Gas injection tests on a Sand Bentonite Mixture: Investigation on the effect of pore water chemistry

Donatella Manca; Mohammad Monfared; Alessio Ferrari and Lyesse Laloui
Swiss Federal Institute of Technology Lausanne, EPFL-LMS, GC Station 18, CH 1015 Lausanne, Switzerland
Contact: Donatella.Manca@epfl.ch

CONTEXT

Within the framework of the FORGE project the impact of gas generation and migration is studied to assess the long term performance of nuclear waste repositories.

The continuous generation of gases from anaerobic corrosion of metal canister containing the waste can cause the excessive increase of the gas pressure in the cavern causing failure of the host rock. In such conditions the long term performance of the repository are jeopardised (Nagra, 2008).

SOLUTIONS:

Engineered gas transport system (EGTS) to create a preferential gas flow path but preserving the retention capacity of the barriers.

Sand/bentonite as backfilling material of seals and plugs for LILW repository: high gas permeability + low hydraulic conductivity.

AIMS OF THE STUDY

To investigate the influence of the pore water chemistry on swelling capacity and breakthrough pressure.

\[ P_g(C) > P_{sw}(C) + P_w \]

Waters characteristic: Two type of water waters with different salt concentration

- Distilled: Is used to determine the maximum swelling capacity of smectite
- Synthetic: Mainly contains Na+ and CL (\( \chi = 0.9 \) kPa). It is used to reproduce the in situ condition of a real repository

EXPERIMENTAL SETUP

Constrained swelling tests: executed on specimens of 80/20 S/B mixture compacted at dry densities and saturated with two type of water.

Swelling pressures of the S/B developed with distilled water and in synthetic pore water.

Gas breakthrough pressure: executed under isochoric / constant stress condition on fully saturated specimens of 80/20 S/B mixture compacted at \( P_d = 1.5 \) MPa.

RESULTS:

- Important reduction of the breakthrough pressure
- The normalized outflow increased of 1 order of magnitude with synthetic water

CONCLUSIONS:

- The use of synthetic water produces an important reduction of the swelling pressure of the mixture.
- The reduction of the swelling capacity of the mixture leads to the reduction of the breakthrough pressure.
- An important increase of the measured outflow is detected when synthetic water is used in the gas experiments.

PERSPECTIVE

- Further measurements are foreseen at different dry density.
- Microstructural investigation will be performed on specimens fully saturated with the two waters.

ACKNOWLEDGEMENT

The research leading to these results has received funding from the European Atomic Energy Community’s Seventh Framework Programme (FP7/2007-2011) under Grant Agreement n° 230357, the FORGE.

REFERENCES