

Physicochemical Treatment Processes

VOLUME 3
HANDBOOK OF ENVIRONMENTAL ENGINEERING

Physicochemical Treatment Processes

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Preface

The past 30 years have seen the emergence of a growing desire worldwide to take positive actions to restore and protect the environment from the degrading effects of all forms of pollution: air, noise, solid waste, and water. Because pollution is a direct or indirect consequence of waste, the seemingly idealistic demand for “zero discharge” can be construed as an unrealistic demand for zero waste. However, as long as waste exists, we can only attempt to abate the subsequent pollution by converting it to a less noxious form. Three major questions usually arise when a particular type of pollution has been identified: (1) How serious is the pollution? (2) Is the technology to abate it available? and (3) Do the costs of abatement justify the degree of abatement achieved? The principal intention of the *Handbook of Environmental Engineering* series is to help readers formulate answers to the last two questions.

The traditional approach of applying tried-and-true solutions to specific pollution problems has been a major contributing factor to the success of environmental engineering, and has accounted in large measure for the establishment of a “methodology of pollution control.” However, realization of the ever-increasing complexity and interrelated nature of current environmental problems makes it imperative that intelligent planning of pollution abatement systems be undertaken. Prerequisite to such planning is an understanding of the performance, potential, and limitations of the various methods of pollution abatement available for environmental engineering. In this series of handbooks, we will review at a tutorial level a broad spectrum of engineering systems (processes, operations, and methods) currently being utilized, or of potential utility, for pollution abatement. We believe that the unified interdisciplinary approach in these handbooks is a logical step in the evolution of environmental engineering.

The treatment of the various engineering systems presented in *Physicochemical Treatment Process* shows how an engineering formulation of the subject flows naturally from the fundamental principles and theories of chemistry, physics, and mathematics. This emphasis on fundamental science recognizes that engineering practice has in recent years become more firmly based on scientific principles rather than its earlier dependency on empirical accumulation of facts. It is not intended, though, to neglect empiricism when such data lead quickly to the most economic design; certain engineering systems are not readily amenable to fundamental scientific analysis, and in these instances we have resorted to less science in favor of more art and empiricism.

Because an environmental engineer must understand science within the context of application, we first present the development of the scientific basis of a particular subject, followed by exposition of the pertinent design concepts and operations, and detailed explanations of their applications to environmental quality control or improvement. Throughout this series, methods of practical design calculation are illustrated by numerical examples. These examples clearly demonstrate how organized, analytical reasoning leads to the most direct and clear solutions. Wherever possible, pertinent cost data have been provided.

Our treatment of pollution-abatement engineering is offered in the belief that the trained engineer should more firmly understand fundamental principles, be more aware of the similarities and/or differences among many of the engineering systems, and exhibit greater flexibility and originality in the definition and innovative solution of environmental pollution problems. In short, environmental engineers should by conviction and practice be more readily adaptable to change and progress.

Coverage of the unusually broad field of environmental engineering has demanded an expertise that could only be provided through multiple authorships. Each author (or group of authors) was permitted to employ, within reasonable limits, the customary personal style in organizing and presenting a particular subject area, and, consequently, it has been difficult to treat all subject material in a homogeneous manner. Moreover, owing to limitations of space, some of the authors' favored topics could not be treated in great detail, and many less important topics had to be merely mentioned or commented on briefly. All of the authors have provided an excellent list of references at the end of each chapter for the benefit of the interested reader. Because each of the chapters is meant to be self-contained, some mild repetition among the various texts was unavoidable. In each case, all errors of omission or repetition are the responsibility of the editors and not the individual authors. With the current trend toward metrication, the question of using a consistent system of units has been a problem. Wherever possible the authors have used the British system along with the metric equivalent or vice versa. The authors sincerely hope that this doubled system of unit notation will prove helpful rather than disruptive to the readers.

