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Sorption of niobium on Olkiluoto soil samples

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A KBS-3-type repository for the spent fuel from the Finnish nuclear power reactors in Olkiluoto and Loviisa is to be built in the bedrock at the Olkiluoto site at the depth of approximately 400 m. The final disposal plan includes a safety assessment of the spent nuclear fuel, where the potential dose contributing nuclear waste nuclides for man are specified. As a part of this assessment, the transport of these prioritized radionuclides from the geosphere to surface environment and their fate within is modelled and evaluated. Nb-94 is classified as high priority radionuclide in the long-term safety assessment of spent nuclear fuel.

The retention of niobium was studied on Olkiluoto soil samples representing humus layer and mineral soil layers. Sampling extended from the soil surface to the bedrock surface. Soil samples were used without pretreatment, e.g. drying or sieving. Mass distribution coefficient, Kd, describing the effectiveness of the retention was determined by batch sorption tests. The liquid phase used in the tests was synthetic soil solution simulant, which composition is similar to the composition of Olkiluoto soil solution. The equilibrium time ranged from one day to three weeks for humus samples and from one week to nine weeks for mineral soil samples. The final activity of the Nb-95 tracer was determined by gammaspectrometry with Wizard ™ 3".

The sorption of niobium was found to be high on mineral soil samples as the Kd values ranged between 1.1×10^3 ml/g and 1.0×10^6 ml/g. Niobium was retained on colloidal particles which was seen as an increase in the Kd values upon filtering. Sorption showed no clear dependence on time or sample depth. The sorption on humus samples was smaller as the Kd values ranged from 230 ml/g to 1.2×10^3 ml/g.

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