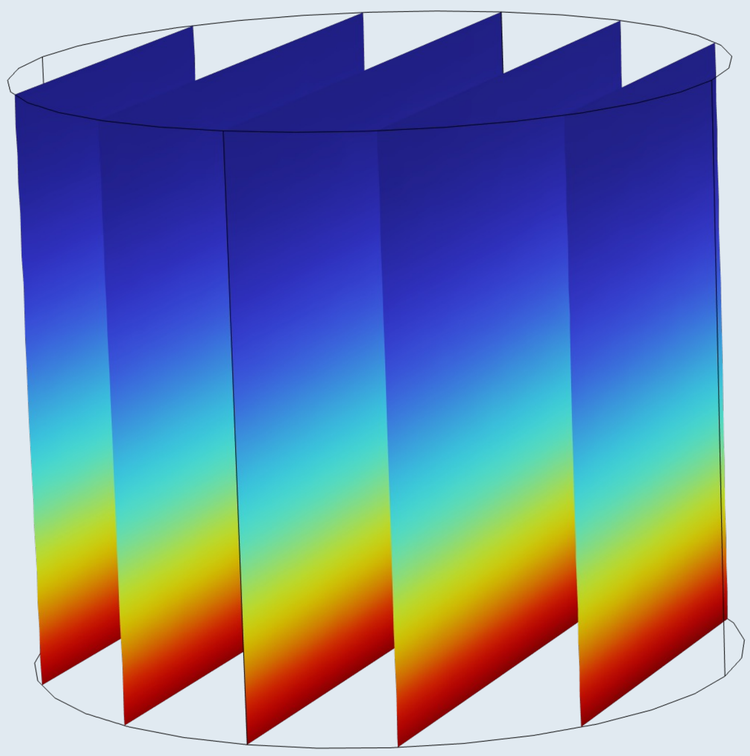

Implementing a New Type of Boundary Condition using the COMSOL® Physics Builder

Advancing of the self developed VIPER-Interface by adding a Neumann Boundary condition for limited water inflow.

M. Kröhn
Repository Research Department, GRS gGmbH, Braunschweig, Germany

Abstract

While the water uptake dynamics of bentonite under unimpeded water access could be simulated using the previously developed VIPER interface [1], a special boundary condition needs to be implemented for the case of restricted water inflow.

For this specific case, a Neumann boundary condition has been implemented using the weak-form equation node in the COMSOL® Physics Builder. A first comparison of simulation results with laboratory data has been showing a satisfying fit.

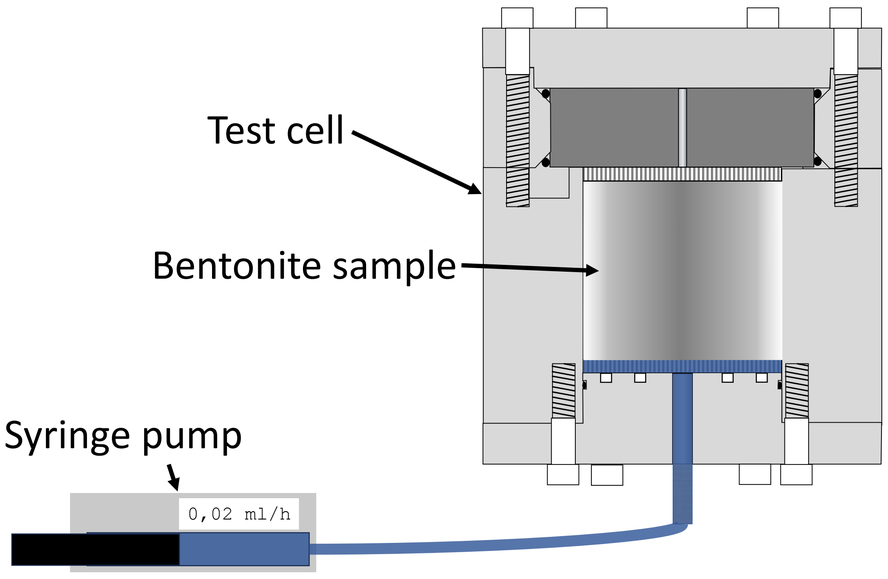

FIGURE 1. Experimental setup

Methodology

$$\int_{\Gamma} \left[\left(-Da - \rho_d \, Da' \frac{\partial w}{\partial rh} \frac{1}{\rho_{v\,sat}} \right) \nabla \rho_v n \right] dA$$

