

ADHESIVE TECHNOLOGY

AND FORMULATIONS HAND BOOK
(HAND BOOK OF ADHESIVES)





ADHESIVE TECHNOLOGY

AND FORMULATIONS HAND BOOK
(HAND BOOK OF ADHESIVES)

Written By :
EIRI Consultants and Engineers

© Copy Reserved by Sudhir Gupta, Delhi

ISBN : 978-81-86732-80-9



ENGINEERS INDIA RESEARCH INSTITUTE

4449, Nai Sarak, Main Road, Delhi-110 006 (India)

E-Mail : eiritechnology@gmail.com

Click Here To Buy This Book Online

Preface

The book **Adhesive Technology and Formulations Hand Book** covers almost all the basic and advanced details to setup own Gums and Adhesive Unit. The new edition of the book is covering latest methods including Introduction, Historical Development of Adhesives and Adhesive Bonding, Types of Adhesives, Emulsion and Dispersion Adhesives, Testing of Adhesives, Protein Adhesives for Wood, Hot Melt Adhesives, Animal Glues and Adhesives, Polyvinyl Acetate/Alcohol Based Adhesives, Ethylene-Vinyl Acetate Copolymers, Polyvinyl Acetal Adhesives, Silicone Adhesives, Epoxide Adhesives, Polyester Adhesives, Furane Adhesives, Phenolic Resin Adhesives, Cellulose Derivative Adhesives, Epoxy Polyurethane Adhesives, Polyisocyanate/Polyurethane Adhesive, Amino (Urea & Melamine) Formaldehyde Adhesives, Paper, Board & Packaging Adhesives, Remoistenable Adhesives, Gum Arabic etc. Adhesives, Footwear Applications of Adhesives, High-Temperature Adhesives, Dispensing of Adhesives, Natural Rubber-Based Adhesives, Polysulfied Sealants and Adhesives, Phenolic Resin Adhesives, Urea-Formaldehyde Adhesives, Melamine-Formaldehyde Adhesives, Polyurethane Adhesives, Unsaturated Polyester Adhesives, Reactive Acrylic Adhesives, Technology of Cyanoacrylate Adhesives for Industrial Assembly, Silicone Adhesives and Sealants, Epoxy Resin Adhesives, Pressure-Sensitive Adhesives, Adhesives in the Automotive Industry, Adhesive Based on Vinyl Acetate, Printing Gums (Guar Gum Based), Leather Based Adhesive, Latex Rubber Based Adhesive, Office Paste, Starch and Dextrin Based Adhesive, Adhesive for Corrugation Dry Powder and Paste, Adhesive (Different Type), Adhesive Industries (Laminated, Fevicol, Sticker DDL and Other Types of Adhesive), Rubber Adhesive, Adhesive (Polyvinyl Butyral Based), Self Adhesive Labels, Ester Gums (Food Grade), Vulcanizing Rubber Solution/Cement for Automobile Tyres, Industrial Adhesive Based on Starch Gum, Dextrin Silicate, Suppliers of Plant & Machineries and Suppliers of Raw Materials.

The book has been written for the benefit and to prove an asset and a handy reference guide in the hands of new entrepreneurs and well established industrialists.

Director

ENGINEERS INDIA RESEARCH INSTITUTE

4449, Nai Sarak, Main Road, Delhi - 110 006 (INDIA)

E-Mail : eiritechnology@gmail.com

Website: <http://www.eiriindia.org>

Contents Cum-Subject Index

Chapter - 1	
INTRODUCTION1-5	
– Why adhesive Bonding 1	
– Advantages and Disadvantages of Adhesive Bonding 2	
– Advantages 2	
– Disadvantages 3	
– Ideal Adhesive 3	
– Application area for Adhesive Bonding 4	
Chapter - 2	
HISTORICAL DEVELOPMENT OF ADHESIVES AND ADHESIVE BONDING 6-13	
– Introduction 6	
– Early History of Adhesives and Sealants 6	
– Modern Adhesives and Sealants 9	
Chapter - 3	
TYPES OF ADHESIVES14-19	
– Physical Classification14	
– Chemical Classification15	
– Thermoplastic Adhesives15	
	– Thermosetting Adhesives16
	– Rubber Resin Blends 16
	Chapter - 4
	EMULSION AND DISPERSION ADHESIVES 20-23
	– Type of Emulsion Adhesives 20
	– Setting Mechanism 21
	– Methods of Application 21
	– Advantages and Limitations 22
	– Engineering Advantages 22
	– Engineering Design with Adhesive 23
	Chapter - 5
	TESTING OF ADHESIVES 24-58
	– Introduction 24
	– Standard Tests 24
	– Some Selected Standards 26
	– A Test for Adhesive Joint Strength 27
	– Tensile Tests 27

