

## CONTENTS

### Part - I Extender & Pigment

<i>Chapter</i>	<i>Page</i>
Extender	13
Attributes of Extender Pigments	13
Properties of Extender Pigments	16
Aluminum Oxide	16
Ash Fly	17
Attapulgite	18
Barium Sulfate	19
Barium Titanate	19
Bentonite	20
Boron Nitride	21
Calcium Carbonate	21
Calcium Hydroxide	22
Calcium Sulfate	23
Diatomaceous Earth	24
Dolomite	25
Kaolin	25
Magnesium Hydroxide	26
Mica	27
Perlite	28
Pumice	29
Pyrophyllite	30
Fumed Silica	30
Fused Silica	31
Precipitated Silica	32
Nanosilica	33
Quartz (Tripoli)	34
Slate Flour	34
Talc	35
Wollastonite	36
Other Fibers	37
Ceramic Beads	37
Cristobalite	38
Cenosphere	39
Lithopone	40
Polymeric Synthetic Expanders	41

Extender	42
The average particle size of different Extender	43
Crystal Structure and Cleavage Pattern of Selected Mineral Extender	44
Specific surface area of some Extender	45
Pore volume and size of some Extender	46
pH of Extender slurry	47
Moisture in Extender	47
Refractive indices of Extender	48
Hardness of Extender	49
Pigment	53
White Lead	53
Titanium Dioxide	54
Zinc Oxide	55
Zinc Sulphide	57
Lithopone	57
Antimony Oxide	58
Carbon Black	59
Graphite	60
Black Iron Oxide	61
Black Micaceous Iron Oxide	61
Aniline Black	62
Anthraquinone Black	63
Iron Oxide brown	63
Iron Oxide Red Synthetic	64
Metal complex brown	64
Yellow Pigments	65
Lead Chromate	65
Cadmium yellow	66
Yellow oxides	67
Bismuth Vanadate	68
Hansa Yellow and Orange Pigments	69
Orthonitraniline and Dinitraniline Oranges	71
Toluidine Para and Chloronitraniline Reds.	72
Arylamide Yellows.	73
Diarylide Yellow	74
Benzimidazolone	76
Disazo condensation	78
Organic metal complexes	78
Isoindolinone	79

Isoindoline	79
Anthrapyrimidine	79
Quinophthalone	80
Flavanthrone	80
Pyrazolone orange	81
Perinone orange	82
Lead chromate	83
Lead molybdate	84
Cadmium red	85
Red iron oxide	85
Beta-naphthol	86
BON arylamides	87
Toners	87
Benzimidazolone	88
Disazo condensation pigments	88
Quinacridone	88
Perylene	89
Anthraquinone	90
Dibromanthron	90
Diketopyrrolo-pyrrole pigments (DPP)	91
Dioxazine violet	91
Prussian blue	92
Ultramarine	93
Cobalt blue	94
Copper phthalocyanine	94
Indanthron	95
Chrome Green (Brunswick green)	96
Chromium oxide green	96
Hydrated Chromium Oxide	97
Phthalocyanine green	98
Corrosion Inhibitive Pigments	98
Red Lead	99
Basic Lead Silico Chromate	100
Zinc chromate	100
Calcium and Zinc Molybdates	100
Calcium plumbate	101
Zinc Tetroxy Chromate	101
Zinc phosphate	102
Zinc dust	102
Corrosion-Inhibiting Pigments	102

White Pigments	103
Black Pigments	103
Yellow Pigments (Inorganic)	104
Yellow Pigments (Organic)	104
Orange Pigments	105
Inorganic Red Pigment	105
Violet and Blue Pigments	105
Organic Red Pigment	106
Green Pigments	107
Difference between Dyes and Pigments	108
READY RECKONER	110
Selection of Pigments - Paints	110
Inorganic Pigments	110
Organic pigments	111
Industrial Paints	111
Inorganic Pigments	112
Pigments for industrial stoving paints	113
Automotive Paints	113
Requirements of Pigments of Automotive Paints	114
Pigments Selection	114
Emulsion Paints	116
Inorganic Pigments	117
Organic Pigments	117
Powder Coatings	118
Blue Pigments	120
Violet Pigments	122
Orange Pigments	123
Yellow Pigments	124
Red Pigments	126
Precipitated Azo Red Pigments (Lakes)	128
Green Pigments	129
Selection of Pigments - Printing Inks	130
<b>Miracles of nature</b>	136

