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A use of iron(III) hydroxo complexes for removal of radionuclides from solution in the presence of complexing anions

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Operation of nuclear power plants and other nuclear industry require solution of the following issues: decontamination of the main equipment and working area, treatment of low radioactive waste (LRW). These problems are closely related to each other, i.e. ineffective treatment of LRW generates large amounts of radioactive waste with complex chemical composition. Behaviour of radionuclides in such processes as sorption, ion-exchange, ultrafiltration, etc., which are used for removal of radionuclides from solution, is largely determined by their speciation in solution.

Speciation of iron (III), cobalt (II) and manganese (II) in aqueous solution was studied. A pH range of existence for mononuclear and soluble polynuclear hydroxo complexes, as well as colloidal particles in the media of weak and strong complex anions was found. It was shown that the presence of complex anions (oxalate, phosphate, iodate, EDTA etc.) affects the hydrolysis and precipitation of metal ions in aqueous solution.

The presence of complex anions in aqueous solution shifts the beginning of the radionuclides (60Co, 54Mn, 109Cd, 65Zn) coprecipitation with iron (III) to higher pH values. The higher the concentration of the complex anion in solution, the higher pH is needed for coprecipitation of the radionuclides. A treatment technology of aqueous solutions with complex chemical composition, containing different radionuclides (60Co, 54Mn, 109Cd, 137Cs, 110mAg, etc.) as well as used deactivation solutions and acidic filtrates from separation columns, was developed. It was shown that by coprecipitation with iron (III) and ultrafiltration at certain conditions total decontamination of the solutions from 60Co, 54Mn, 109Cd, 137Cs, 110mAg radionuclides is reached. Therewith, decontamination factor of 1.103 using one stage and of 5.106 using three stages purification for 109Cd were obtained.

The results of speciation studies show that iron (III) can be precipitated in the presence of organic complex agents, in a form of iron (III) hydroxide, and the radionuclides can be coprecipitated with it. Therefore, coprecipitation can be used as a possible way for decontamination of the radioactive solutions for removal of radionuclides.

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