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> - Shear Tests 30 - Peel Tests 36 - Environmental and Related Considerations 38 - Fracture Mechanics Techniques 47 	<p>Chapter - 7</p> <hr/> <p>HOT MELT ADHESIVES 88-89</p> <hr/> <ul style="list-style-type: none"> - Introduction 88 - Composition 88 - Advantage of Melt Adhesives 88 - Limitations of Melt Adhesives 89 - Application Methods 89 - Use of Melt Adhesives 89
<p>Chapter - 6</p> <hr/> <p>PROTEIN ADHESIVES FOR WOOD 59-87</p> <hr/> <ul style="list-style-type: none"> - Introduction 59 - Soybean Adhesives 61 - Raw Material Source and Preparation 61 - Formulation 62 - Mixing, Application, and Pressing 65 - Blended Formulations 68 - Soybean-Blood Glues 68 - Soybean-Casein Glues 71 - Blood Glues 72 - Raw Material Source and Preparation 72 - Formulation 74 - Mixing, Application, and Pressing 78 - Casein Glues 79 - Raw Material Sources and Preparation 79 - Formulation 80 - Mixing, Application, and Pressing 84 - Other Proteins 86 	<p>Chapter - 8</p> <hr/> <p>ANIMAL GLUES AND ADHESIVES 90-112</p> <hr/> <ul style="list-style-type: none"> - Introduction 90 - Chemical Composition 91 - Types of Animal Glue 93 - Manufacture of Animal Glue 94 - Properties of Animal Glues 95 - Grades And Testing 97 - Preparation of Animal Glues 98 - Flexible and Nonwarp Glues 99 - Liquid Animal Glues 100 - Glue Application 100 - End Uses 102 - Bookbinding 102 - Paper 104 - Paper Converting 105 - Abrasives 106

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> – Woodworking 107 – Matches 108 – Ore and Metal Refining 109 – Gummed Tape 109 – Miscellaneous Applications 110 – Textiles 110 – Rubber Compounding 110 – Luggage and Case Covering 110 – Gaskets 111 – Glass Chipping 111 – Other Applications 111 	Chapter - 11
Chapter - 9	<p>POLYVINYL ACETAL ADHESIVES122-128</p> <ul style="list-style-type: none"> – Properties 122 – Uses 122 – Plasticizers and Solvents 122 – Polyvinyl Butyral Adhesives 123 – Phenolic-Vinyl Butyral Adhesives 123 – Formulations 124 – Laminated Safety Glass 127 – Polyvinyl Formal Adhesives 127 – Polyvinyl Formal Phenolic Adhesives 127 – Formulation 128
<p>POLYVINYL ACETATE/ALCOHOL BASED ADHESIVES113-119</p> <ul style="list-style-type: none"> – Polyvinyl Acetate Adhesives 113 – Properties 114 – Applications 114 – Formulations 115 – Fevicol-Type Adhesive 115 – Polyvinyl (Alcohol) 117 – Properties 118 – Applications 118 – Formulations 119 	Chapter - 12
Chapter - 10	<p>SILICONE ADHESIVES129-132</p> <ul style="list-style-type: none"> – Silicone Resins 129 – Silicone Rubbers 130 – Epoxy Silicones 131
<p>ETHYLENE-VINYL ACETATE COPOLYMERS 120-121</p> <ul style="list-style-type: none"> – Properties 121 	Chapter - 13
<ul style="list-style-type: none"> – Properties 121 	<p>EPOXIDE ADHESIVES133-136</p> <ul style="list-style-type: none"> – A Mine Hardeners 134

