Nanocomposites and nanomaterials

Nanoparticles of Zr(IV) and Fe(III) oxides incorporated into Dowex SBR-P ion exchange resin: effect on sorption of arsenate ions

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Nanodimensional particles (single particles, their aggregates and agglomerates) of zirconium and iron oxides were embedded to polymer gel-like strongly basic anion exchange polymer matrix, such as Dowex SBR-P resin. A sample of the polymer was immersed with a 1 M aqueous solution of metal salts (the ratio of volumes of solid and liquid was 1:1) and heated during 1 h under stirring. Then the beads were filtered, washed, immersed with a 25% NH_4OH solution and treated with ultrasound. Morphology of the samples was researched with scanning and transmission electronic microscopy. The regularities of deposition of the inorganic constituent were discussed. The effect of its composition. temperature and solvent viscosity was considered. Chemical analysis showed that the amount of the inorganic constituent in the synthesized composite materials was 5 - 9 mass %. The ion-exchangers were applied to removal of arsenate ions from aqueous solutions, the effluent was analyzed with an atomic absorption method.

When the initial content of As(V) in the solution was 0.1 $g \cdot dm^{-3}$, the composites containing 7% of oxide demonstrate much higher distribution coefficient of the toxic component (4850 $cm^3 \cdot g^{-1}$) than the pristine resin (1170 $cm^3 \cdot g^{-1}$). Regarding sorption from low concentrated solution (50 $\mu g \cdot dm^{-3}$), more significant effect of the embedded particles has been found: the distribution coefficient increases from 511 (pristine resin) to 9240 $cm^3 \cdot g^{-1}$ (nanocomposite). The effect of amount of the incorporated inorganic constituent on the distribution coefficient is discussed, the structure of the particles and polymer matrix are taken into consideration. The influence of the inorganic particles on regeneration of the ion-exchangers loaded with As(V) has been also found.

The optimal amount of the inorganic constituent in the composite ion-exchangers, at which the maximal distribution coefficient of arsenate ions as well as the highest regeneration degree are reached, has been estimated. The influence of aggregation and agglomeration of the nanoparticles on these characteristics is suggested.