

TC 281-CCC – Carbonation of concrete with supplementary cementitious materials

Meeting 7, Wednesday 21 April 2021, 13.30-17.00 (Brussels time!) online meeting

Zoom link: <https://ugent-be.zoom.us/j/98391953764?pwd=RUJyNFIsSWNOL0hUTIN3WUpuZjFLdz09>

Meeting ID: 983 9195 3764; Passcode: &s4p6NfF

Agenda

Welcome

Update on membership

Approval of the minutes of meeting 6, online (Sheffield), 04/09/2020

Feedback on the status of the working group activities by the working group chairs or their representatives / presentations related to the WG work

WG4: Effects of combined actions: load + carbonation (Ling Wang, Juan Li)

- *Status of first round of the inter-laboratory comparison and start of the second round*

WG1 and WG2: Correlation between atmospheric carbonation and carbonation induced by accelerated testing at high CO₂ concentrations / Effect of SCMs on natural and accelerated carbonation of blended Portland cements (Barbara Lothenbach, Elke Gruyaert, Philip Van den Heede, Stefanie von Greve-Dierfeld)

- *Results of the inter-laboratory test (Elke Gruyaert, Hanne Vanoutrive)*
- *Status of the paper: Critical review of existing standardised test methods to determine carbonation resistance of concrete with supplementary cementitious materials (Susan Bernal)*

WG3: Modelling of carbonation (Bruno Huet)

- *Status of activities of WG3 and future plans*

WG5: Effect of carbonation on corrosion of concrete with SCMs (Ueli Angst, Fabrizio Moro)

- *Update on the activities*

WG6: Carbonation of alkali activated concrete (Gregor Gluth, Xinyuan Ke)

- *Status of activities – carbonation of concrete with high volume of SCMs*

Future activities and meetings:

- *8th meeting: September 2021?*

Closure

Minutes

Attendees (55): N. de Belie, S.A. Bernal, K. Sideris, A. Camoes, Z. Cheng, A. Marsh, A. Idiart, A. Kanellopoulis, A. Vollpracht, B. Lothenbach, C. Andrade, C. Le Galliard, X. Shi, C. Thiel, C. Grengg, E. Gruyaert, E. Piolet, F. Moro, F. Martirena, G. Gluth, G. Ye, G. Geng, H. Vanoutrive, I. Tole, I. Garcia-Lodeiro, I. Ignjatović, J. Sanchez, J.M. Etcheverry, M. Zajac, B. Li, J. Li, W. Ling, Y. Yao, M. Nedeljkovic, M. Cyr, M. Etxeberria, N. Alderete, O. Cizer, P. Van den Heede, P. Quoc Tri, R. Patel, S. Zhutovsky, S. Chinchon-Paya, S. Kamali Bernard, S. von Greve-Dierfeld, S. Keßler, T. Blanco, T-C. Ling, X. Ke, Y. Villagran, Y. Dhandapani, Z. Zhao, X. Shi, Z. Shi, Z. Liu

12:35 Welcome from TC Chair – Prof. Nele De Belie to all TC participants and introduction of new members

12:37 Approval of minutes from previous meeting confirmed

12:40 WG4 presentation – combined actions of load and carbonation (Juan Li)

- Participants of the round robin test were introduced
- Concrete mix designs were presented
- Testing methodology, including sample pre-conditioning was discussed. All concrete samples were exposed to different carbonation conditions (CO₂ and RH) during the testing period, following national standardized testing methodologies
- Results indicate slight reductions in carbonation depths in loaded specimens independently of the exposure CO₂ concentration
- Increase of stress ratio leads to higher carbonation depths
- Carbonation depths measured at different exposure times where reported
- Presentation of plans for follow up experimental programme assessing effect of SCMs in carbonation under load (details in presentation in TC folder)
- Some comments were made regarding error bars significance (standard deviation of individual measurements or of the average?)
- A comment was made regarding considering that different preconditioning RH were used across different labs, which will influence the degree of PC hydration, degree of saturation of concrete and therefore early carbonation. Hence results from different labs cannot be reported in a single plot as direct comparisons cannot be made across the different labs.

More comments in the ZOOM chat document.

13:07 WG1&2 report (presentation by Elke Gruyaert and Philip Van den Heede)

- Introduction about the ILT aim and objectives and timeline of activities conducted were presented
- First publication will be centered on analysis of the accelerated carbonation testing (details of protocols followed available in the slides)
- Paper outline was shared and preliminary observations of provided results were discussed
- Data processing was discussed. Initially 56 days was selected, later on 91 days of carbonation seems to be the most representative exposure time for all cements tested based on small variations of carbonation coefficient across labs/ cement types evaluated.
- Extrapolation to 91 days carbonation depth will be conducted for such cases when full carbonation was recorded at 56 days of exposure
- Analysis was also carried out considering the location within the sample where carbonation reading was conducted (e.g. top or bottom surface) to identify potential effects. It was mentioned that compaction methods might be considered as potential cause of differences in carbonation rate within a single specimen.
- Impact of curing and pre-conditioning was also analyzed given that different standards were adopted in this study by different labs.
- Analysis of effect of CO₂ will be done for mortars where all specimens were pre-conditioning according to the pre-defined protocol
- Carbonation of mortars vs. concrete was evaluated and differences were identified. It was mentioned that higher carbonation in concretes could be a consequence of differences in w/b, paste content and consequently pore structure (diffusivity). Perhaps normalize carbonation depths by paste content could be useful to visualize if differences in carbonation rates prevail when analyzing mortars/ concretes results.
- It will be considered to be discussed in the paper, if possible, effect of reading time of phenolphthalein indicator
- Paper submission and revision schedule was proposed (it is within the interest of the WG to get the paper submitted before the summer holidays)
- Follow up ideas for ILT were presented (e.g. different carbonation assessment techniques e.g. TGA, XRD etc.), more details are given in the slides. Some comments were made regarding what will be learnt from this exercise. It will be important to discuss further the purpose of such tests, feasibility of shipping carbonated chambers across different labs etc.
- Preliminary carbonation results for 56d carbonated specimens were presented, and some differences were observed when curing and binder type were different. Also if

measurements were collected at the bottom or top of the specimens in majority of the lab results reported differences were observed, but it does not seem to be universal. It was recommended to consider the range of variability that is acceptable considering the EN standard (30%) across labs, to indicate if the results are comparable or not.

14:10 Overview in the critical review of standards paper (Susan Bernal)

Little contribution from TC members, but the paper needs to be submitted at a similar time to the paper related to the ILT. So once again people that promised to contribute were reminded about this, but the paper will go ahead with or without those contributions. A preliminary draft will be distributed to TC members hopefully in June 2021.

14:20 WG3 no presentation (B. Huet sent his apologies)

14:20 WG4 no presentation (U. Angst sent his apologies)

This WG published a paper in RILEM Technical Letters, which has been shared with all TC members. The WG chair indicated that there are not other planned activities for this WG.

14:22 WG5 presentation (Gregor Gluth)

- Brief overview about meta-analysis of carbonation of alkali-activated concretes and concretes with high volume of SCMs is progressing. The database has been created and is currently under revision.
- A conference abstract to RILEM week in Mexico was submitted as part of the WG activities, which the WG is hoping will lead to a journal publication. Minutes of the WG pre-meeting are available in the TC folder in the RILEM website.

14:25 Next meeting to be organized in September 2021 virtually (workshop to allow people to report results) most likely in the week starting on 6th September (a doodle will be sent)

14:30 the meeting was closed by the TC chair.