The goals of the *Handbook of Environmental Engineering* series are: (1) to cover the entire range of environmental fields, including air and noise pollution control, solid waste processing and resource recovery, biological treatment processes, water resources, natural control processes, radioactive waste disposal, thermal pollution control, and physicochemical treatment processes; and (2) to employ a multithematic approach to environmental pollution control because air, water, land, and energy are all interrelated. The organization of the series is mainly based on the three basic forms in which pollutants and waste are manifested: gas, solid, and liquid. In addition, noise pollution control is included in one of the handbooks in the series.

This volume, *Physicochemical Treatment Processes*, has been designed to serve as a basic physicochemical treatment text as well as a comprehensive reference book. We hope and expect it will prove to be of high value to advanced undergraduate or graduate students, to designers of water and wastewater treatment systems, and to research workers. The editors welcome comments from readers in all these categories. It is our hope that this book will not only provide information on the physical, chemical, and mechanical treatment technologies, but will also serve as a basis for advanced study or specialized investigation of the theory and practice of the individual physicochemical systems covered.

The editors are pleased to acknowledge the encouragement and support received from their colleagues and the publisher during the conceptual stages of this endeavor. We wish to thank the contributing authors for their time and effort, and for having

patiently borne our reviews and numerous queries and comments. We are very grateful to our respective families for their patience and understanding during some rather trying times.

***Lawrence K. Wang
Yung-Tse Hung
Nazih K. Shamma***

Contents

Preface	v
Contributors	xix
1 Screening and Comminution	
<i>Frank J. DeLuise, Lawrence K. Wang, Shoou-Yuh Chang,</i>	
<i>and Yung-Tse Hung</i>	<i>1</i>
1. Function of Screens and Comminutors	1
2. Types of Screens	2
2.1. Coarse Screens	2
2.2. Fine Screens	2
3. Physical Characteristics and Hydraulic Considerations of Screens	3
4. Cleaning Methods for Screens	5
5. Quality and Disposal for Screens	6
6. Comminutors	7
7. Engineering Specifications and Experience	8
7.1. Professional Association Specifications	8
7.2. Engineering Experience	11
8. Engineering Design	12
8.1. Summary of Screening Design Considerations	12
8.2. Summary of Comminution Design Considerations	14
9. Design Examples	15
9.1. Example 1: Bar Screen Design	15
9.2. Example 2: Bar Screen Head Loss	16
9.3. Example 3: Plugged Bar Screen Head Loss	17
9.4. Example 4: Screen System Design	17
Nomenclature	18
References	18
2 Flow Equalization and Neutralization	
<i>Ramesh K. Goel, Joseph R. V. Flora, and J. Paul Chen</i>	<i>21</i>
1. Introduction	21
2. Flow Equalization	21
2.1. Flow Equalization Basin Calculations	23
2.2. Mixing and Aeration Requirements	25
2.3. Mixer Unit	26
3. Neutralization	28
3.1. pH	28
3.2. Acidity and Alkalinity	29
3.3. Buffer Capacity	30
3.4. Hardness	31
4. Neutralization Practices	32
4.1. Neutralization of Acidity	32
4.2. Neutralization of Alkalinity	33
4.3. Common Neutralization Treatments	34
5. pH Neutralization Practices	36
5.1. Passive Neutralization	36
5.2. In-Plant Neutralization	36
5.3. Influent pH Neutralization	36
5.4. In-Process Neutralization	37
5.5. Effluent Neutralization	38
5.6. Chemicals for Neutralization	38

