Multiscale Poromechanics of Shrinking Cement Pastes

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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 referring to the behavior of materials consisting of a solid skeleton and interconnected pores. Mature cement pastes are complex porous materials, with pore sizes spanning over several orders of magnitude, from single nanometers to several dozens of microns.

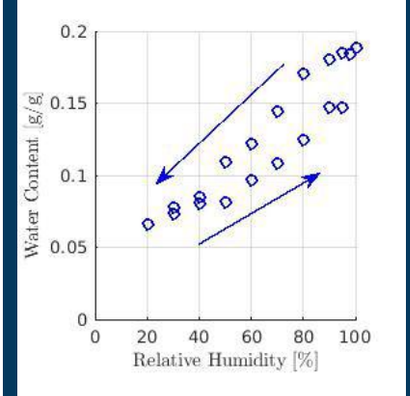
Characterizing Porosity

Adsorption isotherms are used to quantify the pore-size distribution of mature cement pastes. An adsorption isotherm refers to the mass of water in a sample, at constant temperature and in equilibrium states at different relative humidities (RH). The uptake of water resulting from an increase of RH provides access to the amount of pores with specific sizes.

Why Does Cement Shrink?

Reduction of RH results in an increase of pore underpressures. Thus, the solid skeleton is subjected to increasing compression. Macroscopically, this manifests itself as a reduction of the volume of the material. Changes of RH result also in volume changes of nanoscopic C-S-H. Their influence on the macroscopic volume changes is quantified based on a multiscale model.

Desorption and Adsorption Isotherms

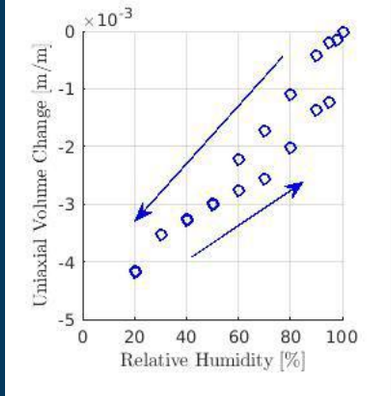


What is the goal of multiscale modelling?

The goal of multiscale modelling is to establish a quantitative links between microstructural key features and macroscopic material properties of hierarchically organised media.

As for mature cement pastes subjected to sorption cycles, the goal is to predict macroscopic volume changes from sorption-induced changes of the microstructure and changes of effective pressures in nanoscopic pore spaces.

Macroscopic Volume Changes



For further information please refer to the following link: https://www.erica-etn.eu/
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