

CONTENTS

	<i>page</i>
PROLOGUE	vii
ACKNOWLEDGEMENTS	xix
PATENTS AND TRADE MARKS	xxiii
Introduction	
1 THE SCOPE OF THIS VOLUME	1
2 HISTORICAL AND GENERAL SURVEY	2
3 A GENERAL SURVEY OF RESIN APPLICATIONS	4
The principle application classes 6	
CHAPTER I	
Fundamentals of Polymer Chemistry	
1 THE CONCEPT OF A POLYMER	7
Historical Introduction 7. Definitions 8	
2 ADDITION POLYMERISATION	9
Free Radical Polymerisation 10. Copolymerisation 17. Methods of Polymerisation 19	
3 CHAIN BRANCHING BLOCK AND GRAFT COPOLYMERS	22
Chain Branching 22. Graft Copolymers 23	
4 POLYMER STRUCTURE AND PROPERTIES	25
Polymer Structure 25. Molecular Weight Effects 30. Transition Points 32. Dicne Polymers 34	
5 THE PRINCIPAL MONOMERS AND THEIR POLYMERS	36
Hydrocarbons 36. Chlorinated Monomers 36. Vinyl Esters 37. Acrylics 38. Polymerisable Acids and Anhydrides 39. Esters for Copolymerisation 40. Allyl Derivatives 41. Vinyl Ethers 41. Miscellaneous Monomers containing Nitrogen 42. Toxicity and Handling 42. Physical Properties of Monomers 43	
6 APPENDIX	45
References 47	
CHAPTER 2	
Emulsions, Emulsion Polymerisation	
1 INTRODUCTION TO COLLOID CHEMISTRY	49
Historical 49. Emulsions 49	
2 SURFACTANTS AND STABILISERS	57
Surfactants 57. Colloids and High Molecular Weight Stabilisers 59. A Survey of Surfactants 68	
3 EMULSION POLYMERISATION — GENERAL PRINCIPLES	85
Elements of Chemistry and Technology 85. Some Formulations 99	
4 EMULSION POLYMERISATION — THEORETICAL CONSIDERATIONS	118

Types of Mechanism **118**. Theories of Harkins and Smith & Ewart **119**. Theory of Medvedev **122**. Further Quantitative Investigations—mainly Styrene **123**. Emulsion Polymerisation of Methyl Methacrylate **124**. Vinyl Acetate Emulsion Polymerisation **126**. Specificity of Surfactants **128**. Copolymerisation **129**. Conclusions **129**
References **130**

CHAPTER 3

General Polymer Emulsion Application

1	INTRODUCTION	133
2	EMULSION VISCOSITY	134
3	FREEZE-THAW AND TROPICAL STABILITY	137
	Freeze-Thaw Stability 137 . Tropical Stability 140	
4	EMULSION FILMS	141
	Film Formation 141 . Theoretical Considerations 143 . Minimum Film-Forming Temperature (MFT) 147 . Conclusions 147	
5	ADDITION OF PLASTICISERS AND COALESCING SOLVENTS	147
	Introduction 147 . Plasticisation of Principal Polymers 149 . The Mechanism of Plasticisation in Emulsion 150 . Transient Plasticisers (Coalescing Solvents) 165	
6	PIGMENTATION	167
	Introduction 167 . Pigmentary Power 169 . Some Common Pigments and Extenders 170 . Pigmentation of Emulsions 173 . General Properties of Pigmented Systems 175 . Summary of Emulsion Compounding 178	
7	THE TESTING OF EMULSIONS	179
	Total Solids Content 179 . Monomer Content 180 . Specific Gravity 182 . pH Stability 182 . Freeze-Thaw Stability 182 . Emulsion Viscosity 182 . Particle Size 183 . Soap Titration; Surface Tension Measurements 186 . Settling and Sedimentation 187 . Mechanical Stability 188 . Minimum Film Temperature (MFT) 188 . Relative Molecular Weight (Viscosity) 188 . Viscosity Measurements 189 . General Film Properties 189 . Determination of Charge 190 References 190	