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> - Acid-Anhydride Hardeners 135 - Other Hardeners 135 <p style="text-align: center;">Chapter - 14</p>	<ul style="list-style-type: none"> - Resorcinol Formaldehyde Adhesives 145 - Properties 146 - Applications 147 <p style="text-align: center;">Chapter - 17</p>
<p>POLYESTER ADHESIVES137-139</p> <ul style="list-style-type: none"> - Unsaturated Polyester Adhesives 137 - Properties138 - Applications138 <p style="text-align: center;">Chapter - 15</p>	<p>CELLULOSE DERIVATIVE ADHESIVES148-153</p> <ul style="list-style-type: none"> - Cellulose Ester Adhesives 149 - Cellulose Nitrate Adhesives 149 - Applications 150 - Cellulose Caprate Adhesives 150 - Cellulose Acetate-Butyrate Adhesives 150 - Cellulose Ether Adhesives 151 - Methyl Cellulose Adhesives 151 - Ethyl Cellulose Adhesive 151 - Other Cellulose Ether Adhesives152 - Fabric Lining Composition153 <p style="text-align: center;">Chapter - 18</p>
<p>FURANE ADHESIVES140-141</p> <ul style="list-style-type: none"> - Properties 140 - Applications 140 <p style="text-align: center;">Chapter - 16</p>	<p>EPOXY POLYURETHANE ADHESIVES154-155</p> <ul style="list-style-type: none"> - Epoxy-Phenolic Adhesives 154
<p>PHENOLIC RESIN ADHESIVES142-147</p> <ul style="list-style-type: none"> - Phenol-Formaldehyde Resin Adhesives142 - Properties 142 - Applications 143 - Dry Glue Film 143 - Phenolic Baking Cement 144 - Phenolic Resin Putty144 - Phenolic Resin Rubber Cement 144 	

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> – One Component Adhesives 154 – High Temperature Adhesives 155 	Chapter - 21
Chapter - 19	<hr/> PAPER, BOARD & PACKAGING ADHESIVES 164-177
<hr/> POLYISOCYANATE/ POLYURETHANE ADHESIVE 156-159	<ul style="list-style-type: none"> – Selection of Adhesives 164 – Laminated Papers166 – Corrugated Board 168 – Book Binding Adhesives 169 – Paper Impregnate 171 – Paper Bag and Cartons 172 – Multiwall Bag seam Past-Water Resistant173 – Carton Sealing 173 – Envelopes 174 – Self-Sealing Envelopes- Adhesives 175 – Stamps 176 – Labels 176
<ul style="list-style-type: none"> – Effectiveness of Polyisocyanate Adhesives 156 – Isocyanate Adhesives 157 – Isocyanate-modified Adhesives 157 – Polyurethane Adhesives158 	Chapter - 22
Chapter - 20	<hr/> REMOISTENABLE ADHESIVES 178-182
<hr/> AMINO (UREA & MELAMINE) FORMALDEHYDE ADHESIVES160-163	<ul style="list-style-type: none"> – Formulation 178 – Stamps 179 – Labels179 – Decalcoaminals 180 – Tapes 181
<ul style="list-style-type: none"> – Urea-Formaldehyda Adhesives 160 – Properties 160 – Applications 161 – Melamine Formaldehyde Adhesives 161 – Properties 162 – Applications 162 	

<i>Chapter Name</i>	<i>Page No.</i>
Chapter - 23	Chapter - 26
GUM ARABIC ETC. ADHESIVES183-184	DISPENSING OF ADHESIVES 193-197
Chapter - 24	<ul style="list-style-type: none"> – Basic Dispensing Principles 193 – Pressure Time Controlled System 194 – Static Pinch Valve 194 – Pressure Time Using Advancing Valve 195 – Pressure Time Using a Rotospray Unit 195 – Cartridge/Syringe Dispensers 195 – Screen Printing of Adhesives 196
FOOTWEAR APPLICATIONS OF ADHESIVES185-189	Chapter - 27
<ul style="list-style-type: none"> – Adhesives for Sole Attaching 186 – Process Requirements 186 – Development of Adhesive and Primers 187 – Solvent Hazards 187 – Adhesive for Ancillary Operations 188 – Topline Folding 188 – Linings 188 – Toe Puff and Heel Stiffener 189 – Lasting 189 – Shank 189 – Heel Covering 189 	NATURAL RUBBER– BASED ADHESIVES198-202
Chapter - 25	<ul style="list-style-type: none"> – Introduction 198 – Latex Adhesives 198 – Solution Adhesives 200 – Pressure-Sensitive Adhesive Tapes 201
HIGH-TEMPERATURE ADHESIVES 190-192	Chapter - 28
<ul style="list-style-type: none"> – Introduction 190 – Traditional Adhesives Systems 191 – Recent Development 192 	POLYSULFIED SEALANTS AND ADHESIVES 203-214
	<ul style="list-style-type: none"> – Introduction 203 – Chemistry of Polysulfide Polymers 204

