6TH INTERNATIONAL CONFERENCE ON DAM ENGINEERING
C.Pina, E.Portela, J.Gomes (ed.)
Lisbon, Portugal, February 15-17, 2011

MODELING THE START OF THE EXPANSION DUE TO ALKALI SILICA REACTION IN CONCRETE

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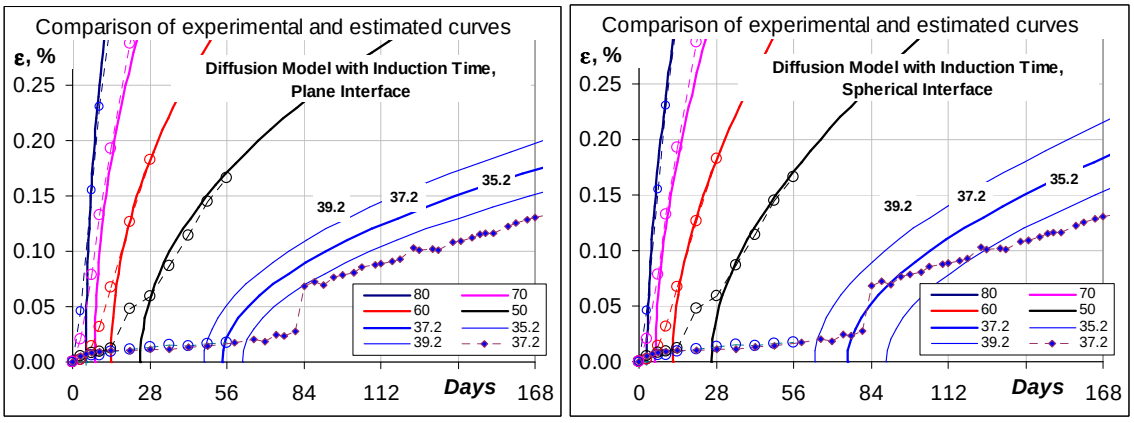
Keywords: AAR, Reaction start, prevision, service life

Abstract. Service life of a concrete affected by alkali-silica reactions (ASR) is the age at which expansion is no longer allowed for normal use of a structure; such expansion level depends on the application. The expansion commonly shows a slow initial rate after which it proceeds quickly. This is similar to what is described as induction period in chemical kinetics of reactions and the present study suggests this induction time to be taken as the service life.

Induction time is an abstract concept and its formulation depends on the model considered, such as an additive, constant time in the diffusion model, or the abscissa where the time axis crosses the tangent to the expansion curve at the inflexion point, in the nucleation and growth model.

Experimental data were obtained by registering the expansion of mortar bars immersed in NaOH 1M, using Tagus river reactive aggregate according to the ASTM C 1260 procedure cured at temperatures of 80, 70, 60, 50 and 37ºC, to model the expansion at constant alkalinity, considering the aggregate reactivity and temperature as variables.

Two kinetic models were considered to fit the data, selecting one of which for further improvement by considering a spherical interface, instead of plane interface, more commonly found, and using the wide information basis existing on the ASR.



The effects of the factors temperature, alkalinity and humidity assumed models referred to in literature, or obtained by regression both of kinetic parameters for each isothermal curve and their temperature coefficients of Arrhenius plots. The correlations obtained allow estimating the strain after the induction period, for any value of the mentioned factors, under

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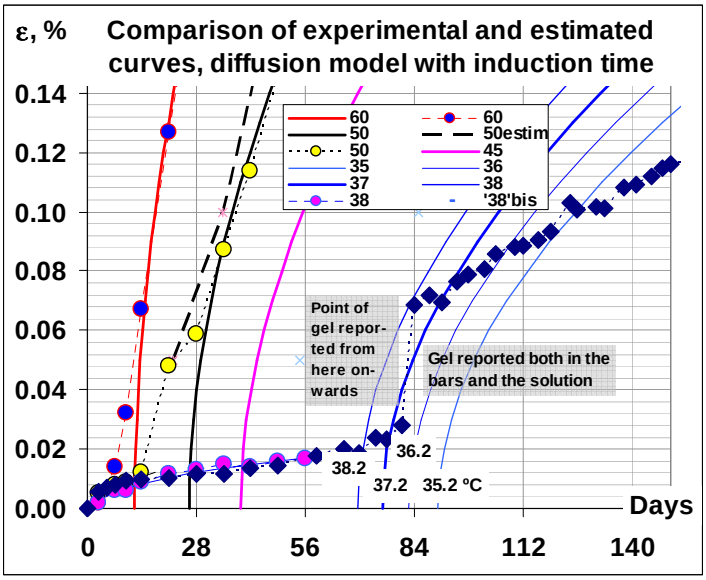
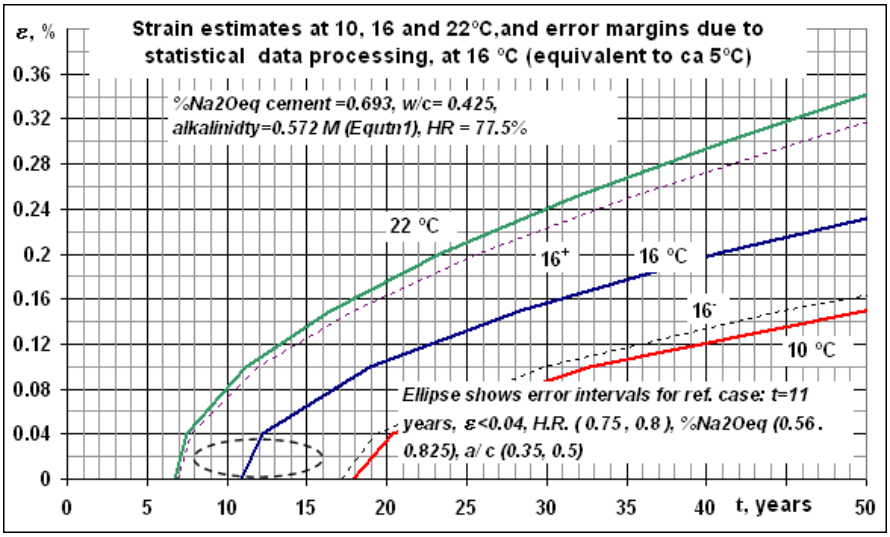
laboratory conditions.

The model estimates at *circa* 37ºC were compared with experimental data in the same setup and this temperature. It is noted that the induction time is better predicted by the spherical interface diffusion, using induction time model, but further expansion development pattern is different.



The model was tentatively applied to a case reported in literature, of a railway sleeper kept in a covered area, which displays early symptoms of ASR after 11 years. Correction for alkalinity of the cement used, temperature and humidity from meteorological data were applied, using equations referred to in the literature.



Results match the model estimates, but these are affected by significant errors, some improvements are suggested that improve the accuracy of the predictions.

The model is especially adequate for estimating the service life when the start of noticeable deformations is critical, as well as, for defining the inspection intervals.