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BOOK REVIEWS

Theory and Applications of Transport in Porous Media. By M. Panfilov. Kluwer, 2000. 363 pp. ISBN 0792 361768. £86.

The synopsis given on the back cover states that 'this book is an attempt to develop the hydrodynamic theory of up-scaling for complex flows through highly heterogeneous porous media. The basic consequence of high heterogeneity is the change of the equation type after homogenization …'.

I approached the task of reviewing this text with high hopes, particularly after reading the Preface and Introduction. There the author presents the basic problems associated with modelling single- and multi-phase flow through porous media very pithily and cogently, and so I looked forward to a readable, comprehensive and self-contained presentation of what had been achieved and what remains to be done in this difficult and important field. Newcomers to the field have usually found much of the literature impenetrable: it is highly formal, uses over-elaborate and potentially confusing notation, is overwhelmed by detail and is rarely linked to experimental observations; there are distinct schools whose approaches and activities remain separate after many decades of publication. An inspired overview of all that is best in this published work is sorely needed so that engineers and scientists in the water-resources and petroleum industries, and their colleagues investigating related natural phenomena, can test and use the techniques and results developed by the theorists.

Sadly, I was disappointed. The text turns out to be little more than an annotated compendium of work published by the author and his Russian colleagues over the past 15 years. This may well be valuable for those already reasonably familiar with the subject and its literature, but is not suitable for those coming to it from other backgrounds. The text and figures have been rather casually put together: terms and symbols are used without proper definition (e.g. the term macroscale, and its symbol L, are not explained in an unambiguous fashion); there are inconsistencies in notation (the various symbols based on ω in § 1.2.1 and Figure 1.1 are a depressing example); there are many typographical infelicities; there is too much reliance on the reader being familiar with or having conveniently available a wide range of other texts and papers; the writer's command of English is not strong enough to justify his regular use of general verbal arguments; there is no index nor list of symbols.

Over half of the book is devoted to single- and two-phase flow of Newtonian fluids in 'double porosity media'. As far as most of the results obtained are concerned, this means a highly idealized, structured medium which is composed of two different 'homogeneous' (i.e. completely describable in this context by a uniform permeability and a uniform porosity) porous media arranged in a strictly periodic fashion. Much of the rest is devoted to heat and mass transport and to the dispersion tensors that have to be introduced to describe these processes. Little attention is given to inhomogeneity over length scales large compared with the periodic or structural length scales, which is where many of the fascinating geological effects arise. No helpful discussion is given of whether or how the results quoted apply to real situations and observations, nor how they can be used in computational up-scaling. Reservoir engineers will not be encouraged by this book to study the important theoretical results that have been obtained by the differing schools.

J. R. A. Pearson

Sedimentation and Thickening – Phenomenological Foundation and Mathematical Theory. By M. C. Bustos, F. Concha, R. Burger & E. M. Tory. Kluwer, 1999. 285 pp. ISBN 0 7923 5960 7. £80.

As stated in the Preface, the aim of the book is to present a rigorous phenomenological and mathematical formulation of sedimentation processes and to show how theory can be applied to the design and control of continuous thickeners. An excellent overview of the book is also presented in the Preface. After an Introduction on the history of sedimentation processes and research, basic mixture theory is presented in Chapter 1, followed by the basic kinematic theory of sedimentation by Kynch in Chapter 2 and modifications to include compression or consolidation of flocculated particles in Chapter 3. The next three chapters give related mathematical theory on the properties of solutions of the initial-value and initial-boundary-value problems arising from conservation laws. Chapters 7 and 8 focus on solutions for batch and continuous sedimentation of ideal suspensions, whereas the following two chapters consider solutions for sedimentation of non-ideal (flocculated) suspensions with compression. Chapter 11 is a review of practical methods for thickener design. The final chapter briefly introduces alternative treatments where the basic assumptions of the Kynch theory do not necessarily hold.

The presentation is likely to appeal more to applied mathematicians than practising engineers, though the authors point out that certain chapters can be skipped by those less interested in mathematical theory. The theory is primarily developed in a general sense, such as citing different behaviours for flux density functions with one or two inflection points, and relatively few numerical examples or experimental data are provided. The book does not have homework problems and will not be widely used as a stand-alone textbook in a course, but it may serve as a reference. While the aim of a rigorous presentation is achieved, the coverage of material is not comprehensive. Issues such as polydisperse suspensions, aggregation, sedimentation in inclined channels, hydrodynamic dispersion, and theoretical considerations of hindered-settling funtions, which are of significant interest to many readers of the *Journal of Fluid Mechanics*, are left out or only touched upon. A taste of some of these subjects is provided in the final chapter of the book.

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