

Porous Media

Fluid Transport and Pore Structure

F. A. L. DULLIEN

*Faculty of Engineering
Department of Chemical Engineering
University of Waterloo
Waterloo, Ontario, Canada*



1979

ACADEMIC PRESS

A Subsidiary of Harcourt Brace Jovanovich, Publishers

New York London Toronto Sydney San Francisco

H

Technische Hochschule Darmstadt
Fachbereich Mechanik

Bibliothek

Inv.-Nr. BM 111181

Contents

<i>Preface</i>	<i>ix</i>
<i>List of Symbols</i>	<i>xi</i>
1 Introduction	1
2 Capillarity in Porous Media	
2.1 Surface between Two Fluids	6
2.2 Systems Containing Solid Surfaces	9
2.3 Capillary Pressure	14
2.4 Quasi-Static Displacement of a Fluid by Another Immiscible Fluid	38
2.5 Pore Structure Models of the Capillary Pressure Function	42
2.6 Adsorption in Porous Media	66
References	72
3 Pore Structure	
3.1 Macroscopic Pore Structure Parameters	76
3.2 Microscopic Pore Structure Parameters	88
3.3 Pore Structure of Some Important Materials	138
References	150
	<i>vii</i>

4 Single-Phase Transport Phenomena in Porous Media

4.1	Introduction	157
4.2	Phenomenological Flow Models	159
4.3	Models Based on Conduit Flow	169
4.4	Use of the Navier–Stokes Equations in Flow through Porous Media	190
4.5	Flow Models Based on Flow around Submerged Objects	198
4.6	Flow of Gases and Diffusion in Porous Media	201
4.7	Non-Newtonian Flow in Porous Media	209
4.8	Anisotropic Permeability	215
4.9	Resistivity (Formation) Factor and Tortuosity	219
	References	230

5 Selected Operations Involving Transport of a Single Fluid Phase through a Porous Medium

5.1	Deep Filtration	235
5.2	Mass Transfer through Membranes	239
5.3	Gel Chromatography	245
	References	247

6 Multiphase Flow of Immiscible Fluids in Porous Media

6.1	Fundamentals of Flow of Immiscible Fluids	251
6.2	Macroscopic (Phenomenological) Description of Flow	254
6.3	Microscopic Flow Mechanisms of Immiscible Fluids in Porous Media	273
6.4	Immiscible Displacement	284
	References	324

7 Miscible Displacement and Dispersion

7.1	Introduction	329
7.2	Dispersion in a Capillary Tube	330
7.3	Hydrodynamic Dispersion (Miscible Displacement) in Porous Media	341
	References	388