RILEM TC CCC - WG3 - Group strategy 30th August, Delft

A. Context:

Engineering model of carbonation such as the fib model (fib bulletin 34) have correction factor in square root of time law to account for:

- Relative humidity
- Insufficient duration of ideal curing (100% RH or water immersion)
- Wetting and drying cycle

On way of constraining these terms is by running experiments:

- for different but constant RH over time
- For different humidity cycles at the boundary, including imbibition to represent rain events
- For different ideal curing duration

B. Objectives

The objective of this working group is to

- Suggest alternative analytical solutions for engineering models that account for various climate boundary conditions or curing conditions
- Build a consensus on how to model concrete carbonation using a deterministic description of the physics and chemistry at play.
- Compare existing numerical models and strategies
- Suggest the path forward to service life evaluation.

To achieve these objectives, the group will focus on three main tasks, described in the section below.

B.1 Experimental evidence

This idea is to collect experimental evidence related to concrete carbonation of standard concrete.
A detailed description of relevant information can be found in this document.
The objective is also to structure experimental evidence so as to classify them in terms of order of importance. This classification should be based on expert judgment (and not sensitivity

analysis) and helps selecting dominant mechanisms relevant for predicting pH profile during carbonation

B.2 Analytical Solution for engineering model

This objective is to build a basis of analytical models based on different assumptions on chemistry and physics at play. Different strategy could be used depending on the collection of experimental evidence:

- 2 front tracking model could be implemented based on coupled ODE for water mass balance and CO_2 mass balance could help better accounting for for cyclic boundary conditions
- Spatially dependent gas diffusivity or hydration degree related to initial curing could lead to time dependent apparent diffusivity of the carbonation front.

B.3 Numerical model

The objective is to build confidence in numerical model:

- Converge on governing equations, i.e. walk in footsteps of what has been done for hygroscopic behavior of porous building materials (see EN 15026:2007 [1])
- Compare simulation results for time or time and spatial dependent measured properties
- Compare the integration of thermodynamic data of cementitious systems for known degree of hydration and/or carbonation.
- Propose reference solutions, possibly analytical solutions.
- Analyze the effect of curing, RH at the boundary and cyclic boundary conditions for well constrained systems (for which we have most complete experimental data set).

[1] EN 15026:2007 "Hygrothermal performance of building components and building elements. Assessment of moisture transfer by numerical simulation"

C. Contributors

Several researchers have already confirmed their capability to contribute to WG5 (see Table below). Some others have expressed their interest or are prospective partners with known experience on concrete numerical modeling.

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