

Contents

1	Introduction.....	1
1.1	Introduction.....	1
	References.....	4
2	Brief Description of the Pulp and Paper Making Process.....	7
2.1	Introduction.....	7
2.2	Pulp and Paper Making Process.....	8
2.2.1	Pulp Making Process.....	8
2.2.2	Stock Preparation and Paper Making Process.....	10
	References.....	13
3	Tree Improvement.....	15
3.1	Introduction.....	15
3.1.1	Forest Trees in the Age of Modern Genetics	16
	References.....	21
4	Biodebarking	23
4.1	Introduction.....	23
4.2	Enzymes Used for Debarking	26
4.3	Application of Enzymes for Debarking	26
4.4	Advantages of Biodebarking.....	29
4.5	Limitations and Future Prospects.....	29
	References.....	30
5	Biodepitching.....	33
5.1	Introduction.....	33
5.2	Environmental Impact of Lipophilic Extractives	34
5.3	Methods for Pitch control	36
5.3.1	Conventional Treatment.....	36
5.3.2	Biological Treatment.....	36
5.4	Advantages, Limitations, and Future Prospects.....	49
	References.....	50

6 Bioretting	57
6.1 Introduction	57
6.2 Methods for Retting	58
6.3 Enzymes Used in Flax-Retting	59
6.4 Application of Enzymes in Flax-Retting	59
6.5 Effect of Enzyme-Retting on Fiber Yield and Properties	64
6.6 Effect of Enzyme-Retting on Effluent Properties	64
References	65
7 Biopulping	67
7.1 Introduction	67
7.2 Pulping Processes	68
7.2.1 Mechanical Pulping	68
7.2.2 Semichemical Pulping	69
7.2.3 Chemical Pulping	70
7.3 Biomechanical Pulping	71
7.4 Biochemical Pulping	79
7.5 Biopulping with Laccase Mediator System	84
7.6 Mechanism of Biopulping	84
7.7 Advantages of Biopulping	86
7.8 Limitations and Future Prospects	87
References	87
8 Biobleaching	93
8.1 Introduction	93
8.2 Xylanase Enzymes	93
8.2.1 Production and Properties of Xylanases	94
8.2.2 Performance of Xylanases in Bleaching	98
8.2.3 Effect of Xylanases on Pulp and Effluent Quality	104
8.2.4 Mechanism of Bleaching	104
8.2.5 Conclusion and Future Prospects	105
8.3 Lignin-Oxidizing Enzymes	106
8.3.1 Performance of Lignin-Oxidizing Enzymes in Bleaching	106
8.3.2 Effect of Lignin-Oxidizing Enzymes on Pulp and Effluent Quality	116
8.3.3 Mechanism of Bleaching	117
8.3.4 Advantages, Limitations, and Future Prospects	121
8.4 White-Rot Fungi	122
8.4.1 Performance of White-Rot Fungi in Bleaching	122
8.4.2 Effect of White-Rot Fungi on Pulp and Effluent Quality	128
8.4.3 Advantages, Limitations, and Future Prospects	128
References	129

9 Biodeinking	139
9.1 Introduction.....	139
9.2 Enzymes Used in Deinking.....	140
9.3 Mechanisms of Enzyme Deinking.....	140
9.4 Application of Enzymes in Deinking.....	141
9.5 Effect of Enzyme on Fiber and Paper Quality.....	152
9.6 Effect of Enzyme on Pulp Yield.....	152
9.7 Effect of Enzyme on Effluent Characteristics.....	153
9.8 Benefits and Limitations.....	154
9.9 Conclusions.....	155
References.....	156
10 Fiber Modification	159
10.1 Introduction.....	159
10.2 Enzymes Promoting Beatability/Refinability.....	160
10.2.1 Enzyme Actions.....	166
10.2.2 Effects of Enzyme.....	167
10.2.3 Potential Benefits of Enzymatic Treatment Before Refining.....	168
10.3 Enzymes Improving Drainage.....	168
10.3.1 Enzyme Action.....	175
10.3.2 Benefits of Improving Drainage.....	176
10.4 Enzymes for Vessel-Picking Problems.....	176
10.5 Conclusions.....	180
References.....	181
11 Removal of Shives	185
11.1 Introduction.....	185
11.2 Application of Enzymes for Shive Removal.....	187
11.3 Mechanism of Shive Removal with Xylanase Enzymes.....	189
11.4 Benefits with Enzymes.....	190
11.5 Conclusions.....	191
References.....	191
12 Production of Dissolving-Grade Pulp	193
12.1 Introduction.....	193
12.2 Enzymes Used in the Production of Dissolving Pulp.....	195
12.3 Application of Enzymes in Production of Dissolving Pulp.....	196
12.4 Conclusions.....	206
References.....	207
13 Biological Treatment of Pulp and Paper Mill Effluents	211
13.1 Introduction.....	211
13.2 Bleaching and Environmental Impact.....	212
13.3 Biotechnological Methods for Treatment of Pulp and Paper Mill Effluents.....	216
13.3.1 Enzymatic Treatment.....	216
13.3.2 Bacterial Treatment.....	219

