Modeling the beginning of expansion acceleration due to alkali silica reaction in concrete.
Part 1- model rationale, structure and parameter evaluation by data fitting

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Abstract. Service life, in alkali-silica reaction (ASR) affected concretes, is reached when expansions no longer allow normal use of a structure. ASR expansions are detected only after a long period, accelerating after that, similarly to reactions having an induction period in Chemical Kinetics

This study deals with service life as a conventional induction time, and uses kinetic methods in its estimate. The classical Unreacted Shrinking Core (USC) model with diffusion control and induction time was selected among other models. Both plane and spherical interfaces were considered adapting their models to expansion data. ASTM C 1260 setup and test conditions were selected, its near constant alkalinity being closer to initial conditions in concrete.

Mortar bars prepared with a reactive Tagus river aggregate were tested at temperatures of 80, 70, 60, 50 and 37ºC. Plane and spherical expansion models were fitted to the isothermal curves obtained; depicting their kinetic parameters in Arrhenius plots suggests the spherical model as better. The main interest of this study is to, in what concerns the potential for alkali-silica Reaction (ASR), discuss and foresee possible problems allowing to schedule monitoring and/or the needs of adequate interventions at a stage as early as possible.

The extension of service life allows savings in raw materials and energy, improvement of the investment economics and, on a long term basis, lower investment requirements, contributing to an improvement of the sustainability of all related sectors.

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