Mechanisms of chemical degradation of cement-based systems

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This book contains the proceedings of a symposium with the above title, which was organized by the Material Research Society in Boston, USA, from 25 to 30 November 1995. It comprises 51 contributions by authors from 15 countries. The host country, the USA, has contributed the largest number of papers (19), followed by France (11 papers) and the UK (7 papers). The contents is divided into eight parts, which, however, do not always differ greatly in the subject matter. Parts 1 and 3 even share the same title, 'Microstructure and mechanisms of chemical degradation'. Apparently the division of the book follows the organization of the symposium where this theme had to be assigned to two sections – presumably due to the large number of papers. Part 1, 'Microstructure and mechanisms of chemical degradation I' (14 papers), contains contributions on the complex problem of chemical attack on concrete, e.g. by acid rain, leaching of $Ca(OH)_2$, ASR, etc., while sulfate attack is treated in Parts 3 and 4. The papers underline the well-known fact that concrete resistance can be enhanced by the addition of or partial substitution of cement by mineral substances such as BFS, fly ash, silica fume, etc. However, in view of the complex overall situation, there is no such thing as a panacea, but solutions have to be tailored to the respective case. Part 2 is devoted to 'Corrosion of reinforcing steel'. Six papers deal with new non-destructive test methods such as impedance spectroscopy and changes in microstructure caused by carbonation, etc., respectively. Another problem that is addressed is the influence of mechanical stress on the durability of reinforced concrete which is exposed to chloride ions. Part 3, 'Microstructure and mechanisms of chemical degradation II' consists of four papers on sulfate attack. They describe not only the damage by ettringite but also traumatize formation causing expansion as well as concrete damage by softening and disintegration of the C-S-H phase, especially by $MgSO_4$. Part 4, 'Implications of curing for durability' (five papers), focuses on damage by delayed ettringite formation and fits in well with the previous chapter. It shows very clearly that the intended fast achievement of strength by steam curing is not only sometimes penalized by the risk of delayed ettringite formation but also by unfavourable changes in microstructure (higher capillary porosity) with its effects on strength, by the easier penetration of harmful substances and by effects on the AS reaction, which – induced by higher temperatures – can occur much more rapidly. Part 5, 'Durability of non-Portland cements', contains six papers. Only five of these relate to the actual topic whereas the sixth deals with normal concrete. Calcium aluminate cement concrete and its resistance to seawater is discussed as well as the mechanisms of destruction (conversion, alkaline hydrolysis and carbonation). Two contributions investigate the durability and chemical resistance of alkali-activated slag. Part 6, containing nine papers, is devoted to 'Cementitious waste forms and performance of concrete barriers for nuclear waste management'. For any kind of waste it requires often lengthy investigations to prove the basic suitability of cement or a cementitious binder for the disposal of radioactive waste in order to find the best possible solution by optimization (e.g. by using pozzolanes, zeolites, etc.). Although the mechanisms of attack are well known there is a clear lack of knowledge about the kinetics of the various kinds of attack, which greatly impairs the reliability of predictions as regards the crucial question for how long radioactive waste can be stabilized by cement (for centuries, millennia?). Part 7, 'Diffusion and modelling', contains four papers, which deal primarily with questions of ion diffusion, mainly of chlorine ions. One paper investigates the problem of assessing the durability of concrete structures. The eighth and last part contains three papers on 'Cementitious waste forms for non-nuclear applications'. The comments on Part 6 generally apply to this chapter as well.

Altogether the book provides a good overview of the research activities that have been going on in the area referred to in the title as well as of the state of the art in 1995. The fact that the contributions have not just been photocopied but typeset so that they are uniform in typeface and appearance is most advantageous for the reader. The fact that a book exists that provides a summary of the most recent research activities in the complex field of destructive chemical mechanisms will be very appreciated by experts. Ready to hand in the library, it will not only be helpful to gain a quick overview of a certain subject, but the large number of contributions and the numerous references will be very welcome in the laborious search for literature.

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