13.3.3	Fungal Treatment	234
13.3.4	Ligninolytic Enzymes and Their Role in Decolorization of Bleaching Effluents.....	250
13.4	Conclusions and Future Perspectives.....	251
	References.....	252
14	Slime Control.....	263
14.1	Introduction.....	263
14.2	Slime Problems in the Mills.....	264
14.3	Microorganisms Within the Slime and Contamination Sources	268
14.4	Sites Chosen by the Microorganisms in the Paper Mill.....	272
14.4.1	Formation of Slime	273
14.4.2	Blocking of the Felts	273
14.4.3	Degradation of the Felt	273
14.4.4	Fermentation of Rosins	274
14.4.5	Stains in the Pulp	274
14.4.6	Cellulolytic Action.....	274
14.4.7	Mold.....	275
14.4.8	Musty Odors.....	275
14.5	Methods for Detection of Slime.....	275
14.5.1	Slime Collection Boards	275
14.5.2	Identification of the Contaminated Points.....	276
14.5.3	Standard Plate Count Method	276
14.5.4	Dip Sticks.....	276
14.5.5	Luminescence	276
14.5.6	Bio-Lert Method	277
14.5.7	Slime Monitor	278
14.6	Biofilm Formation in Paper Systems	278
14.7	Control of Slime.....	281
14.7.1	Traditional Methods	281
14.7.2	Use of Enzymes for Control of Slime.....	288
14.7.3	Biological Equilibrium.....	291
14.7.4	Biodispersants	292
14.7.5	Use of Competing Microorganisms	295
14.7.6	Biofilm Inhibitors.....	296
14.7.7	Use of Bacteriophages	296
	References.....	298
15	Stickies Control	307
15.1	Introduction.....	307
15.2	Problems Caused by Stickies	308
15.3	Control of Stickies	309
15.3.1	Enzyme Approach.....	309
15.4	Conclusion	314
	References.....	314

16 Enzymatic Modification of Starch for Surface Sizing	317
16.1 Introduction.....	317
16.2 Enzymes Used for Starch Conversion.....	318
16.3 Starches Used for Surface Sizing.....	319
16.4 Process for Enzymatic Modification of Starch	321
16.5 Benefits and Limitations of Enzymatically Modified Starches	324
References.....	325
17 Biofiltration of Odorous Gases	327
17.1 Introduction.....	327
17.2 Emissions from Pulping.....	328
17.2.1 Kraft Pulping.....	328
17.2.2 Emissions from Neutral Sulfite Semichemical (NSSC) Pulping	330
17.2.3 Emissions from Sulfite Pulping	330
17.3 Methods for the Elimination of Odorous Compounds.....	331
17.3.1 Biofiltration Technology	331
17.3.2 Microorganisms in Biofilter	333
17.3.3 Packing Materials for Biofilters	335
17.3.4 Mechanisms in Biofilter Operation.....	336
17.3.5 Development of Biofiltration Technology	337
17.3.6 Present Status	341
17.3.7 Parameters Affecting the Performance of Biofilter.....	342
17.3.8 Advantages, Limitations and Future Prospects.....	344
References.....	346
18 Management/Utilization of Wastewater Treatment Sludges.....	349
18.1 Introduction.....	349
18.2 Dewatering of Sludge.....	350
18.3 Methods of Disposal	355
18.3.1 Landfill Application	355
18.3.2 Incineration	358
18.3.3 Land Application (Composting)	360
18.3.4 Recovery of Raw Materials.....	363
18.3.5 Production of Ethanol and Animal Feed.....	364
18.3.6 Pelletization of Sludge	365
18.3.7 Manufacture of Building and Ceramic Materials and Lightweight Aggregate.....	366
18.3.8 Landfill Cover Barrier	367
18.3.9 Other Uses.....	368
References.....	370

19 Integrated Forest Biorefinery.....	375
19.1 Introduction.....	375
19.2 Forest Biorefinery Options.....	377
19.2.1 Hemicellulose Extraction Prior to Pulping	379
19.2.2 Black Liquor Gasification	384
19.2.3 Removal of Lignin from Black Liquor	392
19.2.4 Other Products (Tall Oil, Methanol, etc.).....	396
19.3 Environmental Impacts of Forest Biorefineries	397
References.....	397
Index.....	403



<http://www.springer.com/978-1-4614-1408-7>

Biotechnology for Pulp and Paper Processing

Bajpai, P.

2012, XXII, 414 p., Hardcover

ISBN: 978-1-4614-1408-7