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> – Preparation of Conventional Polysulfide Polymers 204 – Modified Polysulfide 205 – Other Mercaptan-Terminated Polymers 206 – Polythioether Polymers 206 – Properties of Polysulfide Polymers 207 – Compounding, Processing, and Manufacture of Polysulfide Sealants 208 – Polysulfide Sealant Characterization and Testing 211 – Polysulfide/Epoxy Adhesives 212 – Adhesion Considerations 213 	<ul style="list-style-type: none"> – Chemistry and Technology of Application of Phenolic Resin Adhesives for Wood 223 – General Principles of Manufacture 223 – Curing Acceleration Under Alkaline Conditions 225 – Physical Properties of Phenol-Formaldehyde Resins 226 – Applications 228 – PF Wood Binders 228 – Properties of Phenolic Adhesives for Plywood 229 – Additives 231 – Formulation of Plywood Glue Mixes 233 – General Observations on Particleboard Manufacture 234 – Dry-Out Resistance 236 – Foundry Sand Binders and Mineral Fiber Binders 237 – Binders from PF Copolymers with Other Resins 237
Chapter - 29	
PHENOLIC RESIN ADHESIVES 215-239	
<ul style="list-style-type: none"> – Introduction 215 – Chemistry 216 – Acid Catalysis 219 – Alkaline Catalysis 220 – Metallic Ion Catalysis and Reaction Orientation 221 	<ul style="list-style-type: none"> – Chemistry and Technology of Application of Phenolic Resin Adhesives for Wood 223 – General Principles of Manufacture 223 – Curing Acceleration Under Alkaline Conditions 225 – Physical Properties of Phenol-Formaldehyde Resins 226 – Applications 228 – PF Wood Binders 228 – Properties of Phenolic Adhesives for Plywood 229 – Additives 231 – Formulation of Plywood Glue Mixes 233 – General Observations on Particleboard Manufacture 234 – Dry-Out Resistance 236 – Foundry Sand Binders and Mineral Fiber Binders 237 – Binders from PF Copolymers with Other Resins 237
	Chapter - 30
	UREA-FORMALDEHYDE ADHESIVES 240-256
<ul style="list-style-type: none"> – Introduction 240 	<ul style="list-style-type: none"> – Introduction 240

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> – Chemistry of UF Resins: Urea-Formaldehyde Condensation 241 – General Principles of Manufacture and Application 244 – Plywood Adhesives 248 – Particleboard Adhesives 250 – UF Adhesives for Low-Formaldehyde-Emission Particleboard 251 – Other UF Adhesives Applications 254 – Analysis 255 – Formulation 255 	<p style="text-align: center;">Chapter - 32</p> <hr/> <p>POLYURETHANE ADHESIVES 271-301</p> <hr/> <ul style="list-style-type: none"> – Introduction 271 – Applications Overview 274 – Basic Urethane Chemistry 275 – Branching Reactions 277 – Catalysts 279 – Urethane Polymer Morphology 281 – Prepolymer Formation 283 – Adhesive Raw Materials 284 – Isocyanates for Adhesive Applications 288 – Toxicology 293 – Fillers and Additives 294 – Surface Preparation and Primers 294 – Common Adhesive Types 295 – One-Component Adhesives 295 – Two-Component Adhesives 297 – Recent Developments 299 – Hybrid Adhesives 299 – Reactive Hot Melts 300 – Pressure-Sensitive Adhesives 301
Chapter - 31	
<p>MELAMINE-FORMALDEHYDE ADHESIVES 257-270</p>	
<ul style="list-style-type: none"> – Introduction 257 – Uses for MF Resins 257 – Chemistry 258 – Condensation Reactions 258 – Mechanisms and Kinetics 261 – Mixed Melamine Resins 263 – Resin Preparation Glue Mixing And Hardening 264 – Chemical and Physical Analysis 268 – Formulations 270 	

