

1. Record Nr.	UNINA9910583035203321
Titolo	Coulson & Richardson's chemical engineering . Vol. 3a Chemical and biochemical reactors and reaction engineering // edited by R. Ravi, R. Vinu, S. N. Gummadi
Pubbl/distr/stampa	Oxford : , : Butterworth-Heinemann, , 2017
ISBN	0-08-101223-3 0-08-101096-6
Edizione	[4th edition.]
Descrizione fisica	1 online resource (598 pages) : illustrations
Altri autori (Persone)	CoulsonJ. M (John Metcalfe)
Disciplina	660
Soggetti	Chemical engineering Bioreactors
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Front Cover -- Coulson and Richardson's Chemical Engineering -- Coulson & Richardson's Chemical Engineering -- Coulson and Richardson's Chemical Engineering: Volume 3A: Chemical and Biochemical Reactors and Reaction Engineering -- Copyright -- Contents -- List of Contributors -- About Prof. Coulson -- About Prof. Richardson -- Preface -- Introduction -- 1 - Reactor Design-General Principles -- 1.1 Basic Objectives in Design of a Reactor -- 1.1.1 By-products and Their Economic Importance -- 1.1.2 Preliminary Appraisal of a Reactor Project -- 1.2 Classification of Reactors and Choice of Reactor Type -- 1.2.1 Homogeneous and Heterogeneous Reactors -- 1.2.2 Batch Reactors and Continuous Reactors -- 1.2.3 Variations in Contacting Pattern-Semibatch Operation -- 1.2.4 Influence of Heat of Reaction on Reactor Type -- 1.2.4.1 Adiabatic Reactors -- 1.2.4.2 Reactors With Heat Transfer -- 1.2.4.3 Autothermal Reactor Operation -- 1.3 Choice of Process Conditions -- 1.3.1 Chemical Equilibria and Chemical Kinetics -- 1.3.2 Calculation of Equilibrium Conversion -- 1.3.3 Ultimate Choice of Reactor Conditions -- 1.4 Material and Energy Balances -- 1.4.1 Material Balance and the Concept of Rate of Generation of a Species -- 1.4.2 Energy Balance -- 1.5 Chemical Kinetics and Rate Equations -- 1.5.1 Definition of Order of Reaction and Rate Constant -- 1.5.2 Influence of Temperature: Activation Energy

