

Contents

Preface — v

Part I: Colloid and interface science in agrochemical formulations

- 1 Surfactants used in agrochemical formulations and their solution properties — 3**
 - 1.1 General classification of surfactants — 3
 - 1.2 Properties of solutions of surfactants — 12
 - 1.3 Solubility–temperature relationship for surfactants — 17
 - 1.4 Thermodynamics of micellization — 17
 - 1.5 Micellization in surfactant mixtures (mixed micelles) — 24
 - 1.6 Surfactant–polymer interaction — 26
- 2 Emulsion concentrates (EWs) — 33**
 - 2.1 Introduction — 33
 - 2.2 Formation of emulsions — 33
 - 2.3 Mechanism of emulsification — 35
 - 2.4 Methods of emulsification — 36
 - 2.5 Role of surfactants in emulsion formation — 37
 - 2.6 Selection of emulsifiers — 39
 - 2.6.1 The hydrophilic-lipophilic balance (HLB) concept — 39
 - 2.6.2 The phase inversion temperature (PIT) concept — 41
 - 2.6.3 The cohesive energy (CER) concept for emulsifier selection — 43
 - 2.6.4 The critical packing parameter (CPP) for emulsifier selection — 45
 - 2.7 Emulsion stability — 46
 - 2.7.1 Creaming or sedimentation of emulsions — 47
 - 2.7.2 Flocculation of emulsions — 51
 - 2.7.3 Ostwald ripening — 52
 - 2.7.4 Coalescence of emulsions — 54
 - 2.7.5 Phase inversion — 56
 - 2.8 Experimental methods for assessing emulsion stability — 57
- 3 Suspension concentrates (SCs) — 61**
 - 3.1 Introduction — 61
 - 3.2 Preparation of suspension concentrates and the role of surfactants/dispersing agents — 62
 - 3.3 Effect of surfactant adsorption — 66
 - 3.4 Control of the physical stability of suspension concentrates — 67

3.5	Ostwald ripening (crystal growth) —	73
3.6	Stability against claying or caking —	74
3.7	Characterization of suspension concentrates and assessment of their long-term physical stability —	82
4	Suspoemulsions —	99
4.1	Introduction —	99
4.2	Systems investigated for studying interactions —	100
4.3	Creaming/sedimentation of suspoemulsions —	101
4.4	Reduction of suspension/emulsion interaction and prevention of instability —	103
4.5	Summary of the criteria for preparing a stable suspoemulsion —	104
4.6	Preparation of suspoemulsion by emulsification of the oil into the suspension —	105
4.7	Prevention of crystallization —	105
4.8	Model suspoemulsion of polystyrene latex and isoparaffinic oil stabilized with Pluronic PE (PEO–PPO–PEO A–B–A block copolymer) —	106
4.9	Model systems of polystyrene latex with grafted PEO chains and hexadecane emulsions —	108
4.10	Conclusions —	111
5	Oil-based suspension concentrates —	113
5.1	Introduction —	113
5.2	Stability of suspensions in polar media —	113
5.3	Stability of suspensions in nonpolar media —	116
5.4	Settling of suspensions and prevention of formation of dilatant sediments —	120
5.5	Emulsification of oil-based suspensions —	124
5.6	Polymeric surfactants for oil-based suspensions and the choice of emulsifiers —	127
5.7	Emulsification into aqueous electrolyte solutions —	128
5.8	Proper choice of the antissettling system —	128
5.9	Rheological characteristics of the oil-based suspensions —	129
6	Microemulsions in agrochemicals —	131
6.1	Introduction —	131
6.2	Application in agrochemicals —	133
6.3	Basic principles of microemulsion formation and thermodynamic stability —	134
6.3.1	Mixed film theories —	134
6.3.2	Solubilization theories —	135

