A Micromechanics model of Freezing in porous media

R. W. Yang[1], E. Lemarchand[1], and T. Fen-chong[1]

[1]*Universite Paris Est, laboratory of Navier, Champs sur Marne, France*

ABSTRACT:

Freezing of the water saturating or partially saturating the connected pore space of porous media is a deleterious chemo-poromechanical phenomenon which has been paid increasing attention to in Civil Engineering since the pioneering work by Powers in 1949. The present study is a theoretical attempt to providing further clarification of this strongly coupled behavior in light of a micromechanical methodology.

The starting point is the refined description of the morphology of the liquid water distribution, which emphasizes the crucial role played by the nanosized liquid film trapped in between the ice and the solid connected matrix. The latter also introduces a physico-mechanical coupling through a local disjoining overpressure which develops in this confined domain in order to ensure thermodynamics equilibrium with the saturated surrounding micropores.

Taking advantage of these local informations, we develop an Eshelby-based multi-scale and multi-physics approach allowing us to providing a better understanding of the in-lab observed behaviors. Special attention is dedicated to the localization of local tensile behaviors likely to provoke cracks nucleation at solid/pore interfaces.