

Preface

Supplementary cementitious materials (SCMs) are commonly used in concrete practice nowadays, either in blended cements or as separate additions into the concrete mixture. The use of hydraulic and pozzolanic by-products allows to reduce the carbon dioxide emissions related to Portland clinker production and hence provides a way to obtain a more sustainable binder for the construction industry. Furthermore, the use of by-products entails benefits related to costs and some durability aspects. In general, the effects of these supplementary cementitious materials on microstructure and durability have been widely studied over the last decades. Nevertheless, several aspects have been denoted to merit further attention:

- The interaction between Portland clinker hydration and SCM reaction is not yet fully understood. Determination of reaction degrees of SCM is difficult; this is even more so if ternary mixes are concerned.
- The interaction between SCM and commonly used admixtures is often not well documented.
- The quality of by-products such as fly ash is changing due to, for instance, co-combustion in the electrical power plants. The effect of changing composition on the clinker and SCM reactions, and on the resulting microstructure, should be elucidated.
- The ongoing move from Portland to blended cements, and the replacement of Portland cement by SCM in the mix design, will affect construction practices. The exact composition of blended cements, which is often unknown, will affect early age strength development. For the construction industry, it is important to know how the variability of SCM affects the properties of their concrete and curing requirements.

Hence, in July 2011, the RILEM technical committee TC 238-SCM was established with the aim to support the increasing utilisation of hydraulic and pozzolanic industrial by-products, natural resources and societal waste (fly ash, blast-furnace slag and other by-products and residues of thermal industrial processes, calcined clays, limestone, natural pozzolans, natural zeolites, ...) to obtain more sustainable, less CO₂-intensive binders for the construction industry. It was decided that

durability issues would not be a main focus of this TC. The TC was meant to serve as a knowledge platform where fundamental science and practical expertise are gathered to create a horizontal overview of the research area and to implement and promote the dissemination of more integrated generic approaches into the scientific community.

In one of their first meetings, TC 238-SCM defined a Supplementary Cementitious Material or SCM as “*an inorganic material that, when used in conjunction with Portland cement, contributes to the properties of the hardened concrete through chemical reaction e.g. hydraulic or pozzolanic activity*”.

The following subtopics were identified and studied in four different working groups with specific scope:

1. *SCM characterisation* (chairs: Maria Juenger, Jan Elsen)
Quantitative characterisation of the physico-chemical properties of a wide range of traditional and potential SCMs. Identifying challenges on an expanding and evolving SCM market.
2. *SCM reaction kinetics* (chairs: Karen Scrivener, Nele De Belie)
SCM reactivity and overall reaction kinetics in blended cements. Determination of reaction degrees of SCM, also in ternary mixes. Interaction between Portland clinker hydration and SCM reaction.
3. *Hydration product assemblage and microstructure of SCM-blended cements* (chairs: Barbara Lothenbach, Ruben Snellings)
Hydrate reaction product assemblages and pore solution composition in SCM-blended cements, binary and ternary mixtures. Optimisation of sulphate additions. Effect of temperature and clinker replacement proportion. Effect of SCM incorporation on the microstructure. Linking microstructure to performance.
4. *Properties of concrete containing SCMs and interaction of SCMs and admixtures in concrete* (chairs: Marios Soutsos, Guang Ye)
Effect of SCMs and mix proportioning on the properties of fresh and hardened concrete (e.g. early strength development, workability, shrinkage) and curing requirements (especially for in situ cast concrete in adverse weather conditions). Post-blending versus pre-blending. Implications of SCM variability. Interaction between SCM and commonly used admixtures (e.g. superplasticizers, air entrainers).

Over the period 2011–2017, the TC 238-SCM has convened 12 times and has published the outcome of their collaborative research and discussions in various articles, which are mentioned below for further reading. This book is the final outcome of working group 4 of the TC and provides an overview of the state of the art regarding the properties of fresh and hardened concrete containing supplementary cementitious materials. Each chapter was a joint effort of different co-authors and was reviewed by at least two other TC members.

Details of TC members are given after this Preface. I wish to acknowledge their contribution to meetings and discussions, their efforts in writing, reading and commenting on the various drafts of this book and of the other publications mentioned further. Special thanks go to the chairs of the working groups, which have given tremendous assistance to organise the activities within their group. Finally, I want to acknowledge my co-editors, Prof. Marios Soutsos and Dr. Elke Gruyaert, for ensuring that this STAR could be realised within the lifetime of the TC.

Ghent, Belgium

Prof. Nele De Belie
Chair of RILEM Technical Committee TC 238-SCM

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