6.3.3	Thermodynamic theory of microemulsion formation and stability — 138
6.3.4	Factors determining W/O versus O/W microemulsions — 139
6.4	Characterization of microemulsions using scattering techniques — 140
6.5	Characterization of microemulsions using conductivity — 145
6.6	NMR Measurements — 146
6.7	Selection of surfactants for formulation of microemulsions — 147
6.8	Role of microemulsions in enhancing biological efficacy — 148
7	Controlled-release formulations — 153
7.1	Introduction — 153
7.2	Types of controlled-release systems — 153
7.3	Mechanism of controlled release from microparticles — 159
8	Interfacial aspects of agrochemical spray formulations — 163
8.1	Introduction — 163
8.2	Interactions at the air/solution interface and their effect on droplet formation — 167
8.3	Spray impaction and adhesion — 171
8.4	Droplet sliding and spray retention — 174
8.5	Wetting and spreading — 177
8.6	Evaporation of spray drops and deposit formation — 182
8.7	Solubilization and its effect on transport — 183
8.8	Interaction between surfactant, agrochemical and target species — 187

Part II: Colloid and interface science in paints and coatings

9	General introduction — 191
10	Emulsion, dispersion and suspension polymerization preparation of polymer colloids and their stabilization — 199
10.1	Introduction — 199
10.2	Emulsion polymerization — 199
10.3	Polymeric surfactants for stabilizing preformed latex dispersions — 209
10.4	Dispersion polymerization — 214
11	Pigment dispersion and the role of surfactants in wetting — 221
11.1	Introduction — 221
11.2	Powder wetting — 222

11.3	Critical surface tension of wetting —	227
11.4	Effect of surfactant adsorption —	228
11.5	Wetting of powders by liquids —	230
11.6	Wetting agents for hydrophobic pigments —	233
11.7	Dynamics of processing of adsorption and wetting —	235
12	Breaking of aggregates and agglomerates (deagglomeration) and size reduction —	245
12.1	Dispersion of aggregates and agglomerates into single particles —	245
12.2	Classification of dispersants —	246
12.2.1	Surfactants —	246
12.2.2	Polymeric surfactants —	246
12.2.3	Polyelectrolytes —	248
12.3	Assessment and selection of dispersants —	249
12.3.1	Adsorption isotherms —	249
12.3.2	Measurement of dispersion and particle size distribution —	250
12.4	Wet milling (comminution) —	255
13	Rheology of paint formulations —	259
13.1	Introduction —	259
13.2	Experimental techniques for studying paint rheology —	262
13.2.1	Experimental methods for quality control —	262
13.2.2	Rheological techniques for research and development of a paint system —	264
13.3	Application of rheological techniques to paint formulations —	277
13.4	Dispersion and ingredients —	278
13.5	Grinding and mixing —	280
13.6	Application of rheology for paint evaluation —	282
13.7	Flow in pipes —	283
13.8	Examples of the flow properties of some commercial paints —	285

Part III: Colloid and interface science in food colloids

14	Interaction between food-grade surfactants and water —	291
14.1	Introduction —	291
14.2	Interaction between food-grade surfactants and water —	292
14.2.1	Liquid crystalline structures —	292
14.2.2	Binary phase diagrams —	294
14.2.3	Ternary phase diagrams —	298
14.3	Monolayer formation —	299
14.4	Liquid crystalline phases and emulsion stability —	303

15	Proteins as emulsifiers and their interaction with polysaccharides — 305
15.1	Protein structure — 305
15.2	Interfacial properties of proteins at the liquid/liquid interface — 307
15.3	Proteins as emulsifiers — 308
15.4	Protein–polysaccharide interactions in food colloids — 308
15.5	Polysaccharide–surfactant interactions — 310
16	Surfactant association structures, microemulsions and emulsions in food — 313
17	Rheology of food emulsions — 319
17.1	Interfacial rheology — 319
17.2	Correlation of emulsion stability with interfacial rheology — 321
17.2.1	Mixed surfactant films — 321
17.2.2	Protein films — 322
17.3	Bulk rheology of emulsions — 323
17.4	Formation of networks — 325
17.5	Rheology of microgel dispersions — 327
17.6	Fractal nature of the aggregated network — 327
18	Food rheology and mouth feel — 329
18.1	Introduction — 329
18.2	Rheological measurements — 329
18.3	Mouth feel of foods – the role of rheology — 332
18.3.1	Break-up of Newtonian liquids — 334
18.3.2	Break-up of non-Newtonian liquids — 335
18.4	Complexity of flow in the oral cavity — 335
18.5	Rheology–texture relationship — 336
18.6	Practical applications of food colloids — 339
Index — 343	