CHAPTER 4

Technical Polymer Emulsions

1	INTRODUCTION	193
2	POLYVINYL ACETATE AND RELATED COPOLYMERS	194
	Polyvinyl Acetate 194 . Copolymers of Vinyl Acetate 196 . Typical Commercial Products 201	
3	ACRYLIC POLYMERS AND COPOLYMERS	215
	Properties of Acrylic Resins 215 . Properties of Acrylic Resins Films 217 . Technical Acrylic Emulsions 218	
4	STYRENE POLYMERS AND COPOLYMERS	222
	Polystyrene 222 . Styrene-Butadiene Copolymers 223 . Typical Commercial Products 224	
5	POLYMERS BASED ON ALIPHATIC HYDROCARBONS	226

6	VINYL HALIDE POLYMERS	228
	Polyvinyl Chloride 228. Polymers and Copolymers of Vinylidene Chloride 234. Emulsion of Fluorocarbons 240	
7	MISCELLANEOUS	242
	Vinylpyrrolidone Copolymers 242. Emulsion of Polyisobutylene 244. Emulsion of Polyisobutyl Ether 244	
	References	244

CHAPTER 5

Polyester and Non-Vinyl Emulsions

1	INTRODUCTION	246
2	ALKYDS AND POLYESTERS	246
	Polyesters 247. Alkyds and Allied Products 248	
3	AMINOPLASTS	253
4	POLYAMIDE EMULSIONS	254
5	EPOXIDE RESINS AND BLENDS	256
	Direct Emulsification of Epoxides 256. Polyamide-Epoxy Emulsions 257. Epoxy Emulsions with other Resins 259	
6	PHENOPLASTS	259
7	SILICONES	261
	Elementary Chemistry 261. Textile and Paper Applications of Silicone (Organopolysiloxane) Emulsions 264. Silicone Emulsions in Surface Coating and Building 266. Miscellaneous Applications of Silicone Emulsions 267	
8	POLYURETHANES	267
	Chemistry of Isocyanate Adducts 267. Polyurethane Latex 269. Technical Products 272. Applications of Polyurethane Emulsions 272	
9	MISCELLANEOUS	274
	Episulphide Emulsions 274. Polyspirane Emulsions 275	
	References	275

CHAPTER 6

Adhesives

1	INTRODUCTION	279
2	A SURVEY OF ADHESION THEORY	279
	The Function of Adhesives; Emulsion Adhesives 283	
3	PRACTICAL REQUIREMENTS OF EMULSION ADHESIVES	284
	Adhesion Requirements 285	
4	SOME SPECIFIC ADHESIVES	287
	Polyvinyl Acetate and Copolymers 287. Acrylics 301. Vinylidene Chloride Copolymers 303. Polyvinyl Ethers and Polyisobutylene Dispersions 303. Butadiene Copolymers 304	
5	ADHESIVES WITH SPECIFIC FUNCTIONS	305
	Pressure-Sensitive Adhesives 305. Heat-Seal Adhesives 318. Delayed Tack Adhesives 322. Remoistenable Adhesives 327. Quick-Grab and Quick-Tack Adhesives 331	

6	ADHESIVES FOR SPECIFIC APPLICATIONS	333
	Wood Adhesives 333 . Adhesives for Packaging 339 . Miscellaneous Paper Adhesives 342 . Rubber to Fabric Adhesives 343 . Miscellaneous Adhesives for Specific Purposes 349	
	APPENDIX 1	352
	Glossaries 352	
	APPENDIX 2	357
	Specifications and Tests 357	
	References	361

