

Contents

Preface VII

List of Contributors IX

Colloid Aspects of Cosmetic Formulations with Particular Reference to Polymeric Surfactants 1

Tharwat F. Tadros

Abstract 1

- 1.1 Introduction 2
 - 1.2 Interaction Forces and Their Combination 4
 - 1.3 Self-Assembly Structures in Cosmetic Formulations 11
 - 1.4 Structure of Liquid Crystalline Phases 12
 - 1.4.1 Hexagonal Phase 12
 - 1.4.2 Micellar Cubic Phase 13
 - 1.4.3 Lamellar Phase 14
 - 1.4.4 Discontinuous Cubic Phases 15
 - 1.4.5 Reversed Structures 15
 - 1.5 Driving Force for Formation of Liquid Crystalline Phases 15
 - 1.6 Polymeric Surfactants in Cosmetic Formulations 17
 - 1.7 Polymeric Surfactants for Stabilization of Nanoemulsions 20
 - 1.8 Polymeric Surfactants in Multiple Emulsions 28
 - 1.9 Polymeric Surfactants for Stabilization of Liposomes and Vesicles 31
 - 1.10 Conclusions 33
- References* 33

2 Formulation and Stabilization of Nanoemulsions Using Hydrophobically Modified Inulin (Polyfructose) Polymeric Surfactant 35

Tharwat F. Tadros, Martine Lemmens, Bart Levecké, and Karl Booten

Abstract 35

- 2.1 Introduction 36
- 2.2 Materials 38
- 2.3 Preparation of Nanoemulsions 39

4.7.4	Solids Loading	72
4.7.5	SPF Performance in Emulsion Preparations	73
4.8	Discussion	74
4.8.1	Competitive Interactions in Formulations	76
4.9	Conclusion	77
	<i>References</i>	77
5	Use of Associative Thickeners as Rheology Modifiers for Surfactant Systems	79
	<i>Tharwat F. Tadros and Steven Housley</i>	
	Abstract	79
5.1	Introduction	79
5.2	Surfactant Systems as Rheology Modifiers	80
5.3	Associative Thickeners as Rheology Modifiers	81
5.4	Materials and Methods	86
5.5	Results	87
5.6	Discussion	90
5.7	Conclusion	91
	<i>References</i>	91
6	Cosmetic Emulsions Based on Surfactant Liquid Crystalline Phases: Structure, Rheology and Sensory Evaluation	93
	<i>Tharwat F. Tadros, Sandra Léonard, Cornelis Verboom, Vincent Wortel, Marie-Claire Taelman, and Frederico Roschztartz</i>	
	Abstract	93
6.1	Introduction	93
6.2	Structure of Liquid Crystalline Phases	94
6.3	Driving Force for the Formation of Liquid Crystalline Phases	95
6.4	Formulation of Liquid Crystalline Phases	97
6.4.1	Oleosomes	97
6.4.2	Hydrosomes	98
6.5	Emulsion Stabilization Using Lamellar Liquid Crystals	98
6.6	Materials and Methods	99
6.7	Results and Discussion	101
6.7.1	Emulsion Structure and Rheology	101
6.7.2	Emulsion Structure and Sensory Attributes	103
6.7.3	Emulsion Structure, Rheology and Sensory Attributes	103
6.8	Conclusion	104
	<i>References</i>	105

7	Personal Care Emulsions Based on Surfactant–Biopolymer Mixtures: Correlation of Rheological Parameters with Sensory Attributes	107
	<i>Tharwat F. Tadros, Sandra Lionard, Cornelis Verboom, Vincent Wortel, Marie-Claire Taelman, and Frederico Roschztardt</i>	
	Abstract	107
7.1	Introduction	108
7.2	Materials and Methods	109
7.2.1	Materials	109
7.2.2	Preparation of Powder Dispersions	109
7.2.3	Preparation of the Emulsion	110
7.2.4	Rheological Measurements	111
7.2.5	Principal Component Analysis (PCA)	112
7.3	Results	112
7.3.1	Rheological Results for Xanthan Gum and KX Solutions	112
7.3.2	Rheological Investigation of Stabilizing Systems	113
7.3.3	Rheological Investigations of Emulsions	114
7.3.3.1	Influence of Arlatone Concentration	114
7.3.3.2	Influence of Oil Volume Fraction	117
7.3.3.3	Influence of Temperature on the Rheology of KX, Arlatone V100, Arlatone V175 and the Emulsions Prepared Using the Stabilizers	119
7.3.4	PCA Results	119
7.4	Discussion	122
7.5	Conclusions	125
	<i>References</i>	126
8	Correlation of "Body Butter" Texture and Structure of Cosmetic Emulsions with Their Rheological Characteristics	127
	<i>Tharwat F. Tadros, Sandra Lionard, Cornelis Verboom, Vincent Wortel, Marie-Claire Taelman, and Frederico Roschztardt</i>	
	Abstract	127
8.1	Introduction	128
8.2	Experimental	129
8.2.1	Materials	129
8.2.2	Rheological Measurements	129
8.2.2.1	Flow–Viscosity Curve Measurements	129
8.2.2.2	Dynamic (Oscillatory) Measurements	131
8.2.2.3	Constant Stress (Creep Test) Measurements	132
8.2.3	Schematic Representation of the Rheological Curves	132
8.2.4	Spectrum Descriptive Analysis	132
8.2.5	Principal Component Analysis	133
8.3	Results and Discussion	133
8.4	Conclusion	143
	<i>References</i>	144

Interparticle Interactions in Color Cosmetics 145*Lorna M. Kessell and Tharwat F. Tadros*

