Interaction of selected elements with zeolites in cementitious environments

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Construction of multi-barrier concrete based waste disposal solutions and management of alkaline mine drainage water requires cation exchangers combining excellent sorption properties with a high stability and predictable performance in hyper alkaline media. Though highly selective organic cation exchange resins have been developed for most pollutants, they can serve as growth medium for bacterial proliferation, impairing their long-term stability and introducing unpredictable parameters into the evolution of the system. Zeolites represent a family of inorganic cation exchangers, which naturally occur in hyper alkaline conditions and cannot serve as electron donor or carbon source for microbial proliferation. Despite their successful application as industrial cation-exchanger in near neutral conditions, their performance in hyper alkaline, saline water remains highly undocumented [1] [2]. This contribution evaluates the interaction of a selection of elements with zeolitic ion exchangers, in hyper alkaline conditions which are relevant to four pore water regimes that are expected to occur as a result of cement degradation with time.

Due to the limited number of relevant experimental studies available, the interaction was evaluated using information from three sources. For all elements in this report, the dominant speciation in hyper alkaline media was evaluated and a mechanistic evaluation of the potential of these species to interact via a cation exchange mechanism was made. In cases for which reliable experimental results were available, they were used for estimation of the K_D value to the respective concrete pore water conditions with an emphasis on values available for chabazite. The experimental data were filtered to exclude studies impacted by surface precipitation and sorption onto organically modified zeolites.

[1] Van Tendeloo L. *et al.* (2015) *Environ. Sci. Technol.* **49**, 1729–1737 [2] Van Tendeloo L. *et al.* (2015) *Environ. Sci. Technol.* **49**, 2358–2365