-----

## Part - II Natural & Synthetic Binders

<i>Chapter</i>	<i>Page</i>
Film-Forming Materials-Natural and Synthetic	145
Oleoresinous Varnishes	147
Index of Oils	148
Amala	149
Argemone oil	149
Bhilawan Nut Shell	149
Cashew Nut Shell	149
Castor	149
Chiku	150
Cocoa	150
Coconut oil	150
Corn	150
Cottonseed	150
Dupa	151
Groundnut	151
Jatropha	151
Jute Seed	151
Kamala	151
Karanja	152
Karela	152
Kokam	152
Kusum	152
Kutaja	152
Linseed	153
Mahua	153
Mango	153
Maroti	153
Mustered	153
Nahor	154
Neem Oil	154
Oiticika	154
Olive	154
Palash	154
Palm	155
Perila	155
Pilu oil	155
Pisa oil	155
Poppy	155
Rapesseed	156
Rayana	156

Rubberseed	156
Rice bran	156
Sunflower	156
Salseed	157
Sesame	157
Shevage	157
Sitafal	157
Stilinga	157
Tall oil	158
Tea seed	158
Tobacco seed	158
Tumba Seed	158
Tung	158
Undi	159
Vilayati	159
Wallnut	159
Water melon oil	159
Zardalu	159
Fatty Acids in Oils	160
Mango Seed Oil	160
Melon Seed Oil	160
Mustard Seed Oil	160
Niger Seed Oil	160
Plum Kernel Oil	161
Rape Seed Oil	161
Rice Oil	161
Rubber Seed Oil	161
Safflower Oil	162
Sesame Oil	162
Teaseed Oil	162
Tobacca Seed Oil	162
Walnut Oil	163
Sunflower Oil	163
Tung Oil	163
Processed Oils	163
Refined linseed oils (Break free)	163
Heat refining	163
Alkali refining	164
Acid refining	164
Bolled Oil	164
Blown Oil	164
Stand Oil	165
Dehydrated Castor Oil	165
Urethane Oils	166

Epoxidised Oils	166
Fractionated Oils	166
Copolymerised Drying Oils	166
Isomerised Oils	167
Malenised Oils	167
Marine Oils	167
Constants of Oils	168
Alkyd Resins	174
Oil-Modified Alkyd Resins	174
The Fatty Acid Process	174
The Monoglyceride or Alcoholysis Process	175
Comparison of Fatty Acid and Monoglyceride Processes	175
Effect of Oil Modification	175
Properties conferred by drying oils in alkyd resins	176
Preparation of Dehydrated Castor Oil Alkyds	177
Manufacture of Alkyd Resins	177
Non-Drying Alkyds	178
Styrenated Alkyds	178
Amino Resins	179
Equivalent Weights and Properties of Representative Alkyd Raw Materials	181
Abbreviations and Symbols	185
Acid Number or Acid Value (Based on Nonvolatile)	186
Excess Hydroxyl Groups or Equivalents	186
Alkyd Composition Basis	187
Oil Content or Percentage Oil Length	187
Yield	187
Modifiers for Alkyd Resins	188
Formulation of Alkyd Resins	188
Formula Development	190
Calculation of Alkyd Formulations	191
Calculation of Raw Materials for an Alkyd Prepared by the Monoglyceride Process	192
Calculation of Raw Materials for an Alkyd Prepared by the Fatty Acid Process	193
Typical Formulation (all quantities by mass)	195
Long Oil Alkyds	195
Short Oil Alkyds	196
Oil-free Alkyds	196
Invention of Epoxy Resin	197
Reaction with Heat-Convertible Resins	197
Reaction with Amines	198
Reaction with isocyanate	198
Esterification Reaction	199
With other Resins / Phenolic Resins	199
Vinyl Resins	200
Alkyd Resins	200

