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Addendum to “Is long-term autogenous shrinkage a creep phenomenon induced by capillary effects due to self-desiccation?”

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Prof. F.-J. Ulm brought to our attention that we forgot to include an important reference in our manuscript. Indeed, Ulm et al. (1999) showed that, for 5 concretes that differed in their water-to-cement ratio and for which basic creep and autogenous shrinkage were measured by Le Roy (1996), the long-term kinetics of autogenous shrinkage could be explained by creep of the solid skeleton under the action of an internal pore pressure. Their conclusion was based on the observed linearity of the relationship between basic creep compliance and increase in autogenous shrinkage in the long term.

From the slope of this linear relationship, they back-calculated an “effective pore pressure” displayed in Figure 1. Interestingly, this uniaxial “effective pore pressure” –merely calculated from macroscopic observables– is in very good agreement (both in terms of magnitude and in terms of trend with water-to-cement ratio) with the capillary stresses that we estimated at the pore scale with the help of micromechanics (see Fig. 6 in our manuscript). The reason for this agreement lies in Eq. 16 of our manuscript, which reads $\Sigma^\infty = \sigma^\infty$ and shows that, in the linear viscoelastic case with a viscoelastic Poisson's ratio of the matrix equal to 0.2, the long-term “effective” macroscopic stress Σ^∞ that acts at the scale of the concrete sample is equal to the long-term microscopic stress σ^∞ that acts on the C-S-H gel.

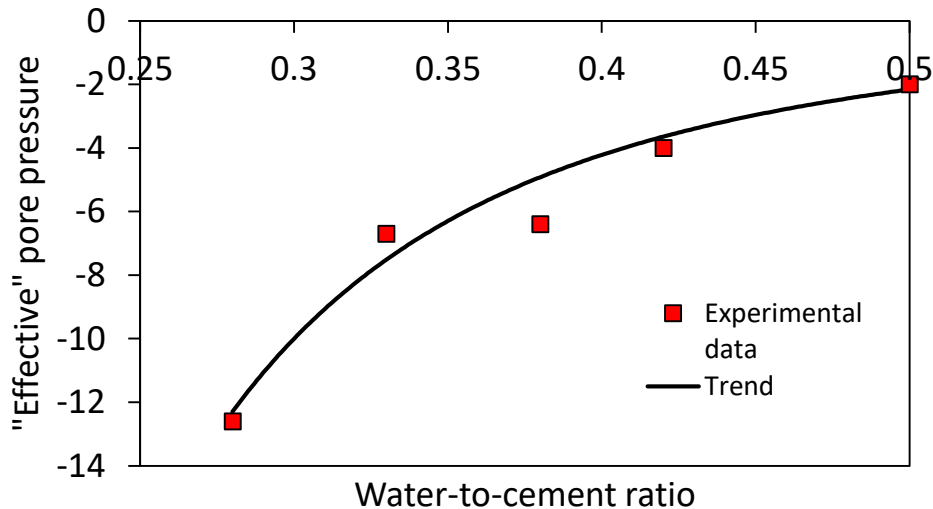


Figure 1: Uniaxial “Effective pore pressure” versus water-to-cement ratio, as reported by Ulm et al. (1999). Figure adapted from Ulm et al. (1999).

References

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