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Book reviews

Calcium hydroxide in concrete. Materials Science of Concrete, Special Volume*; *Edited by Jan Skalny, Juraj Gebauer, Ivan Odler; Published by The American Chemical Society, Ohio, USA, 2001

The title of the book may be read as if it is a comprehensive review of past and present knowledge about the occurrence and effects of calcium hydroxide in concrete. This is not the case. It is a collection of presentations by 17 researchers (some with coauthors) at a workshop comprising 32 invited attendants. Eleven are by university scientists, three by public institute researchers, two by concrete expert investigators and one from a cement company R&D. The attendants at such gatherings get an excellent forum for mutual inspiration and share of experience under less restrained circumstances than at the larger, commercialized conferences and symposia. The readers of the book get current views on the subject matter seen from different angles, i.e., updating of the established knowledge base.

The articles represent a pronounced preference of research made with laboratory model specimens of cement paste and mortars. In this kind of research, each model study represents one preselected course of behavior development. Consequently, one finds in concluding statements in the papers, for instance, both that $Ca(OH)_2$ has none and that it has significant influence on strength, permeability, etc., albeit confined to the used homogenized models of paste and mortars.

The articles represent also a pronounced preference for the use of the different modes of electron microscopy for visualization of the fashions in which $Ca(OH)_2$ occur in the used model specimens. This methodology offers fascinating insight in the submicroscopic structure and composition of cement paste in mortar and of precipitated accessory mineral phases such as $Ca(OH)_2$ (portlandite), ettringite, brucite, alkali–silica gel, etc. Unfortunately, many of the electron images are not well reproduced — some of them making it a matter of belief to accept what the author tells they are showing. (The SEM images in the paper by Stark et al. are exceptions.)

Only a few papers deal with investigations of field concrete, and there are only a few references to sources of the considerable existing knowledge on occurrence and effects of $Ca(OH)_2$, which since the 1950s has been acquired by the use of the optical microscope on thin sections of samples of field concrete. The origins of such samples and the microscopic magnification scale are indispensable link to the concrete reality for SEM and back scattering used on lab specimens. The book is therefore not this “missing link.”

The role of $Ca(OH)_2$ for the durability of field concrete is dealt with in two papers on carbonation, one on alkali–silica reaction (ASR) and a bit in a review of the DEF research. In more than one article, it is mentioned that calcium must be present in concrete for ASR to happen. Classical ASR research (references missing) took the reasonable outset that, in concrete made with Portland cement, this is always the case, and established that the course of the reaction depended on the Ca^{+}/Na^{+}, K^{+} ratio in the pore liquid hydroxide (plus the accessibility of silica in aggregates, aggregate particle sizes, temperature, etc.)

Several of the articles in the book sustain, although not in explicit terms, that pozzolanic reaction in concrete is a beneficial mode of ASR by which the reaction product is the nonswelling calcium/alkali–silica gel. In field concrete without pozzolans, the formation of swelling (low-calcium) alkali–silica gel and cracking in reacting aggregate particles precedes the absorption of calcium from the pore solution, which creates the nonswelling (high-calcium) gel, in the course of time approaching the composition of alkali-enriched C-S-H. This course of the reaction is confirmed in the paper by M. Thomas and stated to be the reason why alkalis remain available for long-time continuation of harmful ASR in large-volume concrete structures. That hydraulic dams are susceptible to such enduring expansive reaction (since the 1950s reported to happen in many countries) is due to (1) higher temperatures on the downstream surface, which is exposed to air and sun, than on the upstream, reservoir facing wet surface, combined with (2) steady-water percolation through the concrete to evaporation from the dry downstream side.

One of the articles about field concrete describes severe carbonation of low-performance concrete in residential basements, which reduced interior surface layers to a soft “popcorn” mixture of calcite and impure, silica-enriched paste. The other article describes cracking of corrugated asbestos–cement roofing tiles. Thin-section microscopy revealed high birefringence zones inward from the interior surfaces, which appeared to be due to formaldehyde/formic acid migration from the applied foam insulation, rather than carbonation of the paste $Ca(OH)_2$. The two articles are examples of effective use of visual microobservations combined with chemical analyses and tests for assessments of the causes of the unusual cases of deterioration. They are useful additions to the international accumulation of case stories about concrete exposed to aggressive exposure conditions.

The 16 articles about $Ca(OH)_2$ in cement paste and mortars are useful contributions to basic clarification of the occurrence and effects of this integral component of cement paste. The introductory article expresses cement industrial interest in invention of low-lime cements. However, it does not indicate that such a novelty is right around the corner, and concrete engineers might ask whether it makes sense to sacrifice the beneficial effects of $Ca(OH)_2$. Meanwhile, a determined quest for the missing link between laboratory modeling and investigations of field concrete is wanted.

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Fundamentals of High-Performance Concrete (Second Edition) **Dr. Edward G. Nawy, P.E. CEng, Wiley, 2001**

Fundamentals of High-Performance Concrete (2nd edition) is a combined effort to address the interaction of concrete materials technology and design of normal-, as well as high-strength concrete elements. This book is intended for material technologists, engineering students and researchers, designers, and constructors. Needless to mention, the extent of author's knowledge on this subject matter is unsurpassed. The book closely delves into various discussions based on the author's past experience in concrete materials research, teaching, consulting, and forensic engineering. Thus, this book ranges from the very basics of high-performance concrete (HPC) to a detailed treatise on HPC, and what HPC ought to be in the millennium.

Unlike several other books on this subject, this book does not represent a compendium of papers by different authors with their own specialties within the domain of HPC. Instead, this book presents a unique recipe that is aimed both at the student and designer, who need to know the fundamentals of HPC, and also fully understand the pros and cons of selecting and proportioning high-performance durable concrete mixtures at an optimum cost.

American Concrete Institute defines HPC as "concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices." In this regard, the book begins (Chapter 1) with the general performance characteristics of cement and its performance criteria. The subsequent chapters cover the fundamentals of the performance of durable, normal-, and high-strength concrete, including a detailed discussion on the roles of mineral and chemical admixtures in producing very-high-strength concretes, and mixture proportioning of concrete to achieve desired concrete strength and durability.

Chapter 5 deals with lightweight aggregate high-strength concrete and its performance. Similarly, Chapters, 6, 7, and 8 detail the mechanisms of long-term creep and shrinkage and their prediction, and materials behavior characteristics of high-strength concrete, and present the micro- and macromechanics of HPC, respectively. In effect, these chapters cover the durability and serviceability requirements for design in the modern era.

Chapter 9 covers the state-of-the-art of high-performance fiber-reinforced concrete and fiber-reinforced plastic reinforcement and its applications. The remaining chapters in the book deal with the economics of high-strength HPC and the principal factors affecting cost.

This book presents a novel orientation of concrete materials technology and design of both normal- and high-strength concrete. It covers different approaches on the development of high-performance, normal-, and high-strength concrete, with particular emphasis on long-term durability considerations.

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