

Contents

1	Sugar derived surfactants	1
	H. S. BEVINAKATTI AND B. K. MISHRA	
1.1	Introduction	1
1.2	Chemical synthesis and production	2
1.2.1	Sorbitan esters	2
1.2.2	Ethoxylated sorbitan esters	5
1.2.3	Sucrose esters	5
1.2.4	Alkyl polyglucosides	7
1.2.5	Alkyl glucamides	8
1.2.6	Aldonamides	10
1.2.7	Bolaamphiphiles	12
1.2.8	Geminis	13
1.3	Enzymatic synthesis	14
1.3.1	Enzymatic synthesis of sugar esters	15
1.3.2	Enzymatic synthesis of alkyl glucosides	18
1.3.3	Enzymatic synthesis of alkyl glucamides	19
1.4	Physical properties and applications	20
1.4.1	Sorbitan esters and ethoxylated sorbitan esters	21
1.4.2	Sucrose esters	23
1.4.3	Alkyl polyglucosides	28
1.4.4	Glucamides/Gluconamides	35
	Acknowledgements	40
	References	40
2	Microbial and enzymatic production of biosurfactants	51
	S. LANG AND L. FISCHER	
2.1	Introduction	51
2.2	Microbial biosurfactants	52
2.2.1	Non-glycolipid biosurfactants	52
2.2.2	Glycolipid biosurfactants	55
2.3	Enzymatic production of biosurfactants	79
2.3.1	Lipase catalysis for the production of glycolipids	81
2.3.2	Glycosidase catalysis for the production of glycolipids	83
2.4	Potential applications of biosurfactants	84
2.5	Perspectives for biosurfactants	86
	References	87

3 Natural hydrocolloids as food emulsifiers 104

N. GARTI AND M. E. LESER

3.1	Introduction	104
3.2	Gum arabic	107
3.3	Galactomannans	112
3.3.1	LBG, guar and fenugreek	112
3.3.2	Fenugreek gum	116
3.3.3	Adsorption isotherms of galactomannans	117
3.3.4	The role of protein in galactomannans	120
3.4	Xanthan gum	122
3.5	<i>Portulaca oleracea</i> and <i>Oritus ficus</i> gums	123
3.6	Tragacanth gum	130
3.7	Pectins	130
3.8	Mechanistic considerations	131
3.9	Protein-polysaccharide interactions	135
3.10	Stabilization by solid particles—colloidal microcrystalline cellulose as emulsifier	137
3.11	Biosurfactants	138
3.12	Conclusions	140
	References	141

4 Narrow alcohol ethoxylates 146

I. HAMA

4.1	Introduction	146
4.2	Chemical synthetic method	146
4.2.1	Catalyst for alkoxylation	146
4.2.2	New catalysts for synthesizing NREs	148
4.2.3	Al-Mg composite oxide catalyst	149
4.2.4	Propoxylation	154
4.3	Basic surfactant properties	156
4.3.1	NRE	156
4.3.2	NREP	157
4.4	Applications	159
4.4.1	Dish-washing detergent	159
4.4.2	Heavy-duty liquid detergent	161
4.4.3	Heavy-duty powder detergent	162
4.4.4	Thickener	162
4.4.5	Other applications	163
4.5	Other derivatives	163
4.5.1	NRE derivatives	163
4.5.2	Ethoxylated fatty acid methyl esters (EFMEs)	165
	Acknowledgments	165
	References	165

5 Catalytic and kinetic effects in ethoxylation processes 168

E. SANTACESARIA, P. IENGO AND M. DI SERIO

5.1	Introduction	168
5.2	Mechanisms of catalytic ethylene oxide condensation	168
5.2.1	Introduction	168
5.2.2	Base-catalysed ethylene oxide ring opening and polymerisation	169
5.2.3	Acid-catalysed ethylene oxide ring opening and polymerisation	170
5.2.4	Transition metal complexes promoting ethylene oxide ring opening and polymerisation	176
5.2.5	Heterogeneous catalysts	181
5.3	Ethoxylation kinetics in the production of surfactants	183
5.3.1	Conditions for the collection of reliable kinetic data and their interpretation	183
5.3.2	A general approach to the kinetic model for the ethoxylation promoted by alkaline catalysts	187
5.3.3	Kinetics of alkylphenol ethoxylation in the presence of alkaline catalysts	192
5.3.4	Kinetics of fatty acid ethoxylation in the presence of alkaline catalysts	195
5.3.5	Propoxylation of primary and secondary alcohols in comparison with ethoxylation	200
5.3.6	Considerations about the kinetics of ethoxylation in the presence of acid catalysts	205
5.4	Conclusions	208
	Nomenclature	209
	References	211

6 Secondary alcohol ethoxylates 216

K. RAKUTANI, Y. ONDA AND T. INAOKA

6.1	Introduction	216
6.1.1	Manufacturing technology	216
6.1.2	Chemical characteristics	217
6.2	Physical properties	218
6.2.1	Viscosity and pour point	219
6.2.2	Gel range	221
6.3	Surface phenomena	222
6.3.1	Surface tension reducibility	222
6.3.2	Wetting power	222
6.3.3	Foaming property	224
6.4	Environmental effects and safety of SAEs	225
6.4.1	Biodegradability	225
6.4.2	Safety of SAEs	227
6.5	The application of SAEs	229
6.5.1	Application in household detergents	229
6.5.2	The industrial applications	234
6.6	Derivatives of SAE	240
6.6.1	Propylene oxide adducts (low foam derivatives)	240
6.6.2	Sulfosuccinate half-esters (SAE-MES)	240
6.7	New production process of SAE	245
6.8	Summary	246
	References	246

