Stability of zeolites in state II concrete pore water: an experimental approach

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To ensure safe, long-term disposal of hazardous and nuclear waste, concrete encapsulation is considered. Ordinary Portland cement (OPC) concrete provides a suitable immobilisation of elements such as As and Cd, but retention of Pb, B, Cs, Sr, Cr and Zn is limited due to competition with Ca. These elements can even induce a deteriorated setting of the OPC. [1–5] Concrete barriers also suffer from degradation and formation of cracks as result of stress, thermal changes and shrinkage. The resulting increase in water percolation significantly reduces the service life of an OPC barrier.[6,7] These factors render the implementation of a defence-in-depth solution for long term OPC based waste disposal advisable. Zeolites such as Chabazite (CHA) can offer such solution. CHA is stable in young concrete pore water and exhibits good sorption properties for Cs^+.[8,9] But for long-term storage, its stability and sorption properties need not only to be valid in young, but also in state II concrete pore water. The latter is dominated by the solubility of portlandite (or $Ca(OH)_2$).[10] Contact between zeolites and solid Portlandite typically results in CSH or CASH formation and must be avoided, and also CO_2 intrusion and the inverse solubility of Portlandite render experimental systems investigating zeolite stability in state II porewater difficult. This contribution discusses such issues and potential solutions, enabling the study of zeolite stability and cation exchange properties in state II pore water.

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