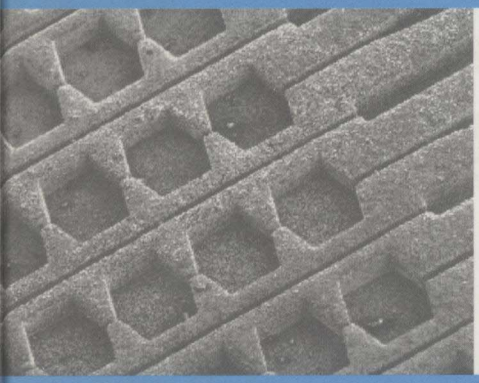

Structure and Performance of Cements

Second Edition

Edited by

J. Bensted and P. Barnes

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Preface

Structure and Performance of Cements was first published in 1983. Much has changed over the last 18 years, but still, a surprisingly large number of the reasons given then for the need for such a book are equally valid today; these include:

- Cements constitute the second largest manufactured commodity (by weight) in the world
- Most peoples' lives are continually dependent upon the properties of cements
- Only a small fraction of income derived from the manufacture and marketing of cements is spent on research into the properties and applications of cements, including new developments

However, although the basic starting materials for the manufacture of most cements have not changed very much, the subject has in fact moved on appreciably. Cements today have a greater number and range of applications than ever before. The various types of cements now available (with and without inclusions of additives/admixtures) have increased significantly in numbers. New techniques of examination have arrived and our understanding of the performance requirements and utilization of many different types of cements has improved.

In particular, wet process manufacture for Portland cements is declining rapidly because of the high energy costs involved in driving off the water from the raw material slurries. Modern developments now permit more environmentally friendly dry process manufacture from soft raw materials like chalk and clay with their significant moisture contents using flash calciners. Also important environmentally friendly uses for materials, previously regarded as industrial wastes in the manufacture of cements, save substantial amounts of traditional fuels like coal, gas and oil. Such pyrotechnic processes now allow wastes that used to be dumped, to be disposed off safely by burning in cement kilns on a routine basis.

This is complemented by cement extension, which means that industrial by-products such as pulverized fuel ash (pfa), ground granulated blast-furnace slag (ggbs) and condensed silica fume (csf or 'microsilica') can partially replace Portland cement clinker in cements. Such replacement permits substantial benefits in the range of applications of the finished cements in grouts, mortars and concretes.

The second edition of the book has been produced, like the first edition, for those scientists and engineers working in both the cement and general construction industry and for research and development specialists in universities and colleges, who need an up-to-date knowledge in key areas of cement technology that have moved on since 1983. It is not intended to be a standard textbook dealing with the whole range of cement types and their applications. Instead, a focused tome has been produced with contributions by a multinational consortium of authors to indicate the global developments that have arisen over the last seventeen years. Modern cement manufacturing methods, key types of cement extenders and important examining techniques, both new, and developments in existing important methods, have been highlighted for addressing a global audience. This updated book is intended to reflect both current production and research in the cement arena, but, as indicated above, is not intended to be an exhaustive treatise, which would have been unmanageably large.

The order of presentation reflects the evolutionary developments that have arisen, and is divided roughly into three broad categories:

- Basic materials and methods – cement manufacture, cement phase composition, Portland cement hydration, calcium aluminate cements, properties of concrete with admixtures, special cements, various reaction/corrosion mechanisms.
- Cement extenders – ggbs, natural pozzolans, pfa, metakaolin and csf – where there have been considerable developments in terms of quality and application; many other extenders have not been included where there is still much basic work needed.
- Techniques of examination highlighted include the well established X-ray diffraction and electron microscopy, where there have been numerous developments in the last seventeen years, together with more recently introduced methods (electrical impedance, NMR, synchrotron radiation-based techniques) which, with cement-based composite microstructures, need to be drawn to the attention of a wider audience. Some of the more traditional techniques have been excluded since relatively few novel applications have appeared in recent years.

As the editors, we have endeavoured to obtain a widespread balance of authors from a number of different countries around the world. Many of these authors are well known internationally. They are joined by others who are newer to the field and who help to establish a broader viewpoint, both technically and through wide international coverage. We feel privileged to have succeeded in bringing such a distinguished worldwide group of authors together in one book under the umbrella title of *Structure and Performance of Cements*.

Notation

Standard cement chemistry notation is assumed throughout this book:

$A=Al_2O_3$	$C=CaO$	$\overline{C}=CO_2$	$F=Fe_2O_3$	$f=FeO$
$H=H_2O$	$K=K_2O$	$M=MgO$	$N=Na_2O$	$S=SiO_2$
$\overline{S}=SO_3$	$T=TiO_2$	C-S-H denotes a variable composition		

AFm denotes a solid solution range within the monosulphate-type structure (i.e. calcium monosulpho-aluminate hydrate to calcium monosulpho-ferrite hydrate).

AFt denotes a solid solution range within the ettringite-type structure (i.e. calcium trisulpho-aluminate hydrate to calcium trisulpho-ferrite hydrate).

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