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

Meeting 3, Tuesday 19th March 2019, 9-18h
Lone Hotel, Rovinj, Croatia

Minutes

In Attendance

TC members: U. Angst, S. Bernal, Ö. Cizer, N. De Belie, K. Dombrowski-Daube, V. Ducman, J. Elsen, B. Ghiassi, G. Gluth, C. Grengg, E. Gruyaert, B. Huet, I. Ignjatović, X. Ke, S. Keßler, T.-C. Ling, B. Lothenbach, F. Martirena, F. Moro, V. Papadakis, J. Perko, J. Provis, M. Serdar, Z. Shi, K. Scrivener, C. Thienel, C. Thiel, H. Vanoutrive, A. Vollpracht, P. Van Den Heede, B. Wu, E. Yogarajah, Z. Zhao

Guests: A. Al-Ameeri, L. Briendl, M. Etxeberria, D. Geedes, A. Humad, M. Krüger, A. Marsh, T. Qureshi, M. Saillio, A. Sajna.

Apologies

N. Alderete, V. Baroghel-Bouny, P. Dangla, D. Hooton, A. Idiart, K. Imamoto, A. Kanellopoulos, C. Martin, I. Martins, K. Olonade, J. Pacheco, S. Park, V. Talakokula, Y. Villagrán, B. Walkley, G. Ye, S. Zhutovsky

Agenda

8.30 *Uploading of presentations in the meeting room*

9.00 *Welcome and short introduction of participants*

Update on membership of the TC / new members.

9.15 *Approval of the minutes of meeting 2, Delft, 30/08/2018*

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

WG1: Correlation between atmospheric carbonation and carbonation induced by accelerated testing at high CO_2 concentrations (Barbara Lothenbach, Elke Gruyaert, Philip Van den Heede)

WG2: Effect of SCMs on natural and accelerated carbonation of blended Portland cements (Karen Scrivener, Leon Black, Stefanie van Greve-Dierfeld)

- *Stefanie von Greve-Dierfeld: Overview of the State-of-the-art paper (status of the different sections, missing contributions, planning of next steps and deadlines, internal review procedure, …)*
- *Barbara Lothenbach: Proposal for an inter-laboratory comparison and discussion*
- *Susan Bernal: overview of standard test methods*

10.00-10.30 coffee break

10:30 *WG3: Modelling of carbonation (Christoph Gehlen, Bruno Huet)*

- *Bruno Huet: status of activities of WG3 and future plans*

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

- Philip Van den Heede: status of activities of WG4 and future plans

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

- Ueli Angst: status of activities of WG5 and future plans

12.00 *WG6: Carbonation of alkali activated concrete (Susan Bernal, Gregor Gluth)*

- Susan Bernal: status of activities of WG6 and future plans

12.30-13.30 lunch

13.30 Future activities and meetings

- Special session of TC 281-CCC: Carbonation of concrete with supplementary cementitious materials, Wednesday 20th March 2019, 13.30-18.00 h

- Meeting 4: as part of the International Congress on Chemistry of Cement (16-20 September 2019) (https://www.iccc2019.org/). The doodle (https://doodle.com/poll/8etd3zarekdn9k8h) indicates that 36 members would attend. Possibility to meet in the Prague Congress Centre on Tuesday, September 17, 2019 from 13:30- 18:00.

- RILEM Spring Convention 2020 Guimarães, Portugal, 10-14 March (dates to be confirmed)

- 74th RILEM Week 2020, Sheffield, UK

*- RILEM Spring Convention 2021 Paris, France *75 years celebration**

To which meeting link a 2-day workshop; or organise this separately elsewhere?

