Multiscale Poromechanics of Shrinking Cement Pastes

Nabor Jiménez Segura
Vienna University of Technology, AT

Objectives:
This research applies a multiscale poromechanics model to upscale sorption-induced shrinkage of C-S-H to volume changes of cement pastes during the desorption and adsorption of water.

What is poromechanics?

Poromechanics is a branch of continuum mechanics that studies the behavior of a medium consisting of a solid matrix and an interconnected porosity. Mature cement pastes are complex porous materials. The porosity of cement pastes ranges across different scales: from pores at the scale of nanometers to larger pores at the scale of micrometers.

Characterizing porosity

Adsorption isotherms are used to calculate the pore-size distributuion of the sample. An adsorption isotherm measures the mass of water in the sample at constant temperature in the equilibrium state at different relative humidites (RH). The increase in water mass between a define RH and the next provides the amount of pores at a certain size.

Why does cement shrink?

Molecular dynamics are used to test the validity of physics within a theoretical model. Many behavioral properties related to water-ions can be explored through MD simulation including diffusion coefficient, radial density function, desorption time constant, and angle distribution.

What is the goal of multiscale modelling?

The goal of a multiscale model is to establish a quantitative link between the properties at different scales. In the case of mature cement pastes, homogenization is subdivided into three steps: nano-, micro-, and macroscale.
Thus the nano-and micro- pressures are upscaled together with volume changes of C-S-H in order to predict the macroscopic shrinkage resulting from sorption processes.