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# CHEMICAL DEGRADATION PROCESSES IN CONCRETE MATERIALS

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## ABSTRACT

In addition to mechanical actions also environmental processes may have to be taken into account for the appropriate description of concrete's behavior. In particular, this minisymposium addresses chemical degradation mechanisms with focus on alkali silica reaction (ASR).

ASR, which is the most common form of alkali-aggregate reaction (AAR), is a deleterious chemical reaction that occurs between reactive forms of silica in the aggregates and alkali and hydroxyl ions in the aqueous pore solution. This produces an amorphous gel, which expands in presence of water and creates an increasing internal pressure resulting into formation of microcracks, and consequently in a drastic reduction of the mechanical properties of the concrete composite.

Even though the ASR reaction process is complicated and consists of several stages, it may be simplified into two-stages: in the first stage, the silica is dissolved from the aggregates forming an amorphous gel and precipitates; In the second stage the gel expands due to absorption of free water. With regard to this chemical process, environmental effects such as temperature and relative humidity play a critical role. In fact, the role of water is fundamental because a certain level of internal humidity is required for dissolution, reaction, and formation of the amorphous gel and precipitates. The gel expansion is governed by water imbibition, and the pore water is necessary for persistent progress of the reaction. Moreover ASR mechanisms are thermo-activated; that is, the higher the temperature, the faster is the chemical reactions. This kinetic effect of temperature on ASR results from the thermo-activation of the dissolution of reactive silica at the aggregate-cement interface and the reaction product formation.

In this Mini-Symposium contributions concerning numerical modeling of ASR evolution and the resulting concrete deterioration, predictive analyses, possibly at the multi-scale, of ASR effects on concrete materials, as well as comparisons of numerical predictions of the structural behavior of concrete structures affected by ASR with experimental data are both welcome to understand deeply this physical phenomenon and provide numerical tools for predicting its evolution in time.