5.7. Encapsulated Phosphate Buffers for <i>In Situ</i> Bioremediation	39
6. Design of a Neutralization System	39
7. Design Examples	40
Nomenclature	43
References	44
3. Mixing	
<i>J. Paul Chen, Frederick B. Higgins, Shoou-Yuh Chang,</i>	
<i>and Yung-Tse Hung</i>	47
1. Introduction	47
2. Basic Concepts	48
2.1. Criteria for Mixing	50
2.2. Mixing Efficiency	52
2.3. Fluid Shear	54
3. Mixing Processes and Equipment	55
3.1. Mixing in Turbulent Fields	55
3.2. Mechanical Mixing Equipment	58
3.3. Impeller Discharge	69
3.4. Motionless Mixers	71
3.5. Mixing in Batch and Continuous Flow Systems	73
3.6. Suspension of Solids	77
3.7. Static Mixer	84
4. Design of Facilities	86
4.1. Pipes, Ducts, and Channels	86
4.2. Self-Induced and Baffled Basins	89
4.3. Mechanically Mixed Systems	90
Nomenclature	99
References	100
4. Coagulation and Flocculation	
<i>Nazih K. Shammas</i>	103
1. Introduction	103
2. Applications of Coagulation	104
2.1. Water Treatment	104
2.2. Municipal Wastewater Treatment	104
2.3. Industrial Waste Treatment	104
2.4. Combined Sewer Overflow	104
2.5. Factors to be Considered in Process Selection	105
3. Properties of Colloidal Systems	105
3.1. Electrokinetic Properties	105
3.2. Hydration	106
3.3. Brownian Movement	106
3.4. Tyndall Effect	106
3.5. Filterability	107
4. Colloidal Structure and Stability	107
5. Destabilization of Colloids	109
5.1. Double-Layer Compression	110
5.2. Adsorption and Charge Neutralization	110
5.3. Entrapment of Particles in Precipitate	111
5.4. Adsorption and Bridging between Particles	111
6. Influencing Factors	112
6.1. Colloid Concentration	112
6.2. Coagulant Dosage	112
6.3. Zeta Potential	112
6.4. Affinity of Colloids for Water	113
6.5. pH Value	113
6.6. Anions in Solution	114

6.7. Cations in Solution	114
6.8. Temperature	114
7. Coagulants	114
7.1. Aluminum Salts	115
7.2. Iron Salts	116
7.3. Sodium Aluminate	116
7.4. Polymeric Inorganic Salts	117
7.5. Organic Polymers	117
7.6. Coagulation Aids	118
8. Coagulation Control	118
8.1. Jar Test	119
8.2. Zetameter	120
8.3. Streaming Current Detector	121
9. Chemical Feeding	121
10. Mixing	122
11. Rapid Mix	124
12. Flocculation	125
13. Design Examples	127
Nomenclature	137
References	138
5. Chemical Precipitation	
<i>Lawrence K. Wang, David A. Vaccari, Yan Li, and Nazih K. Shammam ...</i>	141
1. Introduction	141
2. Process Description	142
3. Process Types	142
3.1. Hydroxide Precipitation	142
3.2. Sulfide Precipitation	144
3.3. Cyanide Precipitation	145
3.4. Carbonate Precipitation	145
3.5. Coprecipitation	146
3.6. Technology Status	146
4. Chemical Precipitation Principles	146
4.1. Reaction Equilibria	146
4.2. Solubility Equilibria	147
4.3. Ionic Strength and Activity	148
4.4. Ionic Strength Example	149
4.5. Common Ion Effect	150
4.6. Common Ion Effect Example	150
4.7. Soluble Complex Formation	151
4.8. pH Effect	152
4.9. Solubility Diagrams	152
5. Chemical Precipitation Kinetics	152
5.1. Nucleation	153
5.2. Crystal Growth	153
5.3. Aging	154
5.4. Adsorption and Coprecipitation	154
6. Design Considerations	155
6.1. General	155
6.2. Chemical Handling	155
6.3. Mixing, Flocculation, and Contact Equipment	156
6.4. Solids Separation	157
6.5. Design Criteria Summary	157
7. Process Applications	158
7.1. Hydroxide Precipitation	158
7.2. Carbonate Precipitation	159
7.3. Sulfide Precipitation	160
7.4. Cyanide Precipitation	161
7.5. Magnesium Oxide Precipitation	162

