

Construction Materials

Review of 'Transport Properties of Concrete'

--Manuscript Draft--

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Book Review

Transport Properties of Concrete

Measurement and applications

P.A. Claisse (2014)

Woodhead Publishing UK. An imprint of Elsevier. 312pp

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This much-anticipated book by Peter Claisse draws together a wealth of information on the mechanisms of solvent, solute and gas transport in concrete. The complex interactions of the underlying process are fundamental to our understanding of the evolution of concrete in service and hence our ability to assess and predict its durability. The author discusses many of the interrelations between the mobile and stationary phases involved; demonstrating that concrete is a continuum of great complexity.

The early part of the book describes the fundamental concepts of advection and diffusion through a permeable medium, in terms of the underlying mathematics, which are presented in a clear and accessible style. This is expanded to show how these processes are perturbed under an applied electrical potential, which is an essential step to understanding the electrically-enhanced test methods described later. The introduction closes with a discussion of how electrolyte transport is affected by other processes, principally adsorption and osmosis. The second chapter shows how these mechanisms may be coded into a computer model and compares this approach with a well-known coupled chemical-transport code (PHREEQC¹).

Chapters 3-7 explore the test methods which have been applied to study transport phenomena in concrete and compare approaches used to follow gas, vapour and liquid migration under a range of conditions. These methods rely on pressure differences to provide the driving force for each test and though well-established, require measurement of quite modest and often slow changes in the system. A description of the measurement of porosity follows and subsequently, the relationships between porosity and permeability are presented.

The following chapters (about half of the book) are concerned with electrically enhanced migration tests in concrete, an area in which this author has considerable experience. The assessment of concrete durability may be enhanced by test methods in which chemical and physical reactions are accelerated. The goal is to compress a service life of (say) one or two hundred years into a much shorter period, through the use of experimental and numerical models. The latter are attractive, as computer time is inexpensive and a sequence of simulated tests can be run in a short time. It is often said of numerical models however, that they are only as good as the data which they use and historic cement and concrete is often markedly different to that used today. Accelerating

experimental models, allow the use of representative materials, but the impact of the accelerating mechanism on the transport properties of materials are often not completely understood. Claisse shows how, through a combination of approaches, it is possible to maximise the confidence with which experimental tests may be accelerated and used to assess the performance of concrete in service.

The book's final chapters show how, using parameters derived from a range of accelerated tests, numerical models may be applied to predict the evolution of engineered concrete. Applications include the durability of reinforced concrete and chemical-transport through massive concrete, using a waste containment system as an example.

Overall, this book is very accessible. The author treats both the mathematics and chemistry without presuming the reader has great expertise in either; an approach which would be very welcome in some other volumes. The book is well-written and illustrated throughout with line drawings and half-tone photographs, the clear reproduction of which are a credit to the publishers. Technically, it fills a gap in the literature and is a timely addition to the field of concrete science and technology.

In conclusion, Peter Claisse has drawn together a body of knowledge covering transport phenomena in concrete and demonstrates how these processes govern the performance of the materials in a range of applications. It will serve as an important introduction to the subject for readers in both the academic and industrial research communities and as a valuable reference for engineers established in this field.

M. Tyrer. November 2014

¹ Parkhurst, DL, Thorstenson, DC and Plummer LN (1990) PHREEQC – a computer program for geochemical calculations. Water Resources Investigations Report 80-96. US Geological Survey, Reston Virginia, USA.

