

Contents

1	Cement Kinds and Principles of their Classification.....	1
1.1	The History of Binders and Concrete.....	1
1.2	Principles of Cement Classification	10
	References	19
2	Portland Cement Clinker	21
2.1	Portland Cement Clinker Burning.....	21
2.2	The Phase Systems Important for Cement Chemistry	32
2.2.1	The System $\text{CaO-SiO}_2\text{-Al}_2\text{O}_3$	32
2.2.2	The System $\text{CaO-Fe}_2\text{O}_3\text{-SiO}_2$	39
2.2.3	The System $\text{CaO-Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$	40
2.2.4	The System $\text{CaO-SiO}_2\text{-Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$	41
2.2.5	Departure from Equilibrium in the Clinkering Process.....	46
2.3	The Clinkering Process in Industrial Mixes.....	48
2.3.1	The Clinkering Process Modification in the Presence of Mineralizers.....	55
2.3.2	Clinkering Process in Rotary Kiln.....	63
2.4	Thermochemistry of Clinkering Process.....	69
2.5	Phase Composition of Portland Cements.....	72
2.5.1	Tricalcium Silicate and Alite Phase.....	77
2.5.2	Dicalcium Silicate and Belite Phase.....	88
2.5.3	$\text{Ca}_3\text{Al}_2\text{O}_6$ and Aluminate Phase in Clinker	98
2.5.4	Ferrite Phase	103
2.5.5	Minor Phases	107
2.5.6	Methods of Clinker Phase Composition Determination.....	115
	References	123
3	Hydration of Clinker Phases.....	129
3.1	Introduction.....	129
3.2	Silicate Hydration.....	131

3.2.1	Tricalcium Silicate Hydration.....	131
3.2.2	Dicalcium Silicate Hydration	147
3.2.3	C–S–H Phase	148
3.3	Hydration of Calcium Aluminates	166
3.3.1	The System $\text{CaO}-\text{Al}_2\text{O}_3-\text{H}_2\text{O}$	166
3.3.2	Calcium Sulphoaluminate Hydrates and Other Aluminate Hydrated Phases	171
3.3.3	C_3A Hydration	179
3.3.4	C_3A Hydration in the Presence of Gypsum.....	186
3.3.5	Hydration of Different C_3A Polymorphs.....	188
3.4	Hydration of Ferrite Phase	190
3.5	Minor Hydrated Phases in Cement Paste.....	191
3.6	Heat of Hardening.....	192
	References.....	200
4	Cement Hydration	205
4.1	Cement Hydration at Room Temperature	205
4.1.1	Paste Phase Composition.....	212
4.1.2	Role of Gypsum in Hydration and Disturbances of the Setting Process	213
4.1.3	Effect of Selected Compounds on Cement Hydration.....	226
4.1.4	The Effect of Grinding Aids	254
4.1.5	Chromium Reducers	256
4.2	Hydration of Cement in Hydrothermal Conditions.....	258
4.2.1	Phases in the $\text{CaO}-\text{SiO}_2-\text{H}_2\text{O}$ System.....	258
4.2.2	The Conditions of Formation and Structures of Some Selected Phases.....	259
4.2.3	Phase Composition of Cement Hydrated in Hydrothermal Conditions	265
	References.....	272
5	The Properties of Cement Paste	279
5.1	The Rheological Properties of Concrete	280
5.2	Relationship Between the Microstructure and Strength of Cement Paste.....	303
5.3	Deformation of the Paste.....	332
5.3.1	Volume Changes of the Plastic Paste.....	333
5.3.2	Drying Shrinkage.....	341
5.3.3	Volume Changes of Concrete	348
5.3.4	Creep.....	349
5.3.5	Permeability of Paste.....	351
	References.....	364

6 Concrete Properties	369
6.1 Effect of Cement Paste on Concrete Properties	369
6.2 Cement Paste–Aggregate Bond.....	374
6.3 Paste–Reinforcement Bond.....	386
6.4 Concrete Corrosion	392
6.4.1 Paste–Aggregate Reactions	396
6.4.2 Limestone Aggregates	412
6.4.3 Delayed Ettringite Formation.....	414
6.4.4 Corrosion of Concrete in the Chlorides Solutions.....	426
6.4.5 Sulphate Attack.....	441
6.4.6 Corrosion in Sea Water.....	454
6.4.7 Miscellaneous Corrosive Media.....	459
6.4.8 Carbonation of Concrete.....	460
6.4.9 Soft Waters.....	467
6.4.10 Action of Frost on Concrete	470
6.4.11 Corrosion of Steel in Concrete	478
6.5 Efflorescence of Concrete	485
6.6 Admixtures Modifying Paste and Concrete Properties	489
6.6.1 Water Reducing Admixtures (Plasticizers).....	490
6.6.2 Superplasticizers.....	495
6.6.3 Shrinkage Reducing Admixtures.....	510
6.6.4 Air Entraining Agents.....	511
6.6.5 Permeability Reducing Admixtures.....	513
6.6.6 Viscosity Modifying Admixtures.....	514
6.7 Mineral and Chemical Composition of Aggregates.....	515
References	522
7 Mineral Additions for Cement Production	533
7.1 Classification.....	533
7.2 Metallurgical Slags.....	538
7.3 Slag Cements.....	548
7.4 Fly Ash	556
7.5 Cements with Fly Ash Addition	567
7.6 Silica Fume.....	573
7.7 Fillers.....	574
7.8 Metakaolinite.....	577
References	578
8 Hydration of Cements with Mineral Additions.....	585
8.1 Hydration of Slag.....	585
8.2 Fly Ash Hydration	590
References	600

9 Special Cements	603
9.1 Calcium Aluminate Cement	604
9.2 White and Coloured Cements	613
9.3 Expansive Cements	615
9.4 Rapid Hardening and Fast-Setting Cements.....	638
9.5 Low Energy Cements	641
9.5.1 Alinite Cements	647
9.6 Oilwell Cement	649
9.7 Sorel Cement.....	651
9.8 Very High Strength Pastes.....	652
References	655
 10 New Concretes	 661
10.1 Introduction.....	661
10.2 High Performance Concretes	662
10.3 Self Compacting Concrete	668
10.4 Reactive Powder Concretes.....	669
10.5 Polymer-Cement Concretes.....	672
References	674
 Index	 677



<http://www.springer.com/978-94-007-7944-0>

Cement and Concrete Chemistry

Kurdowski, W.

2014, XII, 700 p. 477 illus., Hardcover

ISBN: 978-94-007-7944-0