severe. The fact that they work under such conditions should give confidence for their adoption into more general concreting practice. That trend is taking place, but it is an arduous task. Books like this, so long as they are bought and used, should reduce the ardure.

It is inevitable that in a book of this length some duplication occurs. This is particularly evident in Chapter 15 dealing with miscellaneous admixtures. Several admixture types already dealt with recur; for instance, bonding agents, corrosion inhibitors, alkali–aggregate reaction reducers and shotcreting admixtures. However, very useful data are presented, particularly for calcium sulfoaluminate and lime-based expanding admixtures, pigments, damp and waterproofers and flocculants.

It is pleasing to note that Chapter 17, on admixture formulations, covers a detailed search based on *Chemical Abstracts* and specifically patent literature over the period 1985–92. This is a treasure trove of offerings

of value both within themselves and as a stimulant to other ideas. There are some 359 references in this chapter, more than any other chapter in the book, and this should save the product formulator a great deal of effort in carrying out their own survey of current developments.

The book ends with a subject index but no author index.

This is not the type of book that one reads from cover to cover, but should be used as a constant source of reference. It will appeal to all those involved with chemical admixtures, whether they are specifying engineers, formulating chemists or concrete suppliers. Even if you purchased the first edition, the second is a substantial extension, well justifying the relatively modest cost (\$125). Excellent value for money by any standards.

P. C. HEWLETT

Pozzolanic and cementitious materials

V. M. Malhotra and P. Kumar Mehta

Gordon and Breach, London. 191 pp. ISBN 2 884 49211 9. £27.00

This compact book is one of a proposed series of ten under the general heading of advances in concrete technology that will deal with particular aspects of concrete technology. This particular volume is concerned with auxiliary hydraulic binders of the pozzolanic type. The authors refer to these materials as mineral admixtures. If the high quality of this volume is anything to go by the others proposed covering fly ash, fibre reinforcement and alkali aggregate reaction are to be eagerly awaited.

The book consists of nine chapters and is very well referenced (170 in all). There is also an adequate index. The contents are well balanced covering the history, sources and materials types, chemical and physical characteristics as well as the improvements in concrete properties resulting from their use. Particular attention is paid to the durability aspects contributed by the inclusion of these alternative hydraulic binders.

The use of reactive minerals such as pulverized fuel ash, ground granulated blastfurnace slag, silica fume and, perhaps less commonplace, rice-husk ash, have become integrated into good concrete technology worldwide. This adoptive process is likely to continue since not only do these materials give improvements to the concrete made with them, they also have an environmental contribution to make since they can contribute to reducing CO₂ emissions resulting from normal cement manufacture.

It is difficult to select from the nine chapters those that perhaps are more telling, but Chapter 3 dealing with chemical and physical characteristics is compact,

visual and most informative. There are very useful tables of typical compositions of natural pozzolanas, fly ashes, blastfurnace slags and silica fumes, rice-husk ash and metakaolin. To get the best from these mineral materials chemical admixtures of the dispersing type are necessary and a balance has to be struck. These aspects are dealt with in a concise and informative way. The authors endeavour to substantiate any general opinions given by quantitative information.

Inevitably in a book of this size some subjects can only be touched upon and when this happens the authors quite rightly refer the reader to more detailed work. Pozzolanic reactivity is a case in point. Such a style is acceptable and allows the reader to focus on the main points while supplementing them if required.

There is much concern for and much written about the durability of concrete, particularly when it is reinforced with steel. Chapter 7 of this book consisting of some 46 pages makes a major statement on durability in its various forms. The authors highlight, however, that at the root of good durability is impermeability. The addition of these active minerals enhances the density and reduces the permeability of the set and hardened concrete. Limiting access to deleterious chemicals in whatever form is likely to improve the durability of concrete made with these materials. For instance chloride ion penetration is reduced and while carbonation can be increased due to the removal of calcium hydroxide in the pozzolanic reaction, the permeability of the concrete is reduced and the net effect is an improvement. The point is made, and quite rightly so, that to

obtain these benefits good curing practice has to be used.

The relationship between chemical resistance and the denseness of a mix is well shown in Table 7.3, which deals specifically with silica fume. The improvements are apparent and telling.

Incorporation of minerals of these types does not of itself improve freeze–thaw resistance and a proper air void system is necessary. Similar reasoning applies to the very high strength concretes that can be made at low water cement ratios using superplasticizers (reviewer's experience).

Some interesting comments are made on the resistance to fire of mixes containing these mineral types, since, as a result of the concrete's low permeability, the higher strength and density can cause high pressure

build up when the concretes are heated. The responses can on occasions be surprising!

The shortest chapter in the book is that dealing with the selection of materials and mixture proportions (four pages). This section gives general guidance rather than recipes.

The book finishes with a proposal for a performance-oriented specification covering all mineral admixture types. This is in line with the wider attempts to produce performance specifications for concrete.

On balance, this is an excellent compact volume that should form part of the library of both practising and research-orientated materials technologists and engineers having an interest in concrete, and extending its application.

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