Product Description

Chemical reaction engineering is concerned with the exploitation of chemical reactions on a commercial scale. Its goal is the successful design and operation of chemical reactors. This text emphasizes qualitative arguments, simple design methods, graphical procedures, and frequent comparison of capabilities of the major reactor types. Simple ideas are treated first, and are then extended to the more complex.

Contents
Notation /xi
Chapter 1
Overview of Chemical Reaction Engineering /1
Part I
Homogeneous Reactions in Ideal Reactors /11
Chapter 2
Kinetics of Homogeneous Reactions /113
2.1 Concentration-Dependent Term of a Rate Equation /114
2.2 Temperature-Dependent Term of a Rate Equation /127
2.3 Searching for a Mechanism /129
2.4 Predictability of Reaction Rate from Theory /132
Chapter 3
Interpretation of Batch Reactor Data /138
3.1 Constant-volume Batch Reactor /139
3.2 Varying-volume Batch Reactor /167
3.3 Temperature and Reaction Rate /172
3.4 The Search for a Rate Equation /175
Chapter 4
Introduction to Reactor Design /183
Chapter 5
Ideal Reactors for a Single Reaction /190
5.1 Ideal Batch Reactors /191
5.2 Steady-State Mixed Flow Reactors /194
5.3 Steady-State Plug Flow Reactors /1101
Chapter 6
Design for Single Reactions /1120
6.1 Size Comparison of Single Reactors /1121
6.2 Multiple-Reactor Systems /1124
6.3 Recycle Reactor /1136
6.4 Autocatalytic Reactions /1140
Chapter 7
Design for Parallel Reactions /1152
Chapter 8
Heterogeneous Reactions - Introduction 1369
Chapter 18
Solid Catalyzed Reactions 1376
18.1 The Rate Equation for Surface Kinetics 1379
18.2 Pore Diffusion Resistance Combined with Surface Kinetics 1381
18.3 Porous Catalyst Particles I385
18.4 Heat Effects During Reaction 1391
18.5 Performance Equations for Reactors Containing Porous Catalyst Particles 1393
18.6 Experimental Methods for Finding Rates 1396
18.7 Product Distribution in Multiple Reactions 1402
Chapter 19
The Packed Bed Catalytic Reactor 1427
Chapter 20
Reactors with Suspended Solid Catalyst, Fluidized Reactors of Various Types 1447
20.1 Background Information About Suspended Solids Reactors 1447
20.2 The Bubbling Fluidized Bed-BFB 1451
20.3 The K-L Model for BFB 1445
20.4 The Circulating Fluidized Bed-CFB 1465
20.5 The Jet Impact Reactor 1470
Chapter 21
Deactivating Catalysts 1473
21.1 Mechanisms of Catalyst Deactivation 1474
21.2 The Rate and Performance Equations 1475
21.3 Design 1489
Chapter 22
GIL Reactions on Solid Catalyst: Trickle Beds, Slurry Reactors, Three-Phase Fluidized Beds 1500
22.1 The General Rate Equation 1500
22.2 Performance Equations for an Excess of B 1503
22.3 Performance Equations for an Excess of A 1509
22.4 Which Kind of Contactor to Use 1509
22.5 Applications 1510
Part IV
Non-Catalytic Systems I521
Chapter 23
Fluid-Fluid Reactions: Kinetics I523
23.1 The Rate Equation 1524
Chapter 24
Fluid-Fluid Reactors: Design 1.540
24.1 Straight Mass Transfer 1543
24.2 Mass Transfer Plus Not Very Slow Reaction 1546
Chapter 25
Fluid-Particle Reactions: Kinetics 1566
25.1 Selection of a Model 1568
25.2 Shrinking Core Model for Spherical Particles of Unchanging Size 1570
Contents ix
25.3 Rate of Reaction for Shrinking Spherical Particles 1577
25.4 Extensions 1579
25.5 Determination of the Rate-Controlling Step 1582
Chapter 26
Fluid-Particle Reactors: Design 1589
Part V
Biochemical Reaction Systems 1609
Chapter 27
Enzyme Fermentation 1611
27.1 Michaelis-Menten Kinetics (M-M kinetics) 1612
27.2 Inhibition by a Foreign Substance-Competitive and Noncompetitive Inhibition 1616
Chapter 28
Microbial Fermentation—Introduction and Overall Picture 1623
Chapter 29
Substrate-Limiting Microbial Fermentation 1630
29.1 Batch (or Plug Flow) Fermentors 1630
29.2 Mixed Flow Fermentors 1633
29.3 Optimum Operations of Fermentors 1636
Chapter 30
Product-Limiting Microbial Fermentation 1645
30.1 Batch or Plus Flow Fermentors for \( n = 1 \) 1646
30.2 Mixed Flow Fermentors for \( n = 1 \) 1647
Appendix 1655
Name Index 1662
Subject Index 1665