14.00 Working group discussions

15.30-16.00 coffee break

16.00 Reporting on working group discussions / continuation of discussions

Summary of the WG discussions, decisions and future planning presented by the WG chairs. After that, working groups can continue their discussions if wanted until 18.00

18.00 Closure

19th March 2019 – Meeting opened at 9.05

9.05 Welcome and short introduction of participants

Currently TC-CCC has 87 members. New members since the last meeting (August 2018) are:

- Heejeong Kim (Dept. Civil and Environmental Engineering, Daejeon, Republic of Korea)
- Katja Dombrowski-Daube (Technical University Bergakademie Freiberg, Germany)
- Cyrill Grengg (Graz University of Technology, Austria)
- Anna Varzina (KULeuven, Belgium)
- Bahman Ghiassi (The University of Nottingham, UK)
- Yogarajah Elakneswaran (Hokkaido University, Japan)

9.30 Approval of the minutes of meeting 2, Delft, 30/08/2018

The minutes were approved without changes

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

WG1: Correlation between atmospheric carbonation and carbonation induced by accelerated testing at high CO_2 concentrations (Barbara Lothenbach, Elke Gruyaert, Philip Van den Heede)
WG2: Effect of SCMs on natural and accelerated carbonation of blended Portland cements (Leon Black, Stefanie van Greve-Dierfeld)

- Presentation by Stefanie van Greve-Dierfeld. Overview of the State-of-the-art paper. It was presented the status of the different sections, missing contributions, planning of next steps and deadlines and internal review procedure. Specific actions are discussed in WG1 minutes.

- Presentation by Barbara Lothenbach: Proposal for an inter-laboratory (IL) comparison and discussion. It was highlighted that the main difference across different standardised testing methods is the sample preconditioning, which might lead to misleading results of carbonation (e.g. it is unclear the role of internal relative humidity of the tested sample and carbonation progress). Detailed discussion about the interlaboratory testing is reported in the IL minutes.

- Susan Bernal: Overview of standard test methods. It was presented an overview of the evolution of carbonation standards in Japan (translated by E. Yogarajah), as an example of the changes in testing conditions over time, based on empirical data. Differences among different standards was presented, highlighting that the criteria used to determine when (e.g. age of curing, degree of saturation) specimens can be exposed to either natural or accelerated carbonation conditions, changes significantly. Exposure conditions are not very different among standards with some exceptions. It was also highlighted the importance of carbonation depth determination, particularly the use of phenolphthalein, and the carbonation depth readings after spraying. Copy of the summary of accelerated test methods identified up to now is shared with all TC members.

10.35 WG3: Modelling of carbonation (Christoph Gehlen, Bruno Huet)

- Presentation by Bruno Huet: status of activities of WG3 and future plans: The objective of WG3 is to identify both engineering and reactive transport models, validating them with experimental data (of WG1-2). It was mentioned that there are already many activities ongoing on carbonation modelling. FIB – commission 8 considers limiting states (TG 8.8), agreed models (TG 8.9), agreed test procedures (TG 8.11). CEN has TC 250/TG10 (EC2), TC 104/WG1 (EN 206), TC 51 (CEN TC 104/WG12/TG5, responsible for EN 12390-XX). A benchmark of reactive transport models for carbonation has also been made previously. The work of WG3 will be then centered on applying transport models for environment XC of the EN standard. Identified actions to be taken by this WG are discussed in their minutes.

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

- Philip Van den Heede: status of activities of WG4 and future plans. This WG aims to evaluate the effect of a combination of carbonation with compression, tensile and/or bending loads. The effect on gas permeability would be studied separately. More members have been invited to WG4 and a literature review is started. The setup for comparative tests will be further defined during the next TC meeting in Prague. The aim is to do two rounds of comparative testing. At the moment 16 members have agreed to participate actively in WG4 and at least 4 labs will join the comparative test.

For the annotated bibliography, 34 related publications have been collected and some had to be translated from Chinese. A work platform for exchanging data is being established.

For loading, a bending test rig designed by Ivan Ignjatović is discussed (3-point bending, but could be changed to 4-point bending). Compression and tensile setups previously developed in TC-TDC were discussed, but the rigs are quite large to insert in a carbonation chamber. At UGent different leading device prototypes were made and first tests will start next week. The problem to keep the load constant is still under discussion (often there is no access into the carbonation chambers for hydraulic devices to keep the load constant). It may be needed to make intermediate adjustments manually. The tests would not be on cracked samples, but on load levels below the failure load. **It was suggested to start testing natural carbonation under load as soon as possible, this allows to use larger and different setups**. Those samples can be monitored for several years in the setup, and results can be used as benchmark for comparison with results obtained under accelerated carbonated conditions.