<i>Chapter Name</i>	<i>Page No.</i>
Chapter - 33	
UNSATURATED POLYESTER ADHESIVES	302-310
– Introduction	302
– Synthesis	302
– Reaction Between Dicarboxylic Acids or Anhydrides and Diols	302
– Kinetics and Mechanisms	303
– Side Reactions	305
– Catalysts	306
– Resin Reactivity	306
– Cross-Linking Mechanism	307
– Structure-Properties Relationships	308
– Glass-Fiber Lamination	309
Chapter - 34	
REACTIVE ACRYLIC ADHESIVES	311-318
– Introduction	311
– Chemical Reactions in Acrylic Adhesives	311
– Handling of Acrylic Adhesives: Do's and Don'ts With Acrylics	314
– Bond Strengths Available With Acrylic Adhesives	315
– Typical Formulations	317
– HP Acrylic Adhesive	317
– Typical Formulation	317
– Heat-Resistant Epoxy Acrylic Hybrid	317
– U.S Patents	318
– Substrates	318
Chapter - 35	
TECHNOLOGY OF CYANOACRYLATE ADHESIVES FOR INDUSTRIAL ASSEMBLY	319-332
– Introduction	319
– Chemistry of The System	319
– Hot Strength	325
– Speed of Cure	327
– Activators	329
– Improved Commercial Cyanoacrylate Compounds	327
– New Flexible Cyanoacrylates	327
– New Cure-Through-Gap Cyanoacrylates	328
– New Ultrafast-Cure Surface-Insensitive Cyanoacrylates	328
– New Low-Odor Cyanoacrylates	329
– Significant Cyanoacrylate Characteristics	329
– Polypropylene and Polyethylene Bonding	329
– Medical-Grade Materials	329
– Thermal Conductivity	329

<i>Chapter Name</i>	<i>Page No.</i>
– Durability 329	– Plasticizers 355
– Chlorosis 330	– Fillers 356
Chapter - 36	– Solvents 357
SILICONE ADHESIVES AND SEALANTS 333-344	– Additives 358
– Introduction 333	– Elastomers 358
– Cure Chemistry 336	– Applications 359
– Processing Consideration 339	– Building and Construction..... 359
– Property Determinations 339	– Metal Bonding 360
– Basic Formulations 342	– Road Making 361
– High-Modulus Oxime Sealant 342	– Wood Bonding 361
– Medium Modulus Oxime Sealant 343	– Engineering Applications 361
– Substrate Bonding 343	– Electrical Applications 362
Chapter - 37	– Film Adhesives 362
EPOXY RESIN ADHESIVES 345-365	– Miscellaneous Applications 362
– Introduction 345	– Guide Formulations 363
– Chemistry of Epoxy Resins 346	– Water-Based Epoxy Primer 364
– Properties of Epoxies 349	– Epoxy Adhesive for Bonding New Concrete to Old 364
– Resins 349	– Metal-to-Metal Adhesives 364
– Hardeners 349	– Grouting Adhesive 365
– Mixed Product 350	– Cable Jointing Epoxy 365
– Formulating Epoxy Adhesives 351	– Film Adhesives for Preimpregnation 365
– Resins 351	– Fast-Setting Retail Epoxy Liquid 365
– Curing Agents 352	
– Reactive Diluents 355	