-- 1.5.3 Rate Equations and Reaction Mechanism -- 1.5.4 Reversible Reactions -- 1.5.5 Experimental Determination of Kinetic Constants -- 1.6 Batch Reactors -- 1.6.1 Calculation of Reaction Time: Basic Design Equation -- 1.6.2 Reaction Time-Isothermal Operation -- 1.6.3 Maximum Production Rate -- 1.6.4 Reaction Time-Nonisothermal Operation -- 1.6.5 Adiabatic Operation -- 1.6.6 Kinetics From Batch Reactor Data -- 1.6.6.1 Differential Method -- 1.6.6.2 Integral Method. 1.6.6.3 Differential Versus Integral Method: Comparison -- 1.6.6.4 Fractional Life Method -- 1.6.6.5 Kinetics of Gas-Phase Reactions From Pressure Measurements -- 1.7 Tubular Flow Reactors -- 1.7.1 Basic Design Equations for a Tubular Reactor -- 1.7.2 Tubular Reactors-Nonisothermal Operation -- 1.7.3 Pressure Drop in Tubular Reactors -- 1.7.4 Kinetic Data From Tubular Reactors -- 1.8 Continuous Stirred Tank Reactors -- 1.8.1 Assumption of Ideal Mixing: Residence Time -- 1.8.2 Design Equations for Continuous Stirred Tank Reactors -- 1.8.3 Graphical Methods -- 1.8.4 Autothermal Operation -- 1.8.5 Kinetic Data From Continuous Stirred Tank Reactors -- 1.9 Comparison of Batch, Tubular, and Stirred Tank Reactors for a Single Reaction: Reactor Output -- 1.9.1 Batch Reactor and Tubular Plug Flow Reactor -- 1.9.2 Continuous Stirred Tank Reactor -- 1.9.2.1 One Tank -- 1.9.2.2 Two Tanks -- 1.9.3 Comparison of Reactors -- 1.10 Comparison of Batch, Tubular, and Stirred Tank Reactors for Multiple Reactions: Reactor Yield -- 1.10.1 Types of Multiple Reactions -- 1.10.2 Yield and Selectivity -- 1.10.3 Reactor Type and Backmixing -- 1.10.4 Reactions in Parallel -- 1.10.4.1 Requirements for High Yield -- 1.10.4.1.1 Reactant Concentration and Reactor Type -- 1.10.4.1.2 Pressure in Gas-Phase Reactions -- 1.10.4.1.3 Temperature of Operation -- 1.10.4.1.4 Choice of Catalyst -- 1.10.4.2 Yield and Reactor Output -- 1.10.5 Reactions in Parallel-Two Reactants -- 1.10.6 Reactions in Series -- 1.10.6.1 Batch Reactor or Tubular Plug Flow Reactor -- 1.10.6.2 Continuous Stirred Tank Reactor-One Tank -- 1.10.6.3 Reactor Comparison and Conclusions -- 1.10.6.3.1 Reactor Type -- 1.10.6.3.2 Conversion in Reactor -- 1.10.6.3.3 Temperature -- 1.10.6.3.4 General Conclusions -- 1.10.7 Reactions in Series-Two Reactants -- 1.11 Appendix: Simplified Energy Balance Equations for Flow Reactors.
Nomenclature -- References -- Further Reading -- 2 - Flow Characteristics of Reactors-Flow Modeling -- 2.1 Nonideal Flow and Residence Time Distribution -- 2.1.1 Types of Nonideal Flow Patterns -- 2.1.2 Residence Time Distribution: Basic Concepts and Definitions -- 2.1.3 Experimental Determination of $E(t)$ and $F(t)$ -- 2.1.3.1 The Convolution Formula -- 2.1.3.2 Step and Impulse Responses -- 2.1.4 E and F Functions for Ideal Reactors -- 2.1.4.1 Continuous Stirred Tank Reactor -- 2.1.4.2 Plug Flow Reactor -- 2.1.5 Statistics of Residence Time Distribution -- 2.1.6 Application of Tracer Information to Reactors -- 2.2 Zero-Parameter Models-Complete Segregation and Maximum Mixedness Models -- 2.2.1 Special Case of First-Order Reactions: Equivalence of the Segregated and Maximum Mixedness Models -- 2.2.2 PFR and Zero-Parameter Models -- 2.2.3 Residence Time Distribution of the CSTR and the Zero-Parameter Models -- 2.2.4 Bounds on Conversion: Some General Rules -- 2.2.4.1 Zero-Order Kinetics -- 2.2.4.2 First-Order Kinetics -- 2.2.4.3 Second-Order Kinetics -- 2.3 Tanks-in-Series Model -- 2.3.1 Predicting Reactor Conversion From Tanks-in-Series Model -- 2.4 Dispersed Plug Flow Model -- 2.4.1 Axial Dispersion and Model Development -- 2.4.2 Basic Differential Equation -- 2.4.3 Response to an Ideal Pulse Input of Tracer -- 2.4.4 Experimental Determination of Dispersion Coefficient From a Pulse Input -- 2.4.4.1 Many Equally Spaced Points -- 2.4.4.2 Relatively Few Data Points but Each Concentration C_i Measured

Instantaneously at Time t_i () -- 2.4.4.3 Data Collected by a "Mixing Cup" -- 2.4.5 Further Development of Tracer Injection Theory -- 2.4.5.1 Significance of the Boundary Conditions -- 2.4.5.2 Dispersion Coefficients From Nonideal Pulse Data -- 2.4.5.3 Pulse of Tracer Moving Through a Series of Vessels.

