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Transport Processes in Porous Media

 Springer

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The effort I put for this work is dedicated to my wife, Natasa, who offered me the most valuable gift of my life: our three children.

Frank Coutelieris

Preface

What is a “porous medium”? Although several definitions have been proposed, depending on the application the porous material is involved with, a common sense of this term exists to almost everyone. This is mainly due to their abundance. Either artificial or natural, porous materials can be found in the wide majority of scientific applications, technological developments, and the natural environment. Clothing, chalk, underground oil reservoirs, catalytic pellets and sandstones are typical examples of “everyday” porous materials while other, more modern, approaches consider bread, cooked rice and the human scalp as porous media. Independent of the approach adopted, the basic concepts and properties that characterize a porous medium (porosity, connectivity, consolidation, percolation, tortuosity, homogeneity, isotropy and anisotropy, permeability) have to be well defined and understood before one attempts investigating transport phenomena occurring within them.

“Transport processes in porous media” is a field of great industrial interest, but it still requires more research before it can be properly understood. Fundamental and applied research in heat and mass transfer in porous media has generated increasing interest over the past five decades because of the importance of porous media and transport processes in many engineering applications. A large amount of literature has been generated on this subject and significant advances have been made in modeling fluid flow, heat and mass transfer through porous media including clarification of several important physical phenomena.

The main propose in writing this book is to present a new approach, in several respects. Unlike the most recent reference books on porous media, which catalogue in pure and relatively abstract terms the current position of fundamental research on porous media, this book provides a comprehensive description of the flow and mass transport in porous materials. Authors avoid to present heat transfer processes in porous structures because such a topic is too extensive to be covered along with the other transport processes, better requiring an external book.

The overall approach here is based both on experimental and theoretical state-of-the-art studies, covering the physical and engineering aspects encountered within some of the main applications for porous materials. The text is designed to

be intelligible to readers who have some previous knowledge of fundamentals of transport processes as well as a considerable mathematical background. The book's flexible structure makes its accessible to the general engineer or scientist, but also caters for readers with non-scientific backgrounds.

This book was jointly authored from 2010 to 2011, and authors conclude that even if they cannot make any claim of completeness in investigating this crucial field, they believe that some of its recent developments are significantly addressed here. Authors would also acknowledge with gratitude the support received from Sandy Coles and Dr. Eleni Vakouftsi as well as current and previous research teams established in the University of Ioannina—Department of Environmental and Natural Resources Management, Greece, the National Center for Scientific Research—Environmental Research Laboratory, Greece, the University of Western Macedonia—Department of Mechanical Engineering, Greece, and the University of Porto—Faculty of Engineering, Portugal. Finally, the authors would welcome reader comments, corrections and suggestions with the aim of improving any future editions.

Frank Coutelieris
J. M. P. Q. Delgado

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