

Nanocomposites and nanomaterials

Ion exchange resin containing nanoparticles of inorganic constituent for sorption of U(VI) anions

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Regularities of deposition of inorganic ion-exchangers (hydrated oxides of multivalent metals) inside the anion-exchange resin are considered. As found from TEM investigations, the nanoparticles exist both in non-aggregated and aggregated forms. Fractal analysis of TEM images was performed in order to establish the aggregation mechanism. The values of fractal dimension reach 2.5-2.7 indicating diffusion of the nanoparticles as a rate-determining stage of aggregation. Following approaches were applied to determine the precipitation conditions, which affect the particle size. The Ostwald-Freundlich equation reflects the effect of a size of the primary particle on their solubility:

$$\ln(\bar{C} / C_{\infty}) = \frac{\beta V_m \sigma}{RT r} \quad (1)$$

Here \bar{C} and C_{∞} are the concentration of dissolved compound in the ion-exchanger

and its saturated solution respectively, β is the shape factor of particles, V_m is the molar volume of the compound, σ is the surface tension of the solvent, R is the gas constant, r is the particle radius of incorporated particles.

Regarding the aggregates, their size depends on flux of the primary nanoparticles (J) through the grain of polymer ion-exchanger:

$$J = \frac{R^2 T^2 \ln(\bar{C} / C_{\infty})}{6 \pi N_a \eta \beta V_m \sigma} \text{grad } C, \quad (2)$$

where N_a is the Avogadro number, η is the dynamic viscosity of the solvent. The conditions, which can be managed, are choice of the modifier and solvent as well as temperature and size of polymer grains. The particle size of anion-exchanger

containing nanoparticles of hydrated zirconium dioxide has been found to influence sorption of anionic U(VI) complexes from weakly concentrated solutions.