largest particles increase swelling pressure: formally they can be considered to be a cross-linking agent. However, they increase effective diffusion coefficient of $UO_2^{2+}\rightarrow H^+$ exchange from 0.66×10^{-12} up to 1.73×10^{-12} $m^2 s^{-1}$. As a result, this ion-exchanger is the most effective for removal of UO_2^{2+} species from water containing also hardness ions. Regarding the samples containing smaller particles, $UO_2^{2+}\rightarrow H^+$ exchange is complicated by chemical interaction of sorbed ions with functional groups of the inorganic constituent. Sorption isotherms are described by the Dubinin–Radushkevich model. Transformation of porous structure of the polymer due to zirconium hydrophosphate was shown to affect UO_2^{2+} sorption by the composites.

Keywords: Uranium(VI); Ion exchange; Organic-inorganic ion-exchanger; Zirconium phosphate; Standard contact porosimetry

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