

# Handbook of Surfactants

Second edition

M. R. PORTER, BSc, PhD, CChem, MRSC  
Maurice R. Porter & Associates  
Consultants in Speciality Chemicals  
Sully  
South Wales



**BLACKIE ACADEMIC & PROFESSIONAL**

An Imprint of Chapman & Hall

London · Glasgow · Weinheim · New York · Tokyo · Melbourne · Madras

# Contents

<b>1</b>	<b>General introduction</b>	<b>1</b>
<b>2</b>	<b>General approach to using surfactants in formulations</b>	<b>6</b>
2.1	Introduction	6
2.2	Systematic approach	8
2.3	Practical formulation	9
2.4	Understanding formulations and end effects	10
2.5	Properties of the hydrophilic and hydrophobic groups	11
2.5.1	The hydrophilic group	11
2.5.2	The hydrophobic group	11
<b>3</b>	<b>Information sources</b>	<b>14</b>
3.1	Introduction	14
3.2	Manufacturers' literature	15
3.3	Published books	17
3.4	Journals and periodicals	20
3.5	Patents	21
3.6	Symposia, meetings and courses	23
3.7	Government publications	23
3.8	Databases	24
<b>4</b>	<b>Use of surfactant theory</b>	<b>26</b>
4.1	Introduction	26
4.2	Adsorption and critical micelle concentration (CMC)	27
4.3	Micelles, vesicles, liposomes and lamellar structures	39
4.4	Solubility and liquid crystals	46
4.5	Solubilisation and microemulsions	57
4.6	Wetting	61
4.7	Foaming/defoaming	65
4.8	Macroemulsions and HLB	72
4.9	Dispersing	78
4.10	Detergency	84
4.11	Surfactant mixtures and interactions	89
	References	92
<b>5</b>	<b>Surfactants commercially available</b>	<b>94</b>
	Reference	98
<b>6</b>	<b>Anionics</b>	<b>99</b>
6.1	Soaps	100
6.2	Modified carboxylates	104
6.2.1	Ethoxy carboxylates	105
6.2.2	Ester carboxylates	107
6.2.3	Amide carboxylates	109
6.3	Isethionates (ester sulphonates)	111
6.4	Phosphate esters	113

6.5	Sulphates	116
6.5.1	Alcohol sulphates	118
6.5.2	Alcohol ether sulphates	121
6.5.3	Sulphated alkanolamide ethoxylates	126
6.5.4	Sulphated oils and glycerides	127
6.5.5	Nonylphenol ether sulphates	129
6.6	Sulphonates — general	130
6.6.1	Ethane sulphonates	134
6.6.2	Paraffin sulphonates	135
6.6.3	Alkyl benzene sulphonates	138
6.6.4	Fatty acid and ester sulphonates	143
6.6.5	Alkyl naphthalene sulphonates	148
6.6.6	Olefin sulphonates	151
6.6.7	Petroleum sulphonates	155
6.7	Sulphosuccinates and sulphosuccinamates	159
6.7.1	Sulphosuccinates	159
6.7.2	Sulphosuccinamates	164
6.8	Taurates (amide sulphonates)	166
	References	168
<b>7</b>	<b>Nonionics</b>	<b>169</b>
7.1	General introduction	169
7.1.1	The chemistry of ethoxylation	171
7.1.2	General properties of nonionics	175
7.1.3	Surface-active properties of nonionics	180
7.2	Acetylenic surfactants	187
7.3	Alcohol ethoxylates	188
7.4	Alkanolamides	194
7.5	Amine oxides, phosphine oxides and sulfoxides	198
7.6	Surfactants derived from mono- and poly-saccharides	202
7.7	Ethoxylated alkanolamides	210
7.8	Ethoxylated long-chain amines	212
7.9	Ethylene oxide/propylene oxide (EO/PO) copolymers	215
7.10	Fatty acid ethoxylates	222
7.11	Sorbitan derivatives	226
7.12	Ethylene glycol, propylene glycol, glycerol and polyglyceryl esters plus their ethoxylated derivatives	231
7.13	Alkyl amines and alkyl imidazolines	236
7.14	Ethoxylated oils and fats	242
7.15	Alkyl phenol ethoxylates	243
	References	246
<b>8</b>	<b>Cationics</b>	<b>248</b>
8.1	Cationics (general)	248
8.2	Quaternary ammonium	249
8.3	Amine and imidazoline salts	254
	Reference	257
<b>9</b>	<b>Amphoterics</b>	<b>258</b>
9.1	Amphoterics (general)	258
9.2	Betaines	264
9.3	Glycinates	269
9.4	Amino propionates	272
	References	275

<b>10 Speciality surfactants</b>	<b>276</b>
10.1 General	276
10.2 Silicone surfactants	277
10.3 Fluorocarbons	282
10.4 Miscellaneous specialities	285
10.4.1 Bolaform surfactants	285
10.4.2 Gemini surfactants	286
10.4.3 Labile surfactants	287
10.4.4 Polymerisable surfactants	288
References	292
<b>11 Polymeric surfactants</b>	<b>293</b>
References	304
<b>Appendix 1 Names of hydrophobes and average composition of fats and oils</b>	<b>305</b>
<b>Appendix 2 Ecological and toxicity requirements</b>	<b>306</b>
Biodegradation	306
Toxicity	313
References	317
<b>Index</b>	<b>318</b>