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Sorption of uranium and lead on CSH

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To evaluate the long-term safety of low/intermediate level radioactive waste repositories and future deep geological repositories for spent nuclear fuel, it is necessary to investigate the behaviour of radionuclides that will be present, such as uranium or lead. Radionuclide migration is affected by interactions with engineering barriers of the repositories, which may also include sorption of radionuclides on the cementitious materials. In this study, the sorption of selected elements on cement phase CSH (Calcium-Silicate-Hydrate, main sorbing phase in cements) was carried out within different conditions (temperature, addition of EDTA, as a selected representative of the organic substances present in the waste). The sorption behaviour of element is described by the distribution ratio (R_d) between liquid and solid phase (L/S) or with sorption isotherm.
Sorption of U and Pb on synthetic cement phase CSH with Ca/Si ratio 1 was studied in a set of equilibrium and kinetic sorption experiments held within range of L/S = 100–800 L kg^{-1} and temperature range 22–80 ℃ with ^{233}U and stable Pb in an inert atmosphere. The aim of the study was to compare behaviour of these elements with previous study which was done on real cementitious materials and describe the sorption from several point of view: distribution ratio or the isotherm shape under the influence of temperature or addition of EDTA. The measurement of ^{233}U was done on LSC detector. Pb concentration in solution was measured on AAS. Where possible with regard to experimental setup reaction enthalpy, entropy and apparent activation energy were also determined.
Sorption experiments with a synthesised CSH phase in comparison with real cementitious material within several conditions confirmed the dominant role of CSH for sorption of selected radionuclides in cementitious materials corresponding with the higher R_d values of sorption on CSH than on real cementitious materials. Sorption of uranium and lead is strong with high R_d values (in the order about 10^5 L kg^{-1}). Pb sorption is more sensitive to presence of EDTA.
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