Implemented Neumann boundary condition

The newly implemented boundary condition (see above) was checked by experiments at GRS that were aimed at the water uptake dynamics of compacted bentonite at a limited water supply [2]. To that end, a mechanically confined and levelled bentonite sample is slowly saturated using a syringe pump with a controlled flowrate (FIGURE 1).

Results

A comparison of simulation and experimental results is shown in FIGURE 2 for an inflow rate of 0,02 ml/h over different running times. A reasonably good fit between simulation and experimental data was achieved.

Further advancing of the simulation capabilities is intended next. This will also include further comparisons for changed experimental conditions like other inflow rates or running times.

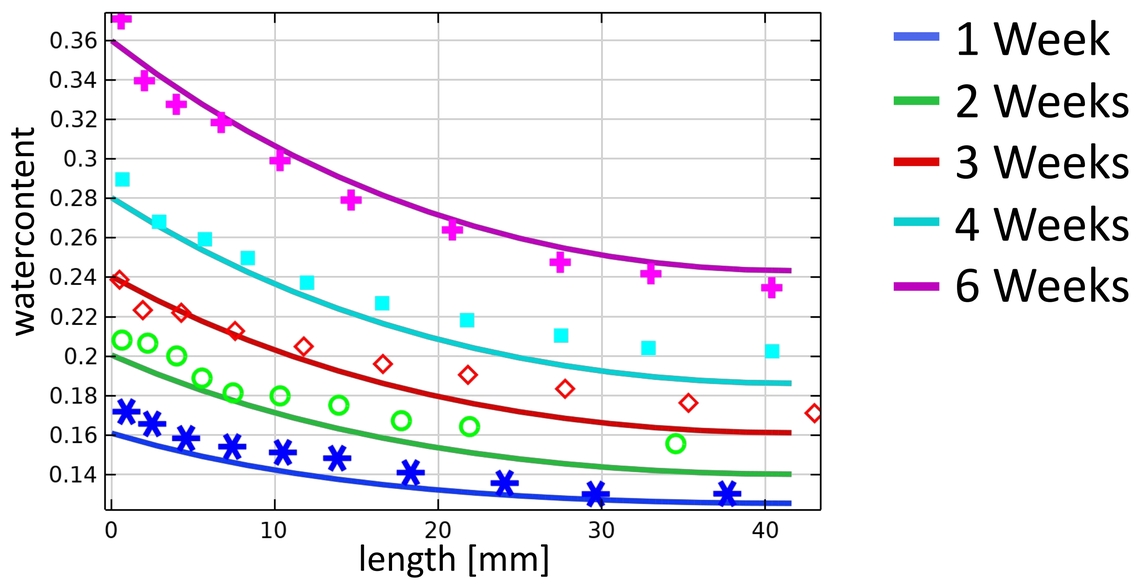

FIGURE 2. Comparison of simulation (line) and experimental (symbol) results for an inflow rate of 0.02ml/h

REFERENCES

1. Kröhn, M. and Fromme, L.: Development of a Special COMSOL® Interface Based on an Alternative Model for Bentonite Re-Saturation. Proceedings of the COMSOL-Conference 2023, München, 25. - 27. October, 2023
2. Kröhn, K.-P., “Bentonite Re-saturation –limited Access to Water and high Temperature”, GRS-501, 2019