LOT PROJECT LONG TERM TEST OF BUFFER MATERIAL AT THE ÄSPÖ HRL

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Bentonite clay has been proposed as buffer material in several concepts for HLW repositories. The decaying spent fuel in the HLW canisters will increase temperature of the bentonite buffer. A number of laboratory test series, made by different research groups, have resulted in various bentonite alteration models (e.g. Karnland and Birgersson, 2006). According to these models no significant alteration of the buffer is expected to take place at the prevailing physico-chemical conditions in the proposed Swedish KBS-3 repository, neither during, nor after water saturation.

The ongoing LOT test series is focused on quantifying the mineralogical alteration in the buffer in a repository like environment at the Äspö HRL. Further, buffer related processes concerning bacterial survival/activity, cation transport, and copper corrosion are studied. In total, the LOT test series includes seven test parcels (Table), of which three are exposed to standard KBS-3 conditions and four test parcels are exposed to adverse conditions.

Table 1: Table Test program for the LOT test series A = adverse conditions, S = standard conditions, T = temperature, pH = high pH from cement, am = accessory minerals added

Type	No.	max T, °C	parameters	Time, y	Remark	Status
A	1	130	T, pH, am	~ 1	pilot test	finalized
A	0	120-150	T, pH, am	~ 1	A1 complement	finalized
A	2	120-150	T, pH, am	~ 5	main test	finalized
A	3	120-150	T	~ 10	main test	
S	1	90	T	~ 1	pilot test	finalized
S	2	90	T	~ 5	main test	
S	3	90	T	~ 10	main test	

Each test parcel contains a central Cu-tube surrounded by bentonite cylinder rings with a diameter of 30 cm, additional test material (Cu coupons, ^{60}Co tracers, bacteria etc) and instruments. Electrical heaters were place within the copper tube in order to simulate effect of decaying power from the spent fuel.

The entire test parcels were released from the rock after the field exposure by overlapping boring and the bentonite material was analyzed with respect to:

- physical properties (water content, density, swelling pressure, hydraulic conductivity, rheology)
- mineralogical alteration in the bentonite
- distribution of added substances (e.g diffusional transport of ^{60}Co)

- copper corrosion
- bacterial survival/activity

Two one year tests were started in 1996 and terminated in 1998. The results from tests and analyses are presented in SKB TR-00-22. The remaining four test parcels were installed during the fall 1999 plus one additional one year test parcel (A0). The parcels A0 and A2 are finalized and the basic tests and analyzes are made.

The most important general and specific results from the analyzed parcels may be summarized as:

- reorganization of easily dissolved accessory minerals e.g. gypsum
- increase in cation exchange capacity in the warm parts of the A2 parcel (Figure)
- changed rheological properties (reduced strain at failure) in warm sections in parcel A2 (Figure)
- expected diffusive transport of trace elements
- expected corrosion rate of metallic copper
- no or insignificant bacterial activity

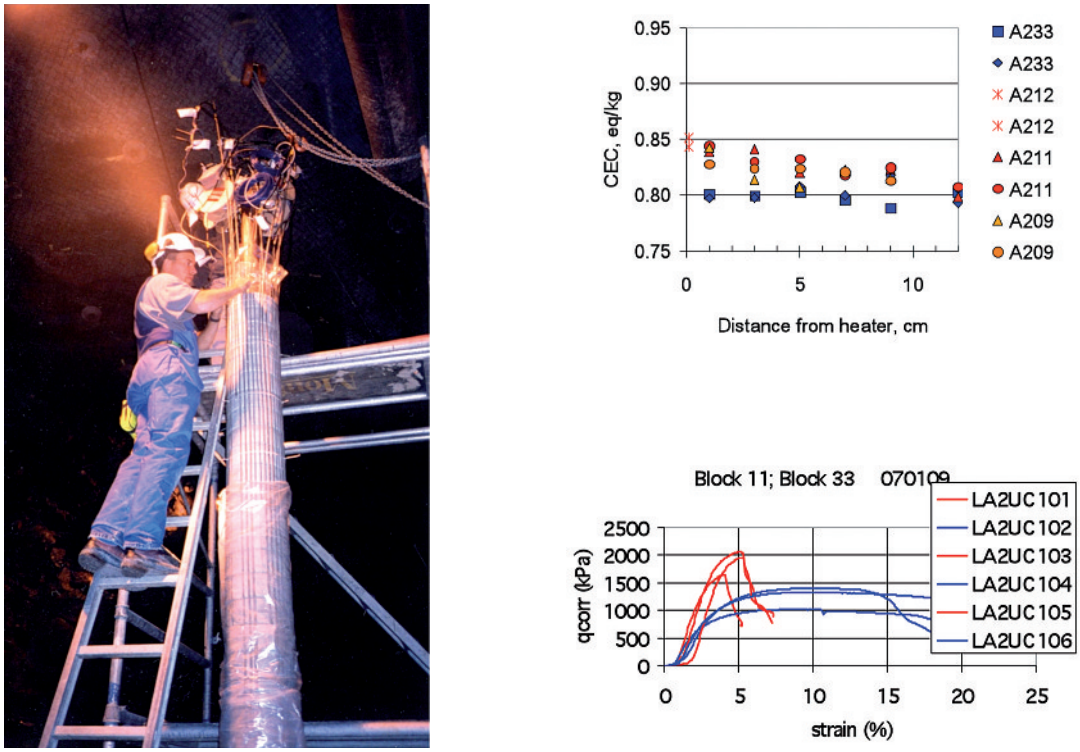

Figure 1: Installation of a test parcel (left). Measured cation exchange capacity in the bulk material from parcel A2 as a function of distance from the copper tube (upper right). Deviator stress versus strain (lower right). Red color indicate material from warm positions and blue from cold.

The LOT project was initiated and is financed by SKB (Sweden). Posiva have contributed from project start by financing clay water analyses performed by VTT. As from the last analyzed A2 parcel, also ANDRA (France), BGR (Germany) and Nagra (Switzerland) have joined the project by financing parallel independent mineralogical analyses performed by laboratories in these countries, respectively.

References:

Karnland, O., Sandén, T., Johannesson L-E., Eriksen, T.E., Jansson, M., Wold, S., Pedersen, K., Mutamedi, M. and Rosborg, B., 2000. Long term test of buffer material. Final report on the pilot parcels. Technical Report TR-00-22. SKB Stockholm, Sweden.

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