7.6. Chemical Oxidation–Reduction Precipitation	162
7.7. Lime/Soda-Ash Softening	162
7.8. Phosphorus Precipitation	162
7.9. Other Chemical Precipitation Processes	163
8. Process Evaluation	163
8.1. Advantages and Limitations	163
8.2. Reliability	164
8.3. Chemicals Required	165
8.4. Residuals Generated	165
8.5. Process Performance	165
9. Application Examples	165
Nomenclature	169
References	170
Appendices	174
6 Recarbonation and Softening	
<i>Lawrence K. Wang, Jy S. Wu, Nazih K. Shammam,</i>	
<i>and David A. Vaccari</i>.....	199
1. Introduction	199
2. Process Description	199
3. Softening and Recarbonation Process Chemistry	201
4. Lime/Soda Ash Softening Process	203
5. Water Stabilization	205
6. Other Related Process Applications	206
6.1. Chemical Coagulation Using Magnesium Carbonate as a Coagulant	206
6.2. Recovery of Magnesium as Magnesium Carbonate	207
6.3. Recovery of Calcium Carbonate as Lime	207
6.4. Recarbonation of Chemically Treated Wastewaters	208
7. Process Design	208
7.1. Sources of Carbon Dioxide	208
7.2. Distribution Systems	210
7.3. Carbon Dioxide Quantities	212
7.4. Step-by-Step Design Approach	212
8. Design and Application Examples	215
Nomenclature	226
Acknowledgments	227
References	227
7 Chemical Oxidation	
<i>Nazih K. Shammam, John Y. Yang, Pao-Chiang Yuan,</i>	
<i>and Yung-Tse Hung</i>.....	229
1. Introduction	229
1.1. Dissolved Oxygen and Concept of Oxidation	230
1.2. The Definition of Oxidation State	231
2. Theory and Principles	233
2.1. Stoichiometry of Oxidation–Reduction Processes	234
2.2. Thermodynamics of Chemical Oxidation	236
2.3. Kinetic Aspects of Chemical Oxidation	240
3. Oxygenated Reagent Systems	243
3.1. Aeration in Water Purification and Waste Treatment	243
3.2. Hydrogen Peroxide and Peroxygen Reagents	246
3.3. High-Temperature Wet Oxidation	248
4. Transition-Metal Ion Oxidation Systems	256
4.1. Chromic Acid Oxidation	256
4.2. Permanganate Oxidation	258
5. Recent Developments in Chemical Oxidation	261
5.1. Ozone (O ₃) Processes	261
5.2. Ultraviolet (UV) Processes	262
5.3. Wet Oxidation	263

5.4. Supercritical Water Oxidation	264
5.5. Biological Oxidation	264
6. Examples	264
Nomenclature	268
References	269

8 Halogenation and Disinfection

Lawrence K. Wang, Pao-Chiang Yuan, and Yung-Tse Hung 271

1. Introduction	271
2. Chemistry of Halogenation	274
2.1. Chlorine Hydrolysis	274
2.2. Chlorine Dissociation	275
2.3. Chlorine Reactions with Nitrogenous Matter	275
2.4. Chlorine Reactions with Other Inorganics	279
2.5. Chlorine Dioxide (ClO ₂) Applications	281
2.6. Chlorine Dioxide Generation	281
2.7. Chlorine Dioxide Reaction with Nitrogenous Matter	282
2.8. Chlorine Dioxide Reactions with Phenolic Compounds and Other Substances	283
2.9. Bromine Hydrolysis	283
2.10. Bromine Dissociation	283
2.11. Bromine Reactions with Nitrogenous Matter	284
2.12. Iodine Hydrolysis	284
2.13. Iodine Dissociation	284
2.14. Iodine Reactions with Nitrogenous Matter	285
3. Disinfection with Halogens	285
3.1. Modes and Rate of Killing in Disinfection Process	285
3.2. Disinfection Conditions	286
3.3. Disinfection Control with Biological Tests	287
3.4. Disinfectant Concentration	288
4. Chlorine and Chlorination	288
4.1. Chlorine Compounds and Elemental Chlorine	289
4.2. Chlorine Feeders	290
4.3. Chlorine Handling Equipment	291
4.4. Measurement of Chlorine Residuals	291
4.5. Chlorine Dosages	292
4.6. Chlorination By-Products	293
5. Chlorine Dioxide Disinfection	294
6. Bromine and Bromination	294
7. Iodine and Iodination	295
8. Ozone and Ozonation	295
9. Cost Data	295
10. Recent Developments in Halogenation Technology	296
10.1. Recent Environmental Concerns and Regulations	296
10.2. Chlorine Dioxide	297
10.3. Chloramines	298
10.4. Coagulant	298
10.5. Ozone	299
10.6. Organic Disinfectants	299
10.7. Ultraviolet (UV)	300
11. Disinfection System Design	300
11.1. Design Considerations Summary	300
11.2. Wastewater Disinfection	301
11.3. Potable Water Disinfection	303
12. Design and Application Examples	305
12.1. Example 1 (Wastewater Disinfection)	305
12.2. Example 2 (Potable Water Disinfection)	308
12.3. Example 3 (Glossary of Halogenation, Chlorination, Oxidation, and Disinfection)	308
Nomenclature	311
References	311

