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CORROSION AT THE BENTONITE IRON INTERFACE

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Bentonites will be used as so called geotechnical barrier surrounding metal canisters containing high-level radioactive waste (HLRW). They should isolate the canister from the host rock and hence be as stable as possible. The metal canister will be hot which accelerates chemical and mineralogical reactions taking place in the bentonite. Moreover, bentonite was found to play a role concerning the corrosion of the metal canister which is one of the most important barriers in these waste repository concepts. The interaction of bentonite and iron was, therefore, investigated systematically, based on 38 well characterised bentonites (Kaufhold et al., 2015). The bentonites were used both in their natural state (natural cation population) and after saturation with Na and Ca, respectively. All bentonite samples were contacted with a precisely weighed iron pellet at 60 °C in a glove box. Bentonite and iron pellet were separated after 5 months. The extent of the corrosion was quantified by measuring the weight loss of the iron pellets. Most of the samples showed greenish colour after terminating the test which can be probably related to the formation of iron-silicates. Various studies reported on the formation of berthierine (the Fe analogue of kaolinite) or chlorites at higher temperatures. The formation of a 1:1 phase was confirmed in a separate test especially designed to produce significant amounts of the corrosion product (Kaufhold et al., 2015).

The extent of the corrosion of the pellets was compared with the bentonite properties. First of all the role of the type of counterion was identified. Most of the Ca/Mg dominated bentonites showed slightly more corrosion (weight loss of the pellets) as compared to most of the Na dominated bentonites. This can be explained by the density of the gels which formed in the laboratory test reactors. Ca bentonites mixed with water yield comparably dense gels which results in a larger number of smectite particles at the iron bentonite interface. This effect, however, has to be elucidated further. The most interesting and relevant result was found when considering Na bentonites and Ca/Mg bentonites separately. Both samples sets revealed the role of the layer charge density (determined by the alkylammonium method; Fig. 1). In conclusion, low layer charge densities lead to increased corrosion. Intermediate to high charged smectites can be used to decrease the corrosion rate.

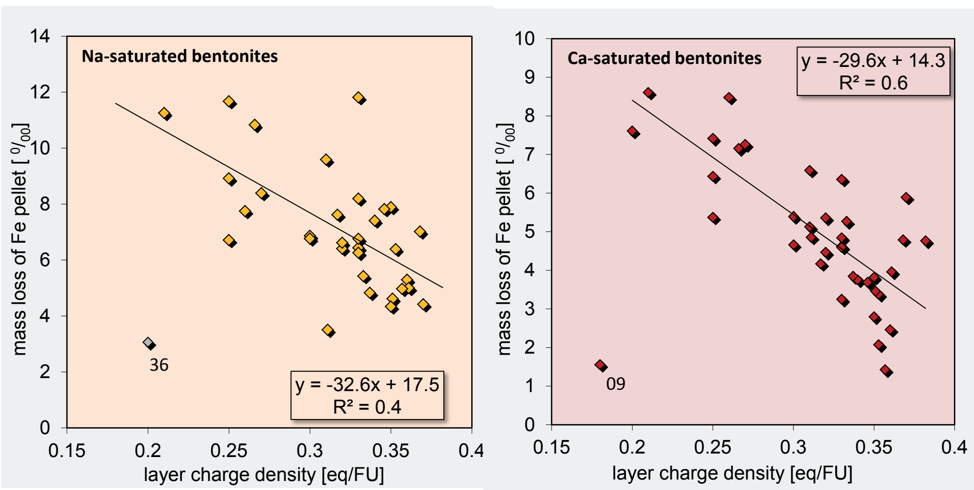

Fig. 1. Comparison of the layer charge density with the mass loss of the iron pellets of the Na-bentonite series (left) and of the Ca-bentonite series (right), Kaufhold et al. (2015).

[1] Kaufhold, S., Sanders, D., Dohrmann, R., Hassel, A. W. (2015). Fe corrosion in contact with bentonites. - Journal of Hazardous Materials, 285, 464-473.