7	Surfactants in floor polishes	248
	R. W. AVERY	
7.1	Historical overview	248
7.1.1	Traditional practices	248
7.1.2	Water-based products	249
7.1.3	Emulsion polymers	253
7.1.4	Non-shellac co-polymers	254
7.1.5	Introduction of polyethylene waxes	254
7.1.6	Amino-functional polymers	255
7.1.7	Metal-containing polymers and polishes	255
7.1.8	Wash and wax polishes	257
7.2	Modern floor polishes	258
7.2.1	Emulsion polymer	258
7.2.2	Polish example	259
7.2.3	Metallizing complex solution	260
7.2.4	Levelling resin	260
7.2.5	Polyethylene wax emulsion	260
7.2.6	Plasticizers	260
7.2.7	Wetting agent	261
7.2.8	Preparation of modern wax emulsions	262
7.3	Polish categories	265
7.3.1	Polymer-rich Drybright	266
7.3.2	Semi- or lightly buffable polish	266
7.3.3	Moderately buffable polish	267
7.4	Environmental trends	268
7.4.1	Elimination of tributoxylethyl phosphate	268
7.4.2	Biodegradable surfactants with multiple benefits	268
7.4.3	Elimination of metal-containing polymers	268
7.4.4	Non-aromatic-based plasticizers	268
	Acknowledgements	269
	References	270
8	Fluorinated surfactants in practice	271
	C. K. TAYLOR	
8.1	Introduction	271
8.2	Surfactants	271
8.2.1	The hydrophobe	272
8.2.2	The hydrophile	272
8.2.3	Fluorinated surfactants without a hydrophile	274
8.3	Fluorinated surfactants—general	274
8.4	Preparation of fluorinated surfactants	275
8.4.1	ECF-derived fluorosurfactants	275
8.4.2	Telomer-derived fluorosurfactants	275
8.4.3	Oligomerization of tetrafluoroethylene	277
8.5	Distinguishing characteristics of fluorocarbon surfactants	277
8.6	Behavior of fluorosurfactants in aqueous systems	278
8.7	Dynamic surface tension—the kinetics of fluorosurfactants	280
8.8	Dynamic surface tension in mixed systems	284
8.9	Foams	286

8.9.1	Avoiding or eliminating foams	291
8.9.2	Reducing foaming with mixtures of surfactants bearing opposite charges	294
8.10	Fluorosurfactants and condensed-phase interfaces	299
8.10.1	Fluorosurfactants at the liquid/liquid boundary	299
8.10.2	Emulsions	300
8.10.3	Fluorosurfactants at the solid/liquid boundary. 'Wetting'	303
8.10.4	Wetting and spreading in mixed systems.	308
8.10.5	Fluorosurfactants and 'Rewet'	309
8.10.6	Fluorosurfactants and dispersions	311
8.11	Detergency	312
8.12	Interactions of fluorinated surfactants with charged surfaces	314
	References	314

9 Polymerizable surfactants: spontaneous polymerization in organized micellar media 317

Y. YASUDA

9.1	Introduction	317
9.2	Polymerization of polymerizable surfactants	318
9.2.1	Fixation of organized micellar structure by polymerization	318
9.2.2	Concentration effect of monomer	318
9.2.3	Orientation effect of monomer	319
9.2.4	Additive effect	319
9.2.5	Inverse micelle system	320
9.3	Spontaneous polymerization of pure vinyl monomers	320
9.4	Spontaneous polymerization of polymerizable surfactants	322
9.4.1	Effect of monomer micellization	323
9.4.2	Effect of alkyl chain length	324
9.4.3	Effect of additives	326
9.4.4	Mutual monomer interaction and spontaneous polymerizability	327
9.4.5	Spontaneous polymerization in organic media	328
9.4.6	Effect of different polymerizable groups	329
9.4.7	Spontaneous polymerization in lyotropic liquid crystal	330
9.5	Spontaneous polymerization in an anisotropic reaction locus	331
9.5.1	Spontaneous polymerization of vinylpyridinium salts	331
9.5.2	Spontaneous polymerization in emulsion polymerization	331
9.5.3	Polymerization of vinyl monomers initiated by water-soluble polymers	333
9.6	Initiation mechanism of spontaneous polymerization in an organized system	335
9.6.1	Spontaneous polymerization of polymerizable surfactants in micelles	335
9.6.2	Spontaneous polymerization of vinyl monomers solubilized in micelle	336
9.7	Conclusions	337
	References	337

10 Computer modelling of surfactants 339

N. QUIRKE

10.1	Introduction	339
10.2	Models of surfactant molecules	339
10.3	Molecular simulation	343
10.4	Molecular models of surfactant solutions	350

10.4.1 Micellisation	350
10.4.2 Interfaces	354
10.5 Conclusions	357
Acknowledgements	357
References	357
Index	360