9 Ozonation

***Nazih K. Shammas and Lawrence K. Wang*..... 315**

1. Introduction	315
1.1. General	315
1.2. Alternative Disinfectants	316
2. Properties and Chemistry of Ozone	316
2.1. General	316
2.2. Physical Properties	316
2.3. Chemical Properties	317
2.4. Advantages and Disadvantages	319
3. Applications of Ozone	319
3.1. Disinfection Against Pathogens	319
3.2. Zebra Mussel Abatement	320
3.3. Iron and Manganese Removal	320
3.4. Color Removal	320
3.5. Control of Taste and Odor	321
3.6. Elimination of Organic Chemicals	321
3.7. Control of Algae	321
3.8. Aid in Coagulation and Destabilization of Turbidity	321
4. Process and Design Considerations	321
4.1. Oxygen and Ozone	321
4.2. Disinfection of Water by Ozone	322
4.3. Disinfection of Wastewater by Ozone	324
4.4. Disinfection By-Products	333
4.5. Oxygenation by Ozone	334
4.6. Advanced Oxidation Processes	337
5. Ozonation System	340
5.1. Air Preparation	341
5.2. Electrical Power Supply	344
5.3. Ozone Generation	344
5.4. Ozone Contacting	345
5.5. Destruction of Ozone Contactor Exhaust Gas	348
5.6. Monitors and Controllers	349
6. Costs of Ozonation Systems	349
6.1. Equipment Costs	349
6.2. Installation Costs	352
6.3. Housing Costs	353
6.4. Operating and Maintenance Costs	353
7. Safety	353
Nomenclature	354
References	355

10 Electrolysis

***J. Paul Chen, Shoou-Yuh Chang, and Yung-Tse Hung*..... 359**

1. Introduction	359
2. Mechanisms of Electrolysis	362
3. Organic and Suspended Solids Removal	363
3.1. Organic and Suspended Solids Removal by Regular Electrolysis	363
3.2. Organic and Suspended Solids Removal by Electrocoagulation	364
4. Disinfection	366
5. Phosphate Removal	368
6. Ammonium Removal	369
7. Cyanide Destruction	369
8. Metal Removal	370
9. Remediation of Nitroaromatic Explosives-Contaminated Groundwater	372
10. Electrolysis-Stimulated Biological Treatment	374
10.1. Nitrogen Removal	375
10.2. Electrolytic Oxygen Generation	374
References	376