<i>Chapter Name</i>	<i>Page No.</i>
Chapter - 38	
PRESSURE-SENSITIVE ADHESIVES366-387	
– Introduction 366	
– Product Types 367	
– Solvent-Based Adhesives368	– Adhesive Applications in The Automotive Industry 388
– Hot-Melt Adhesives 368	– Adhesives for Mechanical Applications 390
– Water-Based Adhesives 370	– Adhesive Applications in the Body Shop393
– Formulating 371	– Adhesives and Sealants in the Paint Shop399
– Applications 376	– Adhesive and Sealant Applications in the Assembly Shop 399
– Tapes 376	– Adhesive Applications in Component Manufacturing 401
– Labels 379	– Some Considerations Regarding Trends in Automotive Adhesive Bonding 406
– Other Applications 380	
– Coating Methods 381	Chapter - 40
– Testing 382	
– Tack 382	ADHESIVE BASED ON VINYL ACETATE 409-410
– Peel 383	– Plant & Machinery 409
– Shear Strength 383	– Fixed Capital 409
– Guide Formulations 384	– Raw Materials 410
– Solvent-Based Adhesives385	– Total Working Capital/Month 410
– Hot-Melt Adhesives 386	– Total Capital Investment410
– Water-Based Adhesives 386	– Turn Over/Annum 410
Chapter - 39	Chapter - 41
ADHESIVES IN THE AUTOMOTIVE INDUSTRY 388-408	PRINTING GUMS (GUAR GUM BASED) 411-412
– Introduction 388	– Plant & Machinery 411

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> - Fixed Capital 411 - Raw Materials 412 - Total Working Capital/Annum 412 - Total Capital Investment 412 - Turn Over/Annum 412 <p style="text-align: center;">Chapter - 42</p> <p>LEATHER BASED ADHESIVE 413-414</p> <ul style="list-style-type: none"> - Plant & Machinery 413 - Fixed Capital 413 - Raw Materials 413 - Total Working Capital/Annum 414 - Total Capital Investment 414 - Turn Over/Annum 414 <p style="text-align: center;">Chapter - 43</p> <p>LATEX RUBBER BASED ADHESIVE 415-417</p> <ul style="list-style-type: none"> - Plant & Machinery 415 - Fixed Capital 416 - Raw Materials 416 - Total Working Capital/Annum 416 - Total Capital Investment 416 - Turn Over/Annum 417 	<p>Chapter - 44</p> <hr/> <p>OFFICE PASTE 418-419</p> <ul style="list-style-type: none"> - Plant & Machinery 418 - Fixed Capital 418 - Raw Materials 419 - Total Working Capital/Month 419 - Total Capital Investment 419 - Turn Over/Annum 419 <p>Chapter - 45</p> <hr/> <p>STARCH AND DEXTRIN BASED ADHESIVE 420-421</p> <ul style="list-style-type: none"> - Plant & Machinery 420 - Fixed Capital 420 - Raw Materials 421 - Total Working Capital/Month 421 - Total Capital Investment 421 - Turn Over/Annum 421 <p>Chapter - 46</p> <hr/> <p>ADHESIVE FOR CORRUGATION DRY POWDER AND PASTE 422-423</p> <ul style="list-style-type: none"> - Plant & Machinery 422 - Fixed Capital 422 - Raw Materials 423

<i>Chapter Name</i>	<i>Page No.</i>
<ul style="list-style-type: none"> - Total Working Capital/Month 423 - Total Capital Investment 423 - Turn Over/Annum 423 <p style="text-align: center;">Chapter - 47</p> <hr/> <p>ADHESIVE (DIFFERENT TYPE) 424-425</p> <ul style="list-style-type: none"> - Plant & Machinery 424 - Fixed Capital 424 - Raw Materials 425 - Total Working Capital/Month 425 - Total Capital Investment 425 - Turn Over/Annum 425 <p style="text-align: center;">Chapter - 48</p> <hr/> <p>ADHESIVE INDUSTRIES (LAMINATED, FEVICOL, STICKER DDL AND OTHER TYPES OF ADHESIVE) 426-428</p> <ul style="list-style-type: none"> - Plant & Machinery 426 - Fixed Capital 427 - Raw Materials 427 - Total Working Capital/Month 427 - Total Capital Investment 428 - Turn Over/Annum 428 	<p style="text-align: center;">Chapter - 49</p> <hr/> <p>RUBBER ADHESIVE 429-430</p> <ul style="list-style-type: none"> - Plant & Machinery 429 - Fixed Capital 429 - Raw Materials 430 - Total Working Capital/Month 430 - Total Capital Investment 430 - Turn Over/Annum 430 <p style="text-align: center;">Chapter - 50</p> <hr/> <p>ADHESIVE (POLYVINYL BUTYRAL BASED) 431-432</p> <ul style="list-style-type: none"> - Plant & Machinery 431 - Fixed Capital 431 - Raw Materials 432 - Total Working Capital/Month 432 - Total Capital Investment 432 - Turn Over/Annum 432 <p style="text-align: center;">Chapter - 51</p> <hr/> <p>SELF ADHESIVE LABELS 433-434</p> <ul style="list-style-type: none"> - Plant & Machinery 433 - Fixed Capital 433 - Raw Materials 434 - Total Working Capital/Month 434 - Total Capital Investment 434 - Turn Over/Annum 434

