ORGANIC-INORGANIC ION-EXCHANGERS FOR SORPTION OF URANIUM(VI) COMPOUNDS FROM MODEL SOLUTIONS. EFFECT OF SYNTHESIS CONDITIONS

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The development of new methods for purification of natural and waste waters from uranium(VI) compounds as well as improvement of known techniques are topical tasks at this time. This is especially important for a number of southern regions of Ukraine, where main enterprises of uranium branches are based. Sorption is one of the effective methods for recovery of uranium compounds from aqueous solutions. Another significant objective is a search of new sorbents, which provide high rate of the process, selectivity the materials and their considerable exchange capacity towards uranium(VI) compounds.

The aim of the work is to investigate the effect of synthesis conditions on functional properties of organic-inorganic ion-exchangers based on strongly acidic gel-like resin and zirconium hydrophosphate. Main attention was focused on sorption of uranium compounds from model solutions.

The uranium(VI) compounds were used as sorbates, which were in model solutions of uranyl acetate ($2.1 \cdot 10^{-4}$ mol dm^{-3}) in a presence of 0.02 mol dm^{-3} HCl. The initial values of solution pH were 2. Strongly acidic gel-like cation exchange Dowex HCR-S resin and organic-inorganic resins based on it were used as sorbents. The procedure of their synthesis involved impregnation of the resin with a $ZrOCl_2$ solution followed by a treatment with H_3PO_4 (Table). Pristine ion exchange resin in a H-form as well inorganic cation-exchanger like zirconium hydrophosphate (ZHP) were investigated for a comparison.

Table. Synthesis of organic-inorganic ion-exchangers

Sample	ZHP	0	1	2	3	4	5	6	7
C ($ZrOCl_2$), M	1	-	0.01	0.1	1	1	1	1	1
C (H_3PO_4), M	1	-	1	1	1	0.01	0.1	0.3	1

The experiments devoted to sorption of uranium(VI) compounds under batch conditions have been performed with continuous shaking at 20±2°C for 0.1–3 h. As shown, the pristine ion-exchanger and organic-inorganic ion-exchangers based on it are effective sorbents for uranium compounds. Irrespective of the synthesis conditions, maximal sorption degree (99.5%) is achieved, when the volume ratio of the solid and liquid phases is 1: 500 (the sorbent volume was 2 g dm^{-3}). However, kinetics of sorption is different for the materials obtained with various manners. The equilibrium (sorption degree is 99,5-99,8%) is reached during 60 (sample 6), 80 (samples 2, 4, 5), 100 (samples 3 and 7), 120 min (samples 0 and 1). Kinetic models of pseudo-first and pseudo-second orders as well as Boyd, Adamson and Mayers. Constants of rate of film diffusion and chemical reactions decrease in the order: sample 6 > sample 4 ≈ sample 5 > sample 2 > sample 1> sample 3 ≈ sample 7 > sample 0 > ZHP. At the same time, the coefficient of particle diffusion reduces as follows: sample 7 > sample 4 > sample 2 > sample 6 > sample 5 > sample 1 >sample 3 > ZHP.

Thus, the sample obtained by precipitation of the inorganic constituent with a plenty of H_3PO_4 (samples 4-6) are the most suitable for removal of uranium(VI) compounds from model aqueous solutions.