



Institute of  
Personal Care Science

# Cosmetic Formulations: An Advanced Guide Book



## Contents

<b>Chapter 1: Investigate and evaluate cosmetic ingredients</b>	<b>4</b>
<b>Chapter 2: Cosmetic ingredient and formula safety</b>	<b>65</b>
<b>Chapter 3: Compliance requirements of cosmetic ingredients</b>	<b>83</b>
<b>Chapter 4: Chemistry principles to select cosmetic ingredients</b>	<b>124</b>
<b>Chapter 5: Select preservatives for personal care formulas</b>	<b>192</b>
<b>Chapter 6: Select rheology modifiers for personal care formulas</b>	<b>244</b>
<b>Chapter 7: Select lipids for personal care formulas</b>	<b>324</b>
<b>Chapter 8: Fragrance or essential oil for personal care formulation</b>	<b>378</b>
<b>Chapter 9: Emulsifiers for personal care formulas</b>	<b>399</b>
<b>Chapter 10: Surfactants for personal care formulas</b>	<b>467</b>
<b>Chapter 11: Prepare skin care formulas</b>	<b>549</b>
<b>Chapter 12: Prepare hair care formulas</b>	<b>615</b>
<b>Chapter 13: Formulation development</b>	<b>655</b>
<b>Appendix A: Basic formulary</b>	<b>686</b>
<b>Appendix B: Formulation template</b>	<b>709</b>
<b>Glossary</b>	<b>710</b>

## Table of Contents

### Chapter 1: Investigate and evaluate cosmetic ingredients

Item	Page
1. Ingredients in cosmetic products	6
1.1 Basic ingredient functions	6
1.2 Determining ingredient functions	12
1.3 INCI names and CAS numbers	16
1.4 Sourcing raw materials and information	18
2. Company philosophy	21
3. Natural vs. synthetic ingredients	28
3.1 Organic ingredients	28
3.2 Certified Organic ingredients	29
3.3 Natural ingredients	30
3.4 Derived from natural	31
3.5 Nature identical ingredients	33
3.6 Synthetic ingredients	33
3.7 Determining natural/synthetic status	34
3.8 Manufacturer's flowcharts	37
4. Ingredient composition	41
4.1 Certificates of Analysis (CofAs)	42
4.2 Calculation composition	43
Appendix A: Answers to Activities	48
Appendix B: Manufacturers flow chart for Lanette O	54
Appendix C: CofA for Myritol 318	55
Appendix D: Manufacturers flow chart for alkyl polyglycosides	59
Appendix E: Product information for Genapol LRO Paste	60
Appendix F: CofA for Hostapon SCI85	61
Appendix G: Data sheet for Genapol LRO Liquid	63
Appendix H: Flow chart for Genagen CAB 818	64

### References and Additional Reading:

Barel, Andre; Paye, Marc; and Maibach, Howard, 2014. *Handbook of Cosmetic Science and Technology, 4<sup>th</sup> Edition*. CRC Press: New York.

Nikitakis, J; Lange, B, eds. 2016. *International Cosmetic Ingredient Dictionary and Handbook 16<sup>th</sup> Edition*. Personal Care Products Council: Washington.

## Table of Contents

### Chapter 2: Cosmetic ingredient and formula safety

Item	Page
1. Safety evaluation and regulation	67
1.1 The safety of cosmetic and personal care products	67
1.2 The need for companies to evaluate	67
1.3 Safety considerations	68
2. Irritants and allergens in cosmetic products	72
2.1 Irritants and irritant reactions	72
2.2 Allergens and allergic reactions	77
2.3 Pregnancy and essential oils	81

## Table of Contents

### Chapter 3: Cosmetic requirements of cosmetic ingredients

Item	Page
1. Cosmetic products	85
2. Ingredient lists	87
3. Australian compliance overview	92
3.1 Cosmetic ingredient compliance	93
4. Overview of European, Japanese and US requirements	111
4.1 Overview of European Union regulations	114
4.2 Overview of Japanese regulations	121
4.3 Overview of US regulations	121

## Table of Contents

### Chapter 4: Chemistry principles to select cosmetic ingredients

Item	Page
1. Structures of chemicals in cosmetic science	126
1.1 Specific functional groups	126
1.2 Physical properties relative to functional groups	135
2. Surfactants	138
2.1 Surfactant charge	142
2.2 Different emulsifiers and emulsion types	146
3. Processing Methods	150
3.1 Physical processing methods	150
3.2 Minimal chemical processing methods	152
3.3 Synthetic chemical processing methods	155
3.4 Oxidation	156
4. Selection of ingredients	157
4.1 Selection based on structural suitability	157
4.2 Selection based on processing methods	158
4.3 Selection based on form of finished product	158
5. The role of pH in personal care science	182
6. Viscosity and specific gravity	186
6.1 Measuring viscosity	186
6.2 Specific gravity	187
Appendix A: Answers to activities	188

## Table of Contents

### Chapter 5: Select preservatives for personal care formulas

Item	Page
1. Preservative actions	194
1.1 Factors affecting preservative performance	194
1.2 Formulating to reduce microbial risk	198
1.3 Factors that increase microbial risk	201
1.4 Manufacturing considerations	202
2. Ancillary agents	203
2.1 Antioxidants	203
2.2 Chelating agents	207
3. Preservative efficacy (challenge) testing	212
4. Selecting the right preservative	218
4.1 Preservative considerations	218
4.2 Evaluating new preservatives	231
4.3 Worked examples: preservative selection	233
Appendix A: Answers to activities	239

#### **References and Additional Reading:**

McKane, H & Kandel, J. 1995. *Microbiology: Essentials and Applications*. 2<sup>nd</sup> Edition. McGraw-Hill, Inc: New York.