<i>Chapter Name</i>	<i>Page No.</i>
Chapter - 52	
ESTER GUMS (FOOD GRADE) 435-436	
– Plant & Machinery 435	– Raw Materials 440
– Fixed Capital 435	– Total Working Capital/Month 441
– Raw Materials 436	– Total Capital Investment 441
– Total Working Capital/Month 436	– Turn Over/Annum 441
– Total Capital Investment 436	Chapter - 55
– Turn Over/Annum 436	SUPPLIERS OF PLANT AND MACHINERIES 442-452
Chapter - 53	– Adhesive Tape Machinery 442
VULCANIZING RUBBER SOLUTION/CEMENT FOR AUTOMOBILE TYRES 437-439	– Chemical Plant Machinery 443
– Plant & Machinery 437	– Storage Tanks 444
– Fixed Capital 437	– Boilers : Industrial 446
– Raw Materials 438	– Evaporators 447
– Total Working Capital/Month 438	– Stirrers : Chemical 448
– Total Capital Investment 438	– Adhesive Applying Machinery 448
– Turn Over/Annum 439	– Adhesion Tester 449
Chapter - 54	– Adhesive Mixer 449
INDUSTRIAL ADHESIVE BASED ON STARCH GUM, DEXTRINE SILICATE 440-441	– Adhesives Dispensers 450
– Plant & Machinery 440	– Adhesive Pumps 450
– Fixed Capital 440	– Gumming Machinery 451
	– Coating Machinery 451
	– Label Printing Applying Machinery 452
	Chapter - 56
	SUPPLIERS OF RAW MATERIALS 453-472
	– Sodium Hydroxide 453

Click Here To Buy This Book Online

<i>Chapter Name</i>	<i>Page No.</i>
– Borax	453
– Urea-Formaldehyde Resins	454
– Dextrin	454
– Glycerin	455
– Neoprene Rubber	455
– Toluene	456
– Methylmethacrylate	456
– Zinc Oxide	456
– Calcium Carbonate	457
– Antioxidants	457
– Phenolic Resins	458
– Magnesium Oxide	458
– Hexane	458
– Fillers Chemical	459
– Rosin	459
– Thickeners	459
– Gelatine	459
– Starches	460
– Casein	460
– Acrylic Acid	461
– Ethylene Oxide	461
– Plasticisers	462
– Defoaming Agents	462
– Caustic Soda	462
– Pigment Dispersions	463
– Boric Acid	463
– Formaldehyde	463
– Hardeners : Epoxy Resin	464
– Phosphoric Acid	464
– Ethyl Acetate	464
– Ammonium Chloride	465
– Sulphur	465
– Butyl Acetate	465
– Nitrile Rubber	465
– Epoxy Resins	466
– Sulphur Dioxide	466
– Fumed silica	466
– Carbon Black	466
– Shellac	466
– Titanium Dioxide	466
– Alumina	466
– Iron Oxide	466
– Calcium Oxide	467
– Wax	468
– Silica	468
– Stearic Acid	468
– Maleic Anhydride	468
– Polybutene Resins	469
– White Oil	469
– Talc	469
– Clay	469
– Surfactants	469
– Bentonite	470
– Gypsum	470
– Cyclohexanol	470
– Aromatic Oil	470
– Isoprene	471
– Resorcinol	471
– Zinc Dust	471
– Xylenes	471
– Wood Rosin	471
– Copper Sulphate	471
– Hydrated Lime	472
– Zinc Chloride	472
– Hydrochloric Acid	472
– Sodium Bicarbonate	472