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A CONCEPTUAL MODELLING APPROACH FOR MICROSTRUCTURAL SELF-HEALING MECHANISMS IN CEMENT-BASED SYSTEMS

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Abstract. A modelling approach for describing the self-healing potential of blended cementitious systems will be addressed in this work. A micro-structural approach for cement-based systems is developed and mainly based on anhydrous cementitious particles mixed through so-called Dissoluble Encapsulated Particles (DEPs). These latter are predefined fractions of original cementitious particles, while their surfaces are covered with a thin membrane. The self-healing principle of these systems is based on the most basic healing process, where a delayed hydration of the DEP fractions may occur and initiated by crack processes. Fracture mechanisms aim at mainly triggering the membrane cracking and to expose the still unhydrated DEPs to water. The membrane region is considered to decapsulate by its dissolution or cracking whenever being triggered by cementitious crack formation: either lowers pH-conditions, due increased CO_2 ingress, or induces mechanical stresses deals with these phenomena. Hence, a delayed hydration of the DEP system will take place, while closing cracks and recovering the mechanical behavior of the cementitious system. The proposed model will demonstrate the healing potential of DEPs inside a cement-based composite and analyze the most dominant parameters affecting the self-healing mechanism. The numerical results will demonstrate the potential of the healing mechanism to bridge cracks and crack widths, and will also show, which fractions of a regular cement should be replaced by DEPs to reach the best efficiency. In addition, a conceptual XFEM approach will be addressed showing the potential next step in upscaling the micro-level results to meso-scale representative elements.