SEALEX In-Situ Experiments-
Performance Tests Of Repository Seals:
Experimental observations and
modelling

Nadia Mokni, J.D. Barnichon

Improvised by A. Dauzères
1-SEALEX experimental program

- New drift excavated in 2008 in Tournemire URL
- 6 SEALEX in-situ tests are installed from this drift

- Test the long-term hydraulic performance of sealing systems (in normal conditions), for different core compositions (pure bentonite, sand/bentonite mixtures) and conditionings (pre-compacted blocks or in situ compacted powder)

- Quantify the impact of intra core geometry —construction joints in the case of pre-compacted blocks— on the hydraulic properties of sealing systems

- Quantify the effect of altered conditions (loss of mechanical confinement)

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SEALEX program: Parametric approach

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<th>Core view</th>
<th>Altered conditions</th>
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<td>RT-1</td>
<td>Monolithic disks Precompacted (70/30)</td>
<td>No</td>
</tr>
<tr>
<td>PT-N1</td>
<td>Disks + internal joints (4/6) Precompacted (70/30)</td>
<td>No</td>
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<td>Variations / Base case</td>
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<td>PT N2</td>
<td>Monolithic disks Precompacted (70/30)</td>
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<td>Pellets/powder In situ compacted (1000t)</td>
<td>Confinement loss</td>
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<td>PT-N3</td>
<td>Pellets/powder In situ compacted (1000t)</td>
<td>No</td>
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<td>PT-N4</td>
<td>Pellets/powder In situ compacted (1000t)</td>
<td>Confinement loss</td>
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</table>
2. Description of SEALEX in-situ tests

Bentonite-based core fully instrumented with 21 wireless sensors: 5 $\sigma$, 8 $P_p$, 8 RH

Flooding phase: fill as much and as possible with water all the technological voids 1 hour

The saturation phase: fully saturate the bentonite-based core from the water pressure condition imposed at both ends of the core.

The performance tests phase: hydraulic tests (pulse, injection...)

Confinement loss phase: removal of the axial confining pressure

Various Technological Gaps

Gaps within the bentonite based disks (PT-N2)
3. Experimental and modelling results

**Base case: performance test, PT-N1**

- Bentonite/sand mixture (70/30 dry mass)
- 8 monolithic pre-compacted discs
- Initial water content ~11%
- Initial dry density of 1.97 Mg/m³
- Non uniform technological void

**Saturation profiles**

**Dry density distribution**

- 140 Days
- 500 Days
- 1000 Days

**Profiles of Dry density**

**Swelling pressures evolution**

- Axial swelling pressure
- Radial swelling pressure

**Total pressure sensor**

- S01
- S02
- S03

**Profiles of Dry density**

- A45
- A11
- R22
- R60

**3-D Model**

- Non-uniform thickness
- Technological gap
3. Outcomes

- Important role of the technological gap, on the saturation and swelling pressure kinetics.

- Different evolutions of radial swelling pressures suggests a heterogeneous structural distribution of bentonite/sand mixture within the blocks (confirmed by µ-CT observations).

- Heterogeneous distribution of dry density is observed.

- The non uniform thickness technological gaps increases this heterogeneous distribution of dry density.

- Remaining dry density gradient after ~10 years of hydration.

- The effect of this dry density gradient should be considered in the evaluation of long term performance of engineered barriers, which focus essentially on the required average dry density.
Thanks for your attention