

MOCK-UP-CZ: DISMANTLING OF THE EXPERIMENT – GEOTECHNICAL RESULTS

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The issue of the disposal of radioactive waste is one of the most pressing challenges of our age, for which, in most countries, the deep repository concept is generally considered to be the most suitable final solution. In order to make such a repository both safe and reliable, intensive research is underway worldwide. The construction of physical models is one approach to the study of the engineered barriers for deep geological repositories; one such experiment, Mock-Up-CZ, has been performed at the Centre of Experimental Geotechnics, CTU in Prague.

The Mock-Up-CZ experiment simulated the vertical placement of a container with radioactive waste, an approach that is in line with the Swedish KBS-3 system. The physical model consisted of a barrier made up of bentonite blocks, powdered bentonite backfill, a heater and hydration and monitoring systems (Figure 1). The whole experiment was enclosed in a cylindrical box, whose construction was able to withstand high pressure due to bentonite swelling. A number of sensors (monitoring changes in temperature, pressure and moisture) were placed inside the bentonite barrier. The basic material used in the experiment consisted of a mixture of Czech bentonite from the Rokle deposit (85%), quartz sand (10%) and graphite (5%).

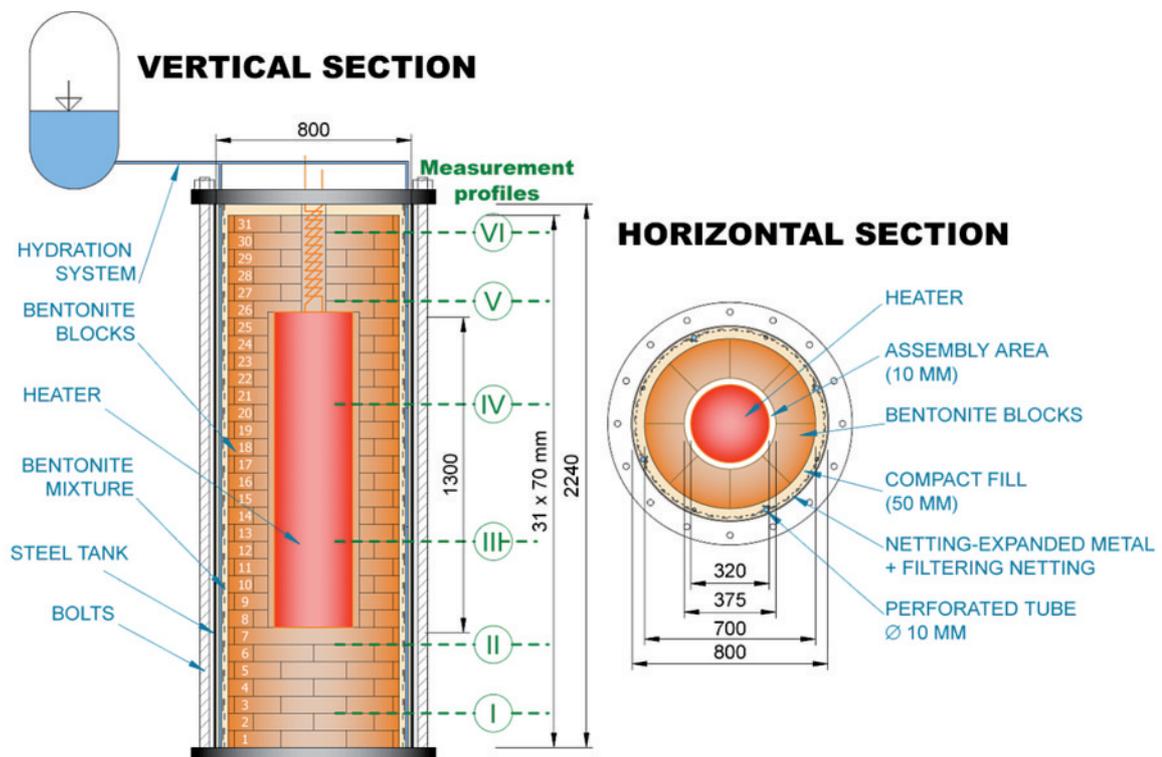


Figure 1: Mock-Up-CZ Cross-section.

The first phase of the experiment commenced on 7th May 2002, during which the heater was switched on, with no water input. After 6 months the second phase commenced in which water was introduced through the hydration system (Pacovský et. al., 2007). This phase ended on 2nd January 2006 when the heater was

switched off. After allowing time for cooling, the dismantling phase commenced (30th January 2006). After a further one and a half months (17th March 2006) the dismantling of the experimental vessel was completed. Post-decommissioning analysis continued until the end of 2007.

Dismantling and post-decommissioning analysis were carried out according to a very detailed plan which included not only procedures for the actual decommissioning of the experiment (opening of the experiment, the taking of samples, documentation etc.) and an extensive sampling plan but also an all-encompassing multidisciplinary scientific research programme which involved the participation of several research partners each of them respected specialists in their various fields:

- Faculty of Civil Engineering - Czech Technical University in Prague.
- Institute of Chemical Technology, Prague.
- Faculty of Science - Charles University, Prague.
- Masaryk University, Brno.

This allowed the performance not only of the originally intended geotechnical research but also the significant enlargement of the post-decommissioning analysis stage to include detailed geochemical, mineralogical, corrosion and bacteriological research.

Geotechnical research included the measurement and evaluation of:

- water content distribution
- density distribution (dry and bulk)
- permeability
- swelling pressure
- thermo-physical properties
- Atterberg limits

The results of each test performed (including details of the spatial coordinates of each sample taken in the experiment) were recorded in a specially set up database which served as the basis for material performance evaluation. Advanced visualisation in 3D was employed to facilitate the final evaluation of the results.

The results of the analysis showed that changes had indeed taken place within the bentonite material but that these changes had practically no impact on the geotechnical performance of the material (note: the results obtained by the various partners listed above can be found elsewhere) (Pacovský et. al., 2008).

The unusually complex nature of both the dismantling project itself and the post-decommissioning analysis brought together teams with widely differing scientific backgrounds which in itself greatly added to the value of the experiment.

References:

- Pacovský, J., Svoboda, J., Zapletal, L., 2007: "Saturation development in the bentonite barrier of the Mock-Up-CZ geotechnical experiment", *Physics and Chemistry of the Earth*, Parts A/B/C, Volume 32, Issues 8-14, 2007, Pages 767-779, Elsevier, Netherlands.
- Pacovský, J., Svoboda, J., Vašíček, R., 2008. Testing Possible Czech Waste Disposal Concept and Clay Material through Real Scale Mock-Up (Dismantling and Preliminary Geotechnical Results), *Science & Technology Series*, no 334 (2008), Andra, France