

Contents

Introduction.....	ix
CHAPTER 1 Processing of calcium montmorillonites for use in polymers	1
1.1 Introduction.....	1
1.2 Definitions	5
1.3 Morphology of montmorillonite which is important for use in the polymer industry	5
1.4 Introduction—the activation of calcium bentonites to achieve a high aspect ratio	8
1.4.1 Problems in determining the soda ash dosage for the deposit-specific optimized cation exchange.....	9
1.4.2 Chemical–mineralogical basis of the alkaline activation of bentonites and technical problems in the realization.....	9
1.4.3 Thixotropy and yield point of bentonite suspensions.....	10
1.4.4 Definitions of a chemical and technical degree of activation.....	12
1.4.5 Activation technique.....	13
1.4.6 Determination of the yield point	16
1.5 Criteria for the selection of calcium bentonites, their alkaline activation, and the achievable aspect ratio	22
1.6 Conclusions	25
References	25
CHAPTER 2 Chemical/physical preprocessing of nanoclay particles	27
2.1 Introduction—montmorillonite	28
2.2 Activation	29
2.2.1 Activation by acids	29
2.2.2 Characterization of activated MMT	31
2.3 Metal cation exchange.....	34
2.3.1 Metal-(II)-cations	34
2.3.2 Metal-(III)-cation	36
2.3.3 Characterization of metal cation–exchanged montmorillonite.....	37
2.4 Organomodification.....	39
2.4.1 Amino acid as modification reagent.....	40
2.4.2 Characterization of organomodified montmorillonite.....	44
2.5 Conclusions	48
References	49

CHAPTER 3 Processing of polymer–nanoclay composites.....	53
3.1 Nanoclay processing basics.....	54
3.1.1 “Melt mixing” (compounding).....	54
3.1.2 Characteristic process parameters	54
3.1.3 Calculation of the shear energy for extrusion and compounding.....	58
3.1.4 Calculation of the shear energy for injection molding.....	58
3.1.5 Visualization of nanoclay dispersion.....	59
3.1.6 Influence of shearing on Young’s modulus and breaking strain.....	59
3.1.7 Influence on internal pressure creep time and longitudinal shrinkage	62
3.1.8 Conclusions	63
3.2 Advanced compounding.....	64
3.2.1 Case study: extrusion of PP nanocomposites by advanced compounding.....	64
3.3 Injection mold compounding	71
3.3.1 Case Study.....	73
3.4 Conclusions.....	89
References	90
CHAPTER 4 Characterization of polymer nanocomposites based on layered silicates	93
4.1 Introduction.....	94
4.2 Offline characterization	94
4.2.1 Spectroscopic measurements	94
4.2.2 Determination of physical properties	97
4.2.3 Rotational rheometry.....	98
4.2.4 Extensional rheometry	100
4.3 Inline and online characterization	101
4.3.1 Online extensional rheometry with the help of Rheotens equipment.....	101
4.3.2 Inline NIR investigations.....	104
4.4 Conclusions.....	122
References	122
CHAPTER 5 Properties and applications of nanoclay composites.....	127
5.1 Introduction.....	127
5.2 Mechanical reinforcement capabilities of layered silicates	128
5.3 Effect of layered silicates on the rheological properties	131

5.4	The influence of layered silicates on barrier properties	133
5.5	The influence of layered silicates on tribology	136
5.6	Thermal conductivity of layered silicate polymer nanocomposites	137
5.7	Thermal stability of layered silicate polymer nanocomposites...	138
5.8	Layered silicates for biodegradation application	140
5.9	Clays for drug delivery systems	142
5.10	Layered silicates as halogen-free FRs.....	143
5.10.1	Development of fire.....	143
5.10.2	Layered silicates as FR additives	148
5.11	Summary	149
	References	150
CHAPTER 6	Safety issues of silica nanomaterials in the frame of industrial use	157
6.1	Introduction.....	157
6.2	Safety assessment according to REACH and guidance	160
6.2.1	Exposure and toxicity assessment.....	160
6.2.2	Standardization.....	164
6.3	Nano-silica use in applications.....	165
6.3.1	Workplace safety	166
6.3.2	Environmental safety on nano-silica	169
6.4	Conclusions	169
	Acknowledgment	171
	Abbreviations	171
	References	172
	Index	177