Miscellaneous Resins	200
Chemical Properties	200
Epoxy Resin modified with Coal Tar	200
Pigmentation	201
Epoxy Resin Grades & Property - I	201
Epoxy Resin Grades & Property - II	202
Epoxy Resin Grades & Property - III	202
Some applications for 'Epoxy' resin coatings	203
Polyols	204
Acrylic polyether Polyester	204
Amines	204
Isocyanates	205
Commercial Polyisocyanates	205
Modifying Resins	205
Pigmentation	206
Solvents	206
Additives	206
Gum Definition	208
Exudate Gums	210
Description and Uses	210
Karaya	211
Tragacanth	212
Seed Gums	212
Mesquite	213
Tara	214
Hard Resins	214
Damar	215
Plant Sources	216
Mastic	216
Dragon's Blood	217
Balsam	218
Benzoin	219
Styrax	220
Peru and Tolu Balsams	221
Copaiba	223
Elemi	224
Asafoetida and Galbanum	226
Latexes	227
Sorva	227
Gutta Percha	228
Balata	228
Minimum Film Forming Temperature (MFFT) and Glass Transition Temperature (Tg)	230
Polyurethane Resins	235



## Part -III Solvent & Plasticizers

<i>Chapter</i>	<i>Page</i>
<b><u>Solvent Action</u></b>	
Solvent Action	245
Solvent Power	246
Dilution Ratios	247
Plasticising Solvents	249
Solvents Balance	255
Viscosity	259
Vapour Pressure and Evaporation Rates	263
Rates of Evaporation	266
Inflammability	267
Toxicity	268
Benzene	268
Toluene	268
Xylene	269
Coal Tar Solvent Naphtha	269
Petroleum Spirit	269
Turpentine	269
Cyclohexane	269
Carbon Disulphide	269
Methyl Alcohol	270
Ethyl Alcohol	270
Propyl Alcohols	270
Butyl Alcohols	270
Amyl Alcohols	270
Cellosolve (Ethyl Glycol)	270
Cyclohexanol and Methyl Cyclohexanol	271
Ethyl Ether	271
Dioxane	271
Ethyl Formate	271
Butyl Formate	271
Amyl Formate	271
Methyl Acetate	271
Ethyl Acetate	271

Propyl Acetates	271
N-Butyl Acetate	272
Amyl Acetate	272
Benzyl Acetate	272
Acetone	272
Methyl Ethyl Ketone	272
Ethylene Chlorhydrine	272
Methylene Dichloride	272
Chloroform	273
Carbon Tetrachloride	273
Dichlorethane	273
Tetrachlorethane	273
Pentachlorethane	273
Trichlorethylene	273
Dichloroethylether	273
Solvents of Low Toxicity	274
Dangerously Toxic Solvents	274
HYDROCARBONS SOLVENTS	275
Benzene. $C_6H_6$	275
Toluene. $C_6H_5 \cdot CH_3$	275
Xylene. $CH_3 \cdot C_6H_4 \cdot CH_3$	276
Coal-tar Solvent Naphtha	276
Cymene. p. $CH_3 \cdot C_6H_4 \cdot CH \begin{matrix} CH_3 \\ CH_3 \end{matrix}$	277
Dipentene . $C_{10}H_{16}$	277
Turpentine	277
Rosin Spirit	277
Cyclohexane	278
Methyl Cyclohexane	278
Petroleum Hydrocarbons	278
Carbon Di-Sulphide – $C S_2$	278
SOLVENTS Alcohols	280
Methanol	280

Ethanol	280
Isopropanol	281
Normal Butyl Alcohol	282
Normal Hexanol	283
Methyl Amyl Alcohol	283
2-Ethyl Butyl Alcohol	283
Octyl Alcohol	284
Glycols	285
Ethylene Glycol	285
Propylene Glycol	286
Diethylene Glycol	286
Triethylene Glycol	287
Alcohol-Ethers Methyl Cellosolve	288
Cellosolve	288
Butyl Cellosolve	289
Methyl Carbitol	290
Carbitol	290
Butyl Carbitol	291
Ethers and Oxides	291
Ethyl Ether	291
Isopropyl Ether	292
Butyle Ether (Normal)	292
Dioxan	293
Dichlorethyl Ether	294
Aldehydes	294
Butyraldehyde	294
Ketones Acetone	295
Methyl Acetone	296
Methyl n-Amyl Ketone	296
Methyl Isobutyl Ketone	296
Esters Methyl Acetate	297
Ethyl Acetate	298
Isopropyl Acetate	298
Butyl Acetate	299
Methyl Amyl Acetate	299
Octyl Acetate	300
2-Ethyl Butyl Acetate	300

