Alteration of mineral phases under liquid nuclear waste disposal conditions

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Deep-well injection of liquid nuclear wastes (LNW) into the water-permeable strata is a practice of LNW management established in Russia since 1963. The sorption processes along with the filtration and permeability properties of the reservoir bed are the key factors governing the radionuclides spreading within the disposal. Prediction of radionuclides migration outside from the location of the injection well requieres characterization of all the surfaces existing in the disposal, including sandy rock minerals and precipitates forming from LNW solution. The disposal is a complex natural and artificial system which needs to be monitored using exploration wells along with investigation under the well controlled laboratory conditions.

The composition of wastes injected in the deep disposal vary significantly including acidic technological wastes, which consist of sodium nitrate, acetic acid, corrosion products (Fe, Cr, Mn, Ni, Al) and radionuclides. Some of the short-lived fission products that sorbed just near the injection well cause the heating of the bed till 100-150°C. Both corrosion products phases and secondary phases of the reservoir bed forming under acid hydrothermal conditions have been studied in this work. The most of radionuclides are sorbed on different surfaces extremely unhomogeneously. Fe/Cr-containing phases along with clayey minerals and organic matter play the important role in the retention of actinides (Pu, U, Am, Np).

The solid phases of corrosion products from LNW solutions along with altered minerals of the sandy rocks of reservoir bed were characterized using XRD, Mössbauer spectroscopy, optical microscopy, SEM-EDX and HRTEM. The retention properties of the different mineral phases towards actinides are presented in the paper.

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