CHAPTER 7

Surface Coatings, Decorative, Fundamentals and Raw Materials

1	HISTORICAL INTRODUCTION	367
2	FUNDAMENTAL FORMULATION AND REQUIREMENTS	369
	The Principal Constituents 369 . General Emulsion Requirements 370 . Plasticisation including Transient Plasticisers 375 . Corrosion Resistance (Storage) 377	
3	VINYL ACETATE POLYMERS AND COPOLYMERS	378
	Homopolymers; Formulation 378 . Paint Formulation—General 381 . Plasticiser Variations 384 . Vinyl Acetate Copolymer Emulsions 388 . Formulation of Copolymer Emulsions and Paints 396 . Chemically Resistant Copolymer Emulsions 400 . The Ease of Hydrolysis of Vinyl Copolymers 410 . Vinyl Acetate—Olefin Copolymers 412	
4	ACRYLIC EMULSIONS AS PAINT MEDIA	415
	General Properties 415 . Formulation Modifications 418 . Manufacturing Techniques for Acrylic Latex Paints 426	
5	HYDROCARBON POLYMER EMULSION PAINTS	427
	Styrene-Butadiene Copolymers 427 . Other Hydrocarbon Polymers and Miscellaneous Copolymers 430	
6	VINYL HALIDE POLYMERS	431
	Vinyl Chloride-Vinyl Ester Copolymers 432	
7	MISCELLANEOUS AND CROSSLINKED POLYMERS	433
	'Core' Type Copolymers in Emulsion Paints 435	
8	SOME EMULSION COMPARISONS	436
	General Properties 436 . Photochemical Degradation 437	
9	PIGMENTS	439
	Titanium Dioxide 440 . Zinc Oxide 444 . Lithopone and Antimony Oxide 446	
10	THE PRINCIPAL EXTENDERS	446
	Formulation with Extenders 450	
11	COLOURED PIGMENTS	454
12	UNIVERSAL TINTERS	461
	References	463

CHAPTER 8

Emulsion Paints—Formulation

1	ASPECTS OF EMULSION PAINT RHEOLOGY	467
	Effects of Surfactants and Dispersants 467. General Colloid Effects 472. Effects of Different Cellulosic Thickeners 472. Viscosity Problems 473. High Thixotropy Emulsions 474. Surfactant Transfer 479. Foam Control Agents 480	
2	TEMPERATURE STABILITY	481
	Freeze-Thaw Stability 481. High Temperature (Tropical) Stability 483	
3	FILM FORMATION	484
	Film Drying Effects 484. Water-Resistance of Paint Films 484. Efflorescence (Lime Staining) 486	
4	MICROBIOLOGICAL PROBLEMS	488
	Microbiocides 489	
5	GLOSS PAINTS	498
	General Principles 498. Particle Size 499. Emulsifiers and Colloids 499. Pigments 500. Plasticisers and Solvents 500. Specific Methods 501. Technical Acrylic Emulsions 503. Addition of Alkali Soluble Resins 505. Some Comparisons 507	
6	UNDERCOATS AND PRIMER-SEALERS	508
	Vinyl Acetate Polymers 508. Coating of Old Oil Paints 511	
7	EMULSION PAINTS FOR EXTERIOR USE	512
	General Requirements 512. Pigments and Extenders 517. Exterior Surfaces (Except Wood) 522. Wood Coatings 525. Blends of Synthetic Resins and Drying Oils 533	
8	EMULSION PAINTS FOR INTERIOR USE	540
9	MISCELLANEOUS SPECIAL PRODUCTS	545
	Fire Retardant Paints 545. Emulsion Paints as Metal Coatings 551. Coatings on Cement and Building Boards 563	
10	SPECIAL PROCEDURES	566
	Reconstitutable Emulsions 566. Pre-pigmented Emulsions 567. Special Additions 568	
11	SPECIAL EFFECTS	568
	Various Patterned Effects 570. Multicolour Paints 573. Insecticidal Paints 576	
12	CONCLUSION	576
	APPENDIX	577
	The Testing of Emulsion Paints 577	
	References	578

CHAPTER 9

Cross-Linking; Industrial Finishing

1	INTRODUCTION	584
---	--------------	-----

2	THE CARBOXYL FUNCTION	586
	Introduction 586. Combinations with Hydroxyl and Epoxide 587. Combinations with Aminoplasts 589. Other Carboxyl Reactions 592	
3	THE HYDROXYL FUNCTION	593
4	THE EPOXIDE FUNCTION	594
5	N-METHYLOLAMIDES	599
	Chemistry of Cross-Linking Reactions 599. Practical Formulations 600. Further Methylolamide Derivatives 603	
6	CROSS-LINKING WITH AMINOPLASTS	604
7	MISCELLANEOUS CROSS-LINKS INVOLVING NITROGEN COMPOUNDS	607
8	MISCELLANEOUS CROSS-LINKING METHODS	609
	Phenolic Resin Cross-Links 609. Vulcanisation via Labile Chlorine Atoms 609. Cross-Links Containing Silicon 609. Miscellaneous Thickening Procedures 609	
9	INDUSTRIAL FINISHING	610
	Introduction: Definitions 610. Combinations of Carboxyl and Amino- plast 612. Combinations of Carboxyl with other Reactive Groups 614. The Hydroxyl Group 617. Finishes Containing Acrylamide and its Derivatives 618. Compositions Including Dienes 619. Self-curing Silicate and Acrylate Coatings 623	
10	ELECTRODEPOSITION	624
	Electrochemical Principles and Definitions 624. The Deposits 626. The Electrocoating Bath 626. Patented Processes 629 References	632