Methyl Cellosolve Acetate	301
Cellosolve Acetate	301
Carbitol Acetate	302
Diethyl Sulphate	302
Ethyl Acetoacetate	303
Methyl Acetoacetate	303
Dibutyl Phthalate	304
Acids and Anhydrides, Acetic Anhydride	304
Chlorinated Compounds, Ethylene Dichloride	305
Propylene Dichloride	306
Trichlorethylene	306
Amines Monoethanolamine	307
Diethanolamine	307
Triethanolamine	308
Ethylene Diamine	309
AMP-95®	309
Typical Properties	310
Recommended Use Levels	311
Selection and Use of Coalescing Agents	315
Role of Coalescing Agents	315
Selection of Coalescing Agents	316
Generic Properties of Coalescing Agents	317
Solvent Selector Chart	319
Coalescent Solvents	331

-----

## Part -IV Additives

<i>Chapter</i>	<i>Page</i>
<b><u>Additives</u></b>	
Abrasion-resistance Improvers	341
Alumina	341
SnC	341
Accelerators	342
Acid Catalysts	342
Acid Scavengers	342
Adhesion Promoters	342
Algaecides	343
Anti-blocking Agent	343
Anti-cratering Agent	343
Anti-crawling Agent	344
Anti-float Agent	344
Anti-flooding Agent	344
Antifouling Agents	344
Anti-freezing Agent	345
Anti-gelling Agent	345
Anti-livering Agent	345
Anti-marring Agent	345
Antioxidant	345
Anti-rust Agent	346
Anti-sag Agents	346
Anti-settling Agent	347
Anti-silking Agent	347
Anti-skid Agents	347
Anti-skinning Agents	347
Antistatic Agents (Antistats)	348
Associative Thickeners	348
Bactericides	349
Barrier Coating Additive	349
Biocides/Fungicides	349
Antimicrobial Polymer Emulsions	351
Inherent Antimicrobial Polymer Approach	352
Active Ingredient Carrier Polymer Approach	352
Silver Ions	353
Aglon <sup>™</sup>	353

---

Ca(OH) <sub>2</sub>	354
Block-resistant Additive	354
Bodifying Agent	354
Brighteners (Optical)	354
Burnish-resistant Additive	355
Catalysts	355
Powder Coatings	356
Charge-control Agents	357
Chelating Agents	357
Cleanability Additives	357
Coagulants	357
Coalescents (Coalescing Agent)	357
Colloid Stabilizers	360
Corrosion Inhibitors	360
Corrosion-inhibitive Pigment	360
Coupling Agent	360
Craze-resistance Additive	362
Crosslinking Agent	362
UV-powder Coatings	363
Curing Agent	363
Deaerators	363
Deflocculant	364
Defoamer	364
Degassing Agents	366
Denaturant	366
Desiccants	366
Detergent	367
Diluent	367
Dispersant/(Dispersing Agent)	367
Driers	369
Drier Stabilizers	371
Dyes (For Use In Stains)	371
Electroconductive Additives	371
Emulsifier	372
Enzyme-based Additives	372
Extenders	373
Hollow Spheres And Opacity	374
Applications For Opacifying Polymers	374
Fish Eye Preventer	375
Flame Retardants	375