2.4.6 Values of Dispersion Coefficients From Theory and Experiment -- 2.4.7 Dispersed Plug Flow Model With First-Order Chemical Reaction -- 2.4.7.1 Case of Small DL/u_L -- 2.4.7.2 Comparison With a Simple Plug Flow Reactor -- 2.4.8 Applications and Limitations of the Dispersed Plug Flow Model -- 2.5 Models Involving Combinations of the Basic Flow Elements -- Nomenclature -- References -- 3 - Gas-Solid Reactions and Reactors -- 3.1 Introduction -- 3.2 Mass Transfer Within Porous Solids -- 3.2.1 The Effective Diffusivity -- 3.2.1.1 The Molecular Flow Region -- 3.2.1.2 The Knudsen Flow Region -- 3.2.1.3 The Transition Region -- 3.2.1.4 Forced Flow in Pores -- 3.3 Chemical Reaction in Porous Catalyst Pellets -- 3.3.1 Isothermal Reactions in Porous Catalyst Pellets -- 3.3.2 Effect of Intraparticle Diffusion on Experimental Parameters -- 3.3.3 Nonisothermal Reactions in Porous Catalyst Pellets -- 3.3.4 Criteria for Diffusion Control -- 3.3.5 Selectivity in Catalytic Reactions Influenced by Mass and Heat Transfer Effects -- 3.3.5.1 Isothermal Conditions -- 3.3.5.2 Nonisothermal Conditions -- 3.3.5.3 Selectivity of Bifunctional Catalysts -- 3.3.6 Catalyst Deactivation and Poisoning -- 3.4 Mass Transfer From a Fluid Stream to a Solid Surface -- 3.5 Chemical Kinetics of Heterogeneous Catalytic Reactions -- 3.5.1 Adsorption of a Reactant as the Rate-Determining Step -- 3.5.2 Surface Reaction as the Rate-Determining Step -- 3.5.3 Desorption of a Product as the Rate-Determining Step -- 3.5.4 Rate-Determining Steps for Other Mechanisms -- 3.5.5 Examples of Rate Equations for Industrially Important Reactions -- 3.5.6 Mechanism of Catalyst Poisoning -- 3.6 Design Calculations -- 3.6.1 Packed Tubular Reactors -- 3.6.1.1 Behavior of Reactors in the Absence of Dispersion -- 3.6.1.1.1 Isothermal Conditions -- 3.6.1.1.2 Adiabatic Conditions.

3.6.1.1.3 Nonisothermal and Nonadiabatic Conditions -- 3.6.1.2 Dispersion in Packed Bed Reactors -- 3.6.1.2.1 The Nature of Dispersion -- 3.6.1.2.2 Axial Dispersion -- 3.6.1.2.3 Axial and Radial dispersion-Nonisothermal Conditions -- 3.6.2 Thermal Characteristics of Packed Reactors -- 3.6.2.1 Sensitivity of Countercurrent Cooled Reactors -- 3.6.2.2 The Autothermal Region -- 3.6.2.3 Stability of Packed Bed Tubular Reactors -- 3.6.3 Fluidized Bed Reactors -- 3.7 Gas-Solid Noncatalytic Reactors -- 3.7.1 Modeling and Design of Gas-Solid Reactors -- 3.7.2 Single Particle Unreacted Core Models -- 3.7.2.1 Unreacted Core Model-Chemical Reaction Control -- 3.7.2.2 Unreacted Core Model-Gas Film Control -- 3.7.2.3 Unreacted Core Model-Solid Product Layer Control -- 3.7.2.4 Limitations of Simple Models-Solids Structure -- 3.7.2.5 Shrinking Particles and Film Growth -- 3.7.3 Types of Equipment and Contacting Patterns -- 3.7.3.1 Fluidized Bed Reactor -- Nomenclature -- References -- Further Reading -- 4 - Gas-Liquid and Gas-Liquid-Solid Reactors -- 4.1 Gas-Liquid Reactors -- 4.1.1 Gas-Liquid Reactions -- 4.1.2 Types of Reactors -- 4.1.3 Rate Equations for Mass Transfer With Chemical Reaction -- 4.1.3.1 Rate of Transformation of A per Unit Volume of Reactor -- 4.1.3.1.1 Region I: 2 -- 4.1.3.1.2 Region II: 0.02<<2 -- 4.1.3.1.3 Region III: <0.02 -- 4.1.4 Choice of a Suitable Reactor -- 4.1.5 Information Required for Gas-Liquid Reactor Design -- 4.1.5.1 Kinetic Constants of the Reaction -- 4.1.5.2 Physical Properties of the Gas and Liquid -- 4.1.5.3 Equipment Characteristics -- 4.1.6 Examples of Gas-Liquid Reactors -- 4.1.6.1 Packed Column Reactors -- 4.1.6.1.1

Height of Packing -- 4.1.6.1.2 Confirmation of Pseudo-First-Order Behavior -- 4.1.6.1.3 Further Comments -- 4.1.6.2 Agitated Tank Reactors: Flow Patterns of Gas and Liquid -- 4.1.6.2.1 Further Comments.
4.1.6.3 Well-Mixed Bubble Column Reactors: Gas-Liquid Flow Patterns and Mass Transfer.