Orth, D. 1999. *IFSCC Monograph Number 5: An Introduction to Cosmetic Microbiology*. Micelle Press: Weymouth.

Pharmaceutical Inspection Convention & Co-Operation Scheme, 2009. *PIC/S Guide to Good Manufacturing Practice for Medicinal Products*. PIC/S, 2017.

## Table of Contents

### Chapter 6: Select rheology modifiers for personal care formulas

Item	Page
1. The properties of 'flow'	246
1.1 Types of flow	246
1.2 Measuring viscosity	250
1.3 Shear in mixing	251
2. Purposes of flow in personal care	254
3. Gums and thickeners used in personal care	262
3.1 Water-based rheological agents	264
3.2 Oil based rheological agents	291
3.3 Gum/thickener selection checklist	298
4. Example formulas and formula builds	304
4.1 Example face/body gel formula build	305
4.2 Example serum build (emulsifier free)	307
4.3 Example o/w lotion/cream formula build	310
4.4 Example w/o lotion/cream formula build	312
Appendix A: Answers to activities	314
Appendix B: Selecting the right 'carbomer' for your formulation	318

#### **References and Additional Reading:**

Knowlton, JL and Pearce SEM, 1993. *The Handbook of Cosmetic Science and Technology*. Elsevier Advanced Technology: Oxford.

Laba, D. 1997. *IFSCC Monograph Number 3: An Introduction to Rheology*. Micelle Press: Weymouth.

Shaw, D. 1992. *Introduction to Colloid & Surface Chemistry 4<sup>th</sup> Ed*. Elsevier Science: Oxford.



## Table of Contents

### Chapter 7: Select lipids for personal care formulas

Item	Page
1. Lipids in personal care products	326
1.1 An overview of lipid types	327
1.2 Spreading profiles	331
2. Natural lipids	334
2.1 Natural oils and butters	334
2.2 Natural waxes	341
3. Natural derivatives of lipids	344
3.1 Chemical processing of derivatives	344
3.2 Properties of derivatives	348
4. Synthetic lipids	353
5. Silicone	355
6. Selecting appropriate lipids for your formula	359
6.1 Lipid selection checklist	367
6.2 Worked examples	368
Appendix A: Answers to activities	376

#### **References and Additional Reading:**

Battaglia, Salvatore, 2003. *The Complete Guide to Aromatherapy, 2<sup>nd</sup> Edition*. The International Centre of Holistic Aromatherapy: Brisbane.

Curtis, Tony and Williams, David, 2001. *An Introduction to Perfumery, 2<sup>nd</sup> Edition*. Micelle Press: New York.

Knowlton, JL and Pearce SEM, 1993. *The Handbook of Cosmetic Science and Technology*. Elsevier Advanced Technology: Oxford.

## Table of Contents

### Chapter 8: Fragrance or essential oil for personal care formulation

<b>Item</b>	<b>Page</b>
1. Essential oil blending	380
1.1 Blending top, middle and base notes	380
1.2 Blending by aroma type	381
2. Formulating with fragrances and essential oils	383
2.1 Legislation on essential oils and fragrances	383
2.2 Safety aspects of essential oils and fragrances	388
2.3 Usage rates	389
2.4 Incorporating fragrance and essential oils into products	390
2.5 Selecting fragrances and essential oils for personal care formulas	393
3. Fragrance and essential oils checklist	394
Appendix A: Answer to activities	396
Appendix B: Allergens according to EU cosmetics directive	398

## Table of Contents

### Chapter 9: Emulsifiers for personal care formulas

<b>Item</b>	<b>Page</b>
1. An overview of colloids	401
1.1 Colloidal system kinetics and thermodynamics	401
1.2 Intermolecular interactions affecting colloidal systems	406
2. Liquid/liquid colloids (emulsions)	415
2.1 Agitation	418
2.2 Emulsifiers	422
2.3 HLB	428
2.4 Emulsifier blends	429
2.5 Manufacturing emulsions	433
2.6 Stabilising emulsions	442
2.7 Selecting the appropriate emulsifier	445
Appendix A: Further reading on HLB	464

## Table of Contents

### Chapter 10: Surfactants for personal care formulas

<b>Item</b>	<b>Page</b>
1. An overview of surfactants	469
2. Properties of surfactants	473
2.1 Surface tension	473
2.2 Foaming	485
2.3 Solubilisation	491
2.4 Detergency	494
3. Types of surfactants	498
3.1 Anionic surfactants	501
3.2 Cationic surfactants	509
3.3 Nonionic surfactants	509
3.4 Amphoteric surfactants	518
4. Reducing the irritancy of surfactants	522
5. Surfactant selection checklist	524
5.1 General method when manufacturing foaming surfactants	528
5.2 Selecting your surfactants	540
5.3 Making final adjustments	547

## Table of Contents

### Chapter 11: Prepare skin care formulas

Item	Page
1. Skin physiology	551
1.1 Absorbance into the skin	555
1.2 Formulating basic facial care products	572
1.3 Formulating baby care products	610
1.4 Formulating men's skin care products	612