Abstract 145

- 9.1 Introduction 145
 - 9.2 Fundamental Principles of Preparation of Pigment Dispersions 146
 - 9.2.1 Wetting of the Powder 146
 - 9.2.2 Wetting of the Internal Surface 147
 - 9.3 Assessment of Wettability 148
 - 9.3.1 Submersion Test – Sinking Time or Immersion Time 148
 - 9.3.2 Contact Measurement for Assessment of Wettability 149
 - 9.4 Dispersing Agents 150
 - 9.5 Stabilization 151
 - 9.5.1 Electrostatic Stabilization 152
 - 9.5.2 Steric Stabilization 153
 - 9.5.3 Optimizing Electrosteric and Steric Stabilization 154
 - 9.6 Surface–Anchor Interactions 154
 - 9.7 Optimizing Steric Potential 155
 - 9.8 Classes of Dispersing Agents 157
 - 9.9 Assessment of Dispersants 159
 - 9.9.1 Adsorption Isotherms 159
 - 9.9.2 Measurement of Dispersion and Particle Size Distribution 160
 - 9.9.3 Rheological Measurements 160
 - 9.10 Application of the Above Fundamental Principles to Color Cosmetics 162
 - 9.11 Principles of Preparation of Color Cosmetics 163
 - 9.11.1 Dispersion/Comminution 164
 - 9.11.2 Optimizing Dispersion in Practice 165
 - 9.11.3 Suspoemulsions 166
 - 9.12 Conclusions 167
- References* 167

Starch-Based Dispersions 169*Ignác Capek*

Abstract 169

- 10.1 Introduction 170
 - 10.2 Starch-Based Nanomaterials 177
 - 10.2.1 Modification Approaches 177
 - 10.2.2 Crosslinking/Gelatinization 184
 - 10.2.3 Grafting 191
 - 10.3 Dispersions 201
 - 10.4 Nanocomposites, Blends and Their Properties 212
 - 10.5 Biodegradability 225
 - 10.6 Starch–Additive Complexes 227
 - 10.7 Conclusions 235
- References* 241

11	<p>In Vivo Skin Performance of a Cationic Emulsion Base in Comparison with an Anionic System 247</p> <p><i>Slobodanka Tamburic</i></p> <p>Abstract 247</p> <p>11.1 Introduction 247</p> <p>11.2 Materials and Methods 249</p> <p>11.2.1 Materials 249</p> <p>11.2.2 Methods 251</p> <p>11.3 Results and Discussion 252</p> <p>11.4 Conclusion 256</p> <p><i>References</i> 256</p>
12	<p>The Impact of Urea on the Colloidal Structure of Alkylpolyglucoside-Based Emulsions: Physicochemical and In Vitro/In Vivo Characterization 259</p> <p><i>Snezana Savic, Slobodanka Tamburic, Biljana jancic, jela Milic, and Gordana Vuleta</i></p> <p>Abstract 259</p> <p>12.1 Introduction 260</p> <p>12.2 Experimental 261</p> <p>12.2.1 Materials 261</p> <p>12.2.2 Preparation of Samples 261</p> <p>12.2.3 Physicochemical Characterization 261</p> <p>12.2.3.1 Microscopy 261</p> <p>12.2.3.2 Wide-Angle X-Ray Diffraction (WAXD) 261</p> <p>12.2.3.3 pH Measurements 262</p> <p>12.2.3.4 Conductivity Measurements 262</p> <p>12.2.3.5 Rheological Measurements 262</p> <p>12.2.3.6 Thermogravimetric Analysis (TGA) 262</p> <p>12.2.4 <i>In Vivo</i> Short-Term Shtdy 262</p> <p>12.2.4.1 Study Design 263</p> <p>12.2.5 <i>In Vitro</i> Release Shtdy 263</p> <p>12.2.6 Statistical Analysis 263</p> <p>12.3 Results and Discussion 264</p> <p>12.3.1 Physicochemical Characterization 264</p> <p>12.4 Conclusion 273</p> <p><i>References</i> 273</p>

**Models for the Calculation of Sun Protection Factors and Parameters
Characterizing the UVA Protection Ability of Cosmetic Sunscreens 275***Bernd Herzog*

- Abstract 275
- 13.1 Introduction 275
- 13.2 Basic Principle 277
- 13.3 Calculation of the Overall UV Spectrum of a Sunscreen Agent 278
- 13.4 Models for Film Irregularities 279
- 13.4.1 The Step Film Model by O'Neill 279
- 13.4.2 The Modified Version of the Step Film Model by Tunstall 282
- 13.4.3 The Calibrated Two-Step Film Model 283
- 13.4.4 The Calibrated Quasi-Continuous Step Film Model 285
- 13.4.5 The Continuous Height Distribution Model Based on the Gamma Distribution 287
- 13.4.6 Comparison of the Models 289
- 13.5 Taking Photoinstabilities into Consideration 290
- 13.6 Consideration of the Distribution of the UV Extinction in the Water and the Oil Phases of the Formulation 294
- 13.7 Calculation of UVA Parameters 297
- 13.7.1 Australian Standard 297
- 13.7.2 UVA/UVB Ratio and Critical Wavelength 297
- 13.7.3 UVA Protection Factor (UVAPF) 298
- 13.7.4 The COLIPA Method for Assessment of UVA Protection 299
- 13.8 Correlations 300
- 13.8.1 Correlation of *In Vivo* SPF Data with SPF Calculations Using the Quasi-Continuous Step Film Model 300
- 13.8.2 Correlation of *In Vivo* UVAPF Data with UVAPF Calculations 302
- 13.9 Conclusion 305
- References* 305

Index 309