11 Sedimentation

***Nazih K. Shammas, Inder Jit Kumar, Shoou-Yuh Chang,
and Yung-Tse Hung*..... 379**

1. Introduction	379
1.1. Historical	379
1.2. Definition and Objective of Sedimentation	380
1.3. Significance of Sedimentation in Water and Wastewater Treatment	380
2. Types of Clarification	380
3. Theory of Sedimentation	381
3.1. Class 1 Clarification	382
3.2. Class 2 Clarification	386
3.3. Zone Settling	387
3.4. Compression Settling	390
4. Sedimentation Tanks in Water Treatment	390
4.1. General Consideration	390
4.2. Inlet and Outlet Control	391
4.3. Tank Geometry	392
4.4. Short Circuiting	392
4.5. Detention Time	392
4.6. Tank Design	393
5. Sedimentation Tanks in Wastewater Treatment	394
5.1. General Consideration and Basis of Design	394
5.2. Regulatory Standards	395
5.3. Tank Types	395
6. Grit Chamber	398
6.1. General	398
6.2. Types of Grit Chambers	399
6.3. Velocity Control Devices	400
6.4. Design of Grit Chamber	402
7. Gravity Thickening in Sludge Treatment	403
7.1. Design of Sludge Thickeners	405
8. Recent Developments	406
8.1. Theory of Shallow Depth Settling	407
8.2. Tube Settlers	409
8.3. Lamella Separator	410
8.4. Other Improvements	411
9. Sedimentation in Air Streams	412
9.1. General	412
9.2. Gravity Settlers	413
10. Costs	414
10.1. General	414
10.2. Sedimentation Tanks	414
10.3. Gravity Thickeners	416
10.4. Tube Settlers	416
11. Design Examples	418
Nomenclature	426
References	427
Appendix: US Yearly Average Cost Index for Utilities	429

12 Dissolved Air Flotation

***Lawrence K. Wang, Edward M. Fahey, and Zucheng Wu* 431**

1. Introduction	431
1.1. Adsorptive Bubble Separation Processes	431
1.2. Content and Objectives	434
2. Historical Development of Clarification Processes	435
2.1. Conventional Sedimentation Clarifiers	435
2.2. Innovative Flotation Clarifiers	437
3. Dissolved Air Flotation Process	440
3.1. Process Description	440

3.2. Process Configurations	441
3.3. Factors Affecting Dissolved Air Flotation	443
4. Dissolved Air Flotation Theory	444
4.1. Gas-to-Solids Ratio of Full Flow Pressurization System	444
4.2. Gas-to-Solids Ratio of Partial Flow Pressurization System	446
4.3. Gas-to-Solids Ratio of Recycle Flow Pressurization	447
4.4. Air Solubility in Water at 1 Atm	448
4.5. Pressure Calculations	449
4.6. Hydraulic Loading Rate	449
4.7. Solids Loading Rate	451
5. Design, Operation, and Performance	453
5.1. Operational Parameters	455
5.2. Performance and Reliability	455
6. Chemical Treatment	455
7. Sampling, Tests, and Monitoring	457
7.1. Sampling	457
7.2. Laboratory and Field Tests	457
8. Procedures and Apparatus for Chemical Coagulation Experiments	457
9. Procedures and Apparatus for Laboratory Dissolved Air Flotation Experiments	459
9.1. Full Flow Pressurization System	459
9.2. Partial Flow Pressurization System	460
9.3. Recycle Flow Pressurization System	461
10. Normal Operating Procedures	462
10.1. Physical Control	462
10.2. Startup	463
10.3. Routine Operations	464
10.4. Shutdown	464
11. Emergency Operating Procedures	464
11.1. Loss of Power	464
11.2. Loss of Other Treatment Units	465
12. Operation and Maintenance	465
12.1. Troubleshooting	465
12.2. Labor Requirements	465
12.3. Construction and O&M Costs	465
12.4. Energy Consumption	465
12.5. Maintenance Considerations	466
12.6. Environmental Impact and Safety Considerations	468
13. Recent Developments in Dissolved Air Flotation Technology	468
13.1. General Recent Developments	468
13.2. Physicochemical SBR-DAF Process for Industrial and Municipal Applications	470
13.3. Adsorption Flotation Processes	471
13.4. Dissolved Gas Flotation	471
13.5. Combined Sedimentation and Flotation	472
14. Application and Design Examples	472
Nomenclature	491
Acknowledgments	492
References	493
13 Gravity Filtration	
<i>J. Paul Chen, Shoou-Yuh Chang, Jerry Y. C. Huang,</i>	
<i>E. Robert Baumann, and Yung-Tse Hung</i>	501
1. Introduction	501
2. Physical Nature of Gravity Filtration	502
2.1. Transport Mechanism	502
2.2. Attachment Mechanisms	504
2.3. Detachment Mechanisms	504
3. Mathematical Models	504
3.1. Idealized Models	505
3.2. Empirical Models	509