Flash Rust Inhibitors	376
Flatting (Matting] Agents	376
Silicas	377
Precipitated And Fumed	378
Diatomaceous Earth	378
Silica Gels	378
Selection And Applications	379
Other Agents	380
Organic Particles	380
Stearates	380
Low Energy Cure	381
Power Coating	381
Flocculants	381
Flow And Leveling Agents/Flow Modifiers	381
Powder Coatings	383
Fluidizing Additives	384
Fluorescent Additives	385
Foaming Agents	385
Foam-control Agents	385
Freeze-thaw Stabilizers	387
Fungicide	387
Fngistat	387
Gelling Agent	387
Gloss Improver	387
Graphite	387
Grinding Aids	388
HamMer Finish Additives	388
Hardeners	388
Epoxy Amine Adducs	388
Mannich-bases	389
Hase Thickeners	390
Heat Stabilizers	390
Heur Thickeners	390
Hindered Amine Light Stabilizers (Hals)	390
Homogenizer	391
Humectants	391
Hydrophiles	392

Hydrophobic Agent	392
Hygienic Coating Additives	392
Aglon™	392
Ca(OH) <sub>2</sub>	392
Hyperdispersants	393
Impact-resistance Improver	393
In-can Reservatives	393
Insecticides	394
Intumescent Additive	394
Leafing Agent	395
Leveling Promoter	395
Lights Stabilizers	395
Lubricants (Surface)	395
Lubricants (Solid)	396
The Four Forms Of Graphite	396
1. Flake Graphite	396
2. Crystalline Vein Graphite	397
3. Amorphous Graphite	398
4. Synthetic Graphite	398
Basic Structural Description	398
Anisotropy	399
Chemical Inertness	399
Luminescent Additives	400
Lustrant	400
Mar-resistance Additive	400
Marproofing Agents	400
Masking Agents	400
Matting Agents	400
Microspheres	400
Thermoplastic	401
Glass	401
Mildewcide	402
Moisture Scavenger	402
Molecular Sieves	403
Molecular Sieves	404
Nanotechnology	404
Inorganic UV Absorbers	405
Odorants	406
Oils	406



Optical Brighteners	406
Organoclays	406
Organoclays	406
Ph-control Agents	407
Photoinitiators	407
Uv Powder Coatings	408
Photosensitizers	408
Pigments	408
Pinhole Preventative	409
Plasticizers	409
Polymeric Disperesant	410
Polymeric Liquid Crystals	411
Preservative	411
Protective Coloids	411
Puffing Agents	411
Reactive Diluent	411
Release Agent	413
Retention Aids	414
Rheology Modifiers	414
Rust Inhibitors	415
Scratch-resistant Additive	415
Seal Coating Additve	416
Slip Aid	416
Soil Repellants	420
Spreading Agent	420
Stain-resistant Additive	420
Static Preventive	420
Substrate Wetting Agents	420
Surface-actiive Agents	420
Surface Additives/Defects	420
Surface Modifier	421
Surface Tension Reducer	423
Surfactants	423
Contribution To Properties	427
Other Surfactants	430
Suspension Agents	433
Synergists	433
Tackifier	433
Texturizing Agents	434

Thickeners	435
Associative Thickeners	436
Non-associative Thickeners That Interact With The Water Phase	439
Inorganic Thickeners (Also See Organoclays)   Clays	441
A. Swelling (Smectite)	441
B. Non-swelling Clasy	442
(1) Kaolin (China Clay) $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$ 1	442
(2) Mica	443
(3) Colloidal Interaction Network	444
Fumed Silica	444
Overbased Calcium Sulfonate Gels	446
Organic Thixotropes	446
Other Types Of Thickeners	447
Thixotropes (Bodying Gents)	448
Tribo-charging Additive	448
Uv Absorbers And Light Stabilizers	448
Inorganic Uv Absorbers	450
Cerium Oxide Nanoparticles	451
Organic Uv Absorbers	452
Viscosity Modifier	453
Water-removal Agents/Scavegers	453
Waxes	454
Tpical Wax Effects	455
Wet Edge Extenders	455
Wetting Agent	456
Xanthan Gum	458
<b>The Blue Page</b>	459
Protein	459
Spider Silk	460
Starch	461
Commercial Bioplastics	463
<b>Physical Constants of Elements and Compounds</b>	467
<b>Approximate Composition and Constants of Typical Commercial Fatty Acids</b>	496
Temperature Conversion Chart	497
<b>Bibilography</b>	498
<b>Glossary</b>	500
Index	519

-----