CHAPTER 10

Miscellaneous Textile Applications

1	INTRODUCTION: VINYL RESINS	635
	Non-Vinyl Emulsions 636. Blocked Urethane Emulsions 637	
2	WARP SIZING	637
	Package Sizing 639 Heat-Set Sizes: Loom Finished Fabrics 639	
3	VINYL RESINS AS FINISHES	640
	Polyvinyl Acetate: Semi-permanent Finishes 641. Acrylics 645. Buta- diene Copolymers 648. Polyvinyl Chloride and Polyvinylidene Chloride 649. Polyethylene 650. Polytetrafluorethylene 651	
4	POLYMERS CAPABLE OF CROSSLINKING REACTIONS	651
5	HOSIERY FINISHES: CATIONIC EMULSIONS	654
	De-Lustering Compositions 656	
6	TREATMENT FOR SPECIFIC FABRICS	657
	Treatments for Cellulosic Fabrics 659. Anti-Shrink Treatments for Wool 668. Finishing of Silk 671	
7	FINISHES (NONCROSSLINKING) FOR SPECIFIC PURPOSES	671
	Anti-Static Finishes 672. Canvas Finishing Including Rot-Proofing 673. Chintz and Glazing Finishes 673. Flame-Proofing 674. Hat	

Finishing 675. Waterproofing Water and Oil Repellancy 676. Unclassified Finishes 678	
8 APPLICATIONS BASED ON ADHESIVE PROPERTIES	680
Introduction 680. Laminates and Flocking 682	
9 NON-WOVEN FABRICS	687
The Fibres in Use 690. The Resin Binders 690. Some Applications 700. Theoretical Considerations 700. Bibliography 701	
10 CARPET AND UPHOLSTERY APPLICATIONS	702
Application to Traditional Carpets 702. Tufted Carpets 703. Rugs 706. Miscellaneous Treatments 708. Techniques of Application 709. Foam Backing 711. Upholstery 711	
11 PIGMENT DYEING AND PRINTING	713
12 COATED AND IMPREGNATED FABRICS	719
Base Fabrics 719. Polymer Compositions 720. Bookcloth 722. Shoe Stiffness 723	
13 FIBRE SPINNING IN EMULSION	724
APPENDIX 1	
Glossary of Terms Relating to Textiles	725
APPENDIX 2	
Textile Tests	728
References	732

CHAPTER II

The Paper Industry

1 INTRODUCTION	739
2 BEATER ADDITION	740
General Principles 740. Acrylic Emulsion Addition 742. Diene Polymer Additives 744. Polyvinyl Acetate 745. Miscellaneous Additives 746. Conclusions: Beater Additives 746	
3 PAPER SATURATION (IMPREGNATION)	746
General Principles 746. Acrylic Emulsions 752. Butadiene-Based Emulsions 757. Miscellaneous Vinyls 758. Internal Polymerisation 759. Non-Vinyl Emulsions 760. Some Applications of Saturated Papers 760. Comparison of Saturation and Beater Additions 761	
4 PAPER AND PAPERBOARD COATING	761
General Properties of Emulsions for Paper Coating 762. Coating Pro- cesses 763. Mineral (Clay) Coatings 766. Specific Compositions for Mineral Coating 770. Coating of Packaging and Greaseproof Papers 796. Miscellaneous Coating Compositions 804	
5 WALLPAPER COATINGS	806
General Requirements 806. Alkali-Soluble Emulsions 806. Wallpaper Top Coats 808. Non-Vinyl Emulsions 810	
6 SPECIAL COATINGS AND EFFECTS	810
Transfer Coatings 810. Coatings direct from Monomers 811. Release Coatings 811. Electroconductive Polymers 812. Repulping Problems 812	

APPENDIX 1	813
Glossary	813
APPENDIX 2	816
Some Methods of Paper Testing	816
References	820

