Analysis of modified cement paste in the context of CO_2 geological storage

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Abstract

In the context of CO2 geological storage in deep saline aquifers, it is im-portant to understand the hydro-chemo-mechanical coupling in rock-cement well interface to assess the safety and efficiency of the storage operation and thus to prevent possible CO2 leakage. This work concerns a study on the ef-fects of bacterial nanocellulose (BNC) and glass microspheres (GM) on chemo – mechanical behavior of cement paste composites when they are subjected to carbonation. A coupled chemo-poromechanical model implemented in finite element code has been used. A homogenization formulation is introduced to account for the BNC and GM in the cement composite. This study aims to sim-ulate the chemo-poromechanical behavior of a system composed of modified cement well and the caprock during CO2 injection. Chemical reactions (car-bonation-dissolution) occurring in the system produce variation of the transport and mechanical properties. The presence of additives in the cement composite reduces the advancement of the front of carbonation in the short-term period of CO2 exposure. Comparison between modified and non-modified cement composites has been analyzed in terms of porosity, permea-bility and pore pressure development. These results justify the importance of the coupled chemo-mechanical numerical analysis for the evaluation of addi-tions to cement composites subjected to acidic pore fluid.