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

- Ueli Angst: status of activities of WG5 and future plans. It addressed that a key question is why carbonation induced corrosion seems not to be a concern in other regions outside of Europe. The WG is trying to obtain case studies from Japan, North-America, etc. Doug Hooton gave feedback that they do not have problems with carbonation, just with combination of carbonation and freeze-thaw. Maria Juenger commented that in US, the European standard is currently followed for accelerated carbonation test. Carmen Andrade mentioned that in US concrete is mainly used in infrastructure, less so in buildings. In infrastructure, chloride problems appear before carbonation problems are identified. John Provis mentioned that Australian standards demand rather high-quality concrete and carbonation is maybe less an issue; also near the coast chlorides are the major issue. In South-Africa the Oxygen Permeability Index (OPI) was proposed in the performance-based design as an important durability indicator, based on its relation to a.o. carbonation.

It was highlighted that in terms of carbonation inducing corrosion the limit state is considered to be reached based on concrete cracking or loss of bond (not really loss of steel cross section since this is rather slow), and the effect of cover depth on these phenomena. The key question this WG will try to answer is: does carbonation really matter?, as if there is no moisture at the steel surface, no corrosion will occur. Also, the larger the cover depth, the more expansion (due to corrosion) it needs to have cracking. Corrosion kinetics in concrete with SCMs are probably not affected by SCMs once the concrete is carbonated.

Next steps: contact consulting engineers worldwide to see if carbonation induced corrosion is a problem

12:30 WG6: Carbonation of alkali activated concrete (Susan Bernal, Gregor Gluth)

- Presentation by Z. Shi: status of activities of WG6 and future plans. WG6 has as first plan to make an extended literature review on carbonation of concrete with high volume of SCMs. There are very few studies in this topic. An overview of the review was also presented were only 6 papers were found for concrete with over 70% SCM replacement (most studies were on paste or mortar, and with lower replacement). It was shown that there is a good relation between carbonation depth and Fc, but this was obtained based on one study (if different studies are combined you do not find such good correlation). **TC members are asked to provide additional papers or unpublished data on this topic**. Further discussion and actions to be taken by WG members are reported in the WG minutes.

14.00 New TC members were welcomed by Nele, and all TC member were invited to join a WG to start discussion

16.00 A representative from each WG was invited to provide an overview of the discussion. Details can be found in the WG minutes. Other general issues were also discussed:

Future activities and meetings

- Meeting 4: as part of the International Congress on Chemistry of Cement (16-20 September 2019) (https://www.iccc2019.org/). The doodle (https://doodle.com/poll/8etd3zarekdn9k8h) indicates that **36 members** would attend. The meeting is scheduled in the **Prague Congress Centre on Tuesday, September 17, 2019 from 13:30-18:00**. The meeting room is confirmed: **Club D at the Prague Congress Centre**. The room accommodates up to 70 people.

- Meeting 5: it has been proposed to meet up at the RILEM Spring Convention 2020 Guimarães, Portugal, 10-14 March (final dates to be confirmed), **or** at the 2nd Conference on Construction Materials for a Sustainable Future (CoMS), 16th-17th April 2020, Bled Slovenia.

- Meeting 6: 74th RILEM Week 2020, Sheffield, UK, 31st August to 4th September. Maybe including a TC workshop (conference session), e.g. 1-1.5 days workshop + 0.5 day meeting.

- Meeting 7: RILEM Spring Convention 2021 Paris, France *75 years celebration*

Actions

- Dates for RILEM spring convention 2020 need to be confirmed (Nele)
- Doodle to decide the place for meeting 5 needs to be distributed, or a decision taken by the chair and deputy chair (Nele & Susan).
- It is kindly requested to all TC members to check if they are listed in the TC website (https://www.rilem.net/groupe/281-ccc-carbonation-of-concrete-with-supplementary-cementitious-materials-373), as just those listed have access to the TC documents available in the RILEM website.
- It is kindly requested to all TC members interested in participating in the **inter-laboratory test** to **send the form to Elke by 30th April**.

Changes in WG leadership

- Karen Scrivener has stepped down as WG1 leader
- Susan Bernal has stepped down as WG6 leader, and Xinyuan Ke has volunteered to take this place.

Procedures: try to limit mail traffic!

- Mailing list: rilemtc-ccc@lists.ugent.be to be used by TC and WG chairs

- Doodles to confirm participation / apologize for meetings

17.00 Closure