

Nanocomposites and nanomaterials

Composite ion-exchanger as prospective materials for sorption of uranium(VI) compounds

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In order to obtain organic-inorganic ion-exchanger, the method, which involves reorganization of gel-like cation exchange matrix in non-aqueous media followed by zirconium hydrophosphate precipitation, has been proposed. Reorganization, which is confirmed with standard contact porosimetry and NMR ²³Na spectroscopy, means a narrowing of nanosized transport pores of the polymer. As a result of precipitation in the reorganized matrix, aggregates of nanoparticles of zirconium hydrophosphate are formed. When additionally sorbed electrolyte (ZrOCl₂) 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 fields of the polymer. Otherwise particles of micron size were precipitated in structure defects. Transmission electron microscopy has shown a size of these formations of ≈200 nm in a diameter. It has been found with a method of X-ray fluorescence analysis, a molar ratio of Zr:P in the inorganic constituent is up to 1:0.4. The regularities of precipitation are considered from the point of view of Ostwald-Freundlich and Volfkovich equations.

Sorption of U(VI) compounds were carried out from modeling solutions, which contained also an excess amount of Fe(III) and HCl. At pH 2 of the solution, increasing of the sorbent dosage from 2 to 10 g dm⁻³ causes growth of U(VI) removal degree from 50 to 90-99.5 % and shortage of time, which is necessary for equilibrium. Less dosage (4 g dm⁻³) is required at pH 6-10: the removal degree of 98-99.5 is reached after 0.5-2 h. The composites are more selective towards U(VI) compounds than the pristine resin. Sorption behavior of the materials was considered from the point of view of porous structure of the polymer constituent, chemical composition and morphology of the incorporated modifier.