CHAPTER 12

Leather

1 INTRODUCTION	824
2 FINISHING	824
General Requirements of Finishing Emulsions 825. Problems of the Substrate 830. Comparisons of Leather Finishing Emulsions 831. Specific Finishing Compositions 835. Simultaneous Dyeing and Finishing 848	
3 CURTAIN COATING	849
Physical Properties of the Composition 849. The Pigment Paste and Coating Composition 850. Operation of the Coater 850. Application of the Coater 851. Advantages of Curtain Coating 851	
4 IMPREGNATION	852
Principles 852. Some Technical Investigations 853. Processes and Patents 854	
5 TREATMENT WITH NON-VINYL EMULSIONS	857
6 SHOE FINISHES	858
7 LEATHERBOARD AND SYNTHETIC LEATHER	859
APPENDIX 1	859
Glossary	859
APPENDIX 2	861
Test Methods	861
References	862

CHAPTER 13

Polishes

1 HISTORICAL AND INTRODUCTION	865
2 EMULSION POLISH INGREDIENTS	866
Introduction 866. The Principal Polymers 866. Waxes: Natural and Synthetic 879. Alkali-Soluble Resins 882. Plasticisers and Levelling Agents 884. Minor Additives 887	
3 POLISH FORMULATION AND PROBLEMS	889
Introduction—Gloss 889. Function of the Constituents 889. Some Miscellaneous Formulations 896. Sealers 909	
4 POLYMERS WITH METAL CROSSLINKING AGENTS	911
Metal Complexes 911. Some Ionically Crosslinked Polymers 914. Polish Formulations 917	

5	ACID REMOVABLE POLISHES	920
	APPENDIX	922
	Test Methods	922
	References	924

CHAPTER 14

The Building Industry

1	INTRODUCTION	927
2	ADHESIVES AND SEALANTS	927
	Adhesives 927. Sealing and Keying 929	
3	HYDRAULIC BINDING AGENTS (PLASTER)	932
4	CEMENT ADDITIVES	933
	General Properties 933. Addition of Polyvinyl Acetate 934. Some Typical Flooring Compositions 939. Modifications of the Cement 940. Modifications of the Emulsions 941. Compositions for Decks, Fuel Containers and Pipes 942. Emulsion Additives, General 946. Cement and Concrete Paints 957	
5	CEMENT-FREE FLOORING COMPOSITIONS	958
	Specific Compositions 959	
6	DECORATIVE FACINGS AND WALL COATINGS	962
	References	963

CHAPTER 15

Miscellaneous Applications

1	INTRODUCTION — HISTORICAL	967
	Binding of Leather Scrap 967	
2	FOODSTUFF APPLICATIONS	971
	FDA Regulations 971. Coatings for Packaging 972. Direct Coating 972	
3	GLASS FIBRE TREATMENT	974
	General Principles 974. Special Treatments for Glass Fibres 977	
4	VIBRATION DAMPING AND SOUND DEADENING	979
	Vibration Damping 979. Sound Deadening Compositions 982. Epoxide Emulsions with other Resins 984	
5	PHOTOGRAPHIC AND COPYING PAPER	985
	Modifications to the Silver Halide/Gelatin Process 985. Electrophotographic Processes 985. Emulsions in the Diazotype Process 986. Heat Sensitive Recording Papers 990	
6	UNCLASSIFIED COATINGS	992
	Coatings for Synthetic Films and Sheets 992. Fire-Resistant Coatings 994. Coatings not otherwise Classified 996	
7	EMULSIONS AS BINDERS	997
	Casts and Moulds 997. Impregnation of Wood and Cellulosic Materials 998. Applications in Pyrotechnics and Explosives 1000. Horticultural Applications 1000. Inks and Writing Elements 1001	

8	MISCELLANEOUS	1002
	Foams 1002. Medical Cosmetic and Toilet Applications 1003	
	References	1004

CHAPTER 16

New Developments

1	HYDROSOLS	1008
	Formation 1008. Applications 1010	
2	NON-AQUEOUS DISPERSIONS (DISPERSYMERS)	1011
	Introduction: Definitions 1011. Chemistry of Formation 1011.	
	Applications 1015	
3	EPILOGUE	1016
	References	1017
	INDEX	1019