Computational modelling of hygro-thermo-chemo-mechanical phenomena for prediction of salt crystallization-induced damage.

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ABSTRACT

A mathematical model of chemo-hygro-thermo-mechanical behavior of porous building materials, considering damage induced by salt crystallization, was formulated. The effective stress principle approach was applied to take into account the external loading and the pressure exerted by the phases occupying pore voids, including salt crystals. We analyze the possible brick fracture due to sodium sulphate crystallization, highlighting the impact of microstructure on the possible damage. The kinetic approach for modeling salt phase change was adopted. According to thermodynamic constrains the salt crystalizes starting from the largest pores. The crystallization pressure appears only for supersaturated solution and depends on the pore size where the crystals grow. The set of governing equations, namely the set of parabolic and elliptic partial differential equations (PDS) was solved using finite difference and finite element methods. The influence of crystallization rate on the crystallization pressure is examined. The delayed damage model appears to be very effective for salt crystallization problem, which takes place locally close to the surface. The mathematical model possess one internal variable: damage parameter, which is described by ODE.

REFERENCES

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