4.	Design Considerations of Gravity Filters	510
4.1.	Water Variables	510
4.2.	Filter Physical Variables	511
4.3.	Filter Operating Variables	517
5.	Applications	522
5.1.	Potable Water Filtration	522
5.2.	Reclamation of Wastewater	522
6.	Design Examples	527
	Nomenclature	539
	References	540
14	Polymeric Adsorption and Regenerant Distillation	
	<i>Lawrence K. Wang, Chein-Chi Chang, and Nazih K. Shammass</i>	545
1.	Introduction	545
2.	Polymeric Adsorption Process Description	547
2.1.	Process System	547
2.2.	Process Steps	547
2.3.	Regeneration Issues	547
3.	Polymeric Adsorption Applications and Evaluation	548
3.1.	Applications	548
3.2.	Process Evaluation	550
4.	Polymeric Adsorbents	550
4.1.	Chemical Structure	550
4.2.	Physical Properties	552
4.3.	Adsorption Properties	552
5.	Design Considerations	552
5.1.	Adsorption Bed, Adsorbents, and Regenerants	552
5.2.	Generated Residuals	555
6.	Distillation	557
6.1.	Distillation Process Description	557
6.2.	Distillation Types and Modifications	557
6.3.	Distillation Process Evaluation	560
7.	Design and Application Examples	560
	Acknowledgments	570
	References	571
15	Granular Activated Carbon Adsorption	
	<i>Yung-Tse Hung, Howard H. Lo, Lawrence K. Wang,</i>	
	<i>Jerry R. Taricska, and Kathleen Hung Li</i>	573
1.	Introduction	573
2.	Process Flow Diagrams for GAC Process	576
3.	Adsorption Column Models	577
4.	Design of Granular Activated Carbon Columns	585
4.1.	Design of GAC Columns	585
4.2.	Pilot Plant and Laboratory Column Tests	590
5.	Regeneration	591
6.	Factors Affecting GAC Adsorption	592
6.1.	Adsorbent Characteristics	592
6.2.	Adsorbate Characteristics	592
7.	Performance and Case Studies	593
8.	Economics of Granular Activated Carbon System	595
9.	Design Examples	602
10.	Historical and Recent Developments in Granular Activated Carbon Adsorption	623
10.1.	Adsorption Technology Milestones	623
10.2.	Downflow Conventional Biological GAC Systems	625
10.3.	Upflow Fluidized Bed Biological GAC System	627
	Nomenclature	628
	References	630

16	Physicochemical Treatment Processes for Water Reuse <i>Saravanamuthu Vigneswaran, Huu Hao Ngo, Durgananda Singh Chaudhary, and Yung-Tse Hung</i>	635
	1. Introduction	635
	2. Conventional Physicochemical Treatment Processes	636
	2.1. Principle	636
	2.2. Application of the Physicochemical Processes in Wastewater Treatment and Reuse	651
	3. Membrane Processes	658
	3.1. Principle	658
	3.2. Application of Membrane Processes	661
	References	675
17	Introduction to Sludge Treatment <i>Duu-Jong Lee, Joo-Hwa Tay, Yung-Tse Hung, and Pin Jing He</i>	677
	1. The Origin of Sludge	677
	2. Conditioning Processes	678
	2.1. Coagulation	678
	2.2. Flocculation	681
	2.3. Conditioner Choice	681
	2.4. Optimal Dose	682
	3. Dewatering Processes	684
	3.1. Dewatering Processes	684
	3.2. Sludge Thickening	685
	3.3. Sludge Dewatering	687
	4. Stabilization Processes	691
	4.1. Hydrolysis Processes	691
	4.2. Digestion Processes	695
	5. Thermal Processes	699
	5.1. Sludge Incineration	699
	5.2. Sludge Drying	701
	5.3. Other Thermal Processes	702
	References	703
	Index	705

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