

CONTENTS

Preface	5
Acknowledgments	6
I. INTRODUCTION	7
1.1 Industrial Importance of Heterogeneous Catalysis	
1.2 General Characteristics of Solid Catalysts	
1.2.1 Activation Energy	
1.2.2 Functionality and Classification	
1.2.3 Selectivity of Solid Catalysts	
1.2.4 The Catalytic Site	
1.2.5 Configuration of Solid Catalysts	
1.2.6 Naming of Solid Catalysts	
1.3 The Catalytic Sequence	
References	
II. ADSORPTION	25
2.1 Types of Adsorption	
2.2 Comparison between Physical and Chemical Adsorption	
2.2.1 Surface Coverage	
2.2.2 Heat of Adsorption	
2.2.3 Catalytic Cycle	
2.2.4 Rate of Adsorption	
2.2.5 Effect of Temperature	
2.3 Adsorption Isotherms	
2.3.1 Langmuir Isotherm	
2.3.2 Competitive Adsorption	
2.3.3 Determination of Surface Area	
2.4 Other isotherms	
2.4.1 BET isotherm	
2.4.2 Surface Area by BET isotherm	
References	
III. CHARACTERIZATION OF SOLID CATALYSTS	45
3.1 Physical Characterization	
3.1.1 Determination of Surface Area	
3.1.2 Measurement of Total Pore Volume	
3.1.3 Pore Size Distribution	
3.2 Chemical and Structural Characterization	
3.3 Mechanical Characterization	

References

IV.	KINETICS OF CATALYTIC REACTIONS	62
4.1	Classification of Kinetic Models	
4.2	Langmuir-Hinshelwood (L-H) Model	
4.2.1	Irreversible, Unimolecular, Surface Reactions	
4.2.2	Irreversible, Bimolecular, Surface Reactions	
4.2.3	Inhibition in Bimolecular, Surface Reactions	
4.2.4	Reversible, Unimolecular, Surface Reactions	
4.2.5	Reversible, Bimolecular, Surface Reactions	
4.2.6	Irreversible, Bimolecular, Reactions: Different Sites	
4.3	Eley-Rideal (E-R) Model	
4.4	Effect of Temperature on Reaction Rate	
	References	
V.	TRANSPORT EFFECTS IN CATALYTIC REACTIONS	77
5.1	Inter-Phase and Intra-Phase Mass Transfer	
5.2	The Effectiveness Factor	
5.2.1	Isothermal First-Order Catalytic Reactions	
5.2.2	Effectiveness Factor for First-Order Reactions	
5.2.3	Effectiveness Factors for Other Catalyst Shapes	
5.2.4	Parameter Estimation	
5.3	Behavior of Observed Reaction Rate: Falsification of Kinetic Data	
5.4	Laboratory Reactors	
	References	
VI.	DEACTIVATION OF SOLID CATALYSTS	98
6.1	Causes of Deactivation	
6.2	Deactivation by Thermal Degradation	
6.3	Deactivation by Fouling	
6.4	Deactivation by Poisoning	
6.5	Other Causes of Deactivation	
6.6	Kinetics of Catalytic Deactivation	
6.7	Catalyst Regeneration	
	References	
VII.	INDUSTRIAL CATALYTIC REACTORS	112
7.1	Types of Reactors and Applications	
7.1.1	Packed-Bed Reactor Family	
7.1.2	Fluidized-Bed Reactor Family	
7.2	Design of Isothermal Packed-Bed Reactor	

7.3 Three-Phase Catalytic Reactors
References
References

PROBLEMS

142