
Contents

Chapter 1	Introduction	1
1.1	Scope of the Book	1
1.1.1	Target Group Description	1
1.1.2	Specialties Outside the Scope.....	2
1.2	Protection Mechanisms of Organic Coatings.....	2
1.2.1	Diffusion of Water and Oxygen.....	3
1.2.2	Electrolytic Resistance.....	5
1.2.3	Adhesion.....	6
1.2.3.1	What Adhesion Accomplishes.....	6
1.2.3.2	Wet Adhesion.....	7
1.2.3.3	Important Aspects of Adhesion	7
1.2.4	Passivating with Pigments	8
1.2.5	Alternative Anodes (Cathodic Protection).....	8
	References.....	8
Chapter 2	Composition of the Anticorrosion Coating	11
2.1	Coating Composition Design.....	11
2.2	Binder Types.....	11
2.2.1	Epoxies.....	12
2.2.1.1	Chemistry.....	12
2.2.1.2	Ultraviolet Degradation	13
2.2.1.3	Variety of Epoxy Paints.....	14
2.2.2	Acrylics.....	15
2.2.2.1	Chemistry.....	15
2.2.2.2	Saponification	17
2.2.2.3	Copolymers.....	18
2.2.3	Polyurethanes	18
2.2.3.1	Moisture-Cure Urethanes.....	20
2.2.3.2	Chemical-Cure Urethanes.....	20
2.2.3.3	Blocked Polyisocyanates.....	21
2.2.3.4	Health Issues	21
2.2.3.5	Waterborne Polyurethanes.....	22
2.2.4	Polyesters	22
2.2.4.1	Chemistry	22
2.2.4.2	Saponification	23
2.2.4.3	Fillers	23
2.2.5	Alkyds	23
2.2.5.1	Chemistry	24
2.2.5.2	Saponification.....	24

2.4.2	Reactive Reagents	50
2.4.3	Contra-Environmental Chemicals.....	50
2.4.4	Special Effect Inducers	5.1
	References.....	5.1

Chapter 3 Waterborne Coatings..... 55

3.1	Technologies for Polymers in Water	56
3.1.1	Water-Reducible Coatings and Water-Soluble Polymers.....	56
3.1.2	Aqueous Emulsion Coatings.....	56
3.1.3	Aqueous Dispersion Coatings.....	56
3.2	Water vs. Organic Solvents.....	57
3.3	Latex Film Formation	57
3.3.1	Driving Force of Film Formation	58
3.3.2	Humidity and Latex Cure	59
3.3.3	Real Coatings	60
	3.3.3.1 Pigments.....	60
	3.3.3.2 Additives.....	62
3.4	Minimum Film Formation Temperature.....	62
3.4.1	Wet MFFT and Dry MFFT.....	63
3.5	Flash Rusting.....	63
	References.....	64

Chapter 4 Blast Cleaning and Other Heavy Surface Pretreatments..... 67

4.1	Introduction to Blast Cleaning.....	68
4.2	Dry Abrasive Blasting.....	68
4.2.1	Metallic Abrasives.....	69
4.2.2	Naturally Occurring Abrasives	69
4.2.3	By-product Abrasives.....	70
	4.2.3.1 Variations in Composition and Physical Properties.....	71
4.2.4	Manufactured Abrasives.....	71
4.3	Wet Abrasive Blasting and Hydrojetting.....	72
4.3.1	Terminology	73
4.3.2	Inhibitors	73
4.3.3	Advantages and Disadvantages of Wet Blasting.....	74
4.3.4	Chloride Removal	75
4.3.5	Water Containment.....	75
4.4	Unconventional Blasting Methods.....	76
4.4.1	Carbon Dioxide.....	76
4.4.2	Ice Particles.....	77
4.4.3	Soda.....	77
4.5	Testing for Contaminants after Blasting.....	78
4.5.1	Soluble Salts.....	78
4.5.2	Hydrocarbons	79
4.5.3	Dust	80

4.6	Dangerous Dust: Silicosis and Free Silica	81
4.6.1	What is Silicosis?.....	81
4.6.2	What Forms of Silica Cause Silicosis?.....	82
4.6.3	What is a Low-Free-Silica Abrasive?.....	82
4.6.4	What Hygienic Measures Can Be Taken to Prevent Silicosis?.....	82
	References.....	83

Chapter 5 Abrasive Blasting and Heavy-Metal Contamination..... 85

5.1	Detecting Contamination.....	85
5.1.1	Chemical Analysis Techniques for Heavy Metals.....	86
5.1.2	Toxicity Characteristic Leaching Procedure.....	86
5.2	Minimizing the Volume of Hazardous Debris.....	87
5.2.1	Physical Separation	88
5.2.1.1	Sieving	88
5.2.1.2	Electrostatic Separation	88
5.2.2	Low-Temperature Ashing (Oxidizable Abrasive Only).....	89
5.2.3	Acid Extraction and Digestion	89
5.3	Methods for Stabilizing Lead	90
5.3.1	Stabilization with Iron	90
5.3.2	Stabilization of Lead through pH Adjustment.....	91
5.3.3	Stabilization of Lead with Calcium Silicate and Other Additives	92
5.3.3.1	Calcium Silicate.....	92
5.3.3.2	Sulfides.....	92
5.4	Debris as Filler in Concrete.....	93
5.4.1	Problems that Contaminated Debris Pose for Concrete.....	93
5.4.2	Attempts to Stabilize Blasting Debris with Cement	94
5.4.3	Problems with Aluminum in Concrete.....	96
5.4.4	Trials with Portland Cement Stabilization	96
5.5	Other Filler Uses.....	97
	References.....	97

Chapter 6 Weathering and Aging of Paint..... 99

6.1	UV Breakdown.....	100
6.1.1	Reflectance.....	101
6.1.2	Transmittance	101
6.1.3	Absorption.....	101
6.2	Moisture	103
6.2.1	Chemical Breakdown.....	104
6.2.2	Weathering Interactions	104
6.2.3	Hygroscopic Stress.....	104
6.2.4	Blistering/Adhesion Loss.....	105

6.2.4.1	Alkaline Blistering.....	106
6.2.4.2	Neutral Blistering.....	106
6.3	Temperature.....	107
6.4	Chemical Degradation.....	108
	References.....	111

Chapter 7 Corrosion Testing — Background and Theoretical Considerations.....113

7.1	The Goal of Accelerated Testing.....	113
7.2	What Factors Should Be Accelerated?.....	114
7.2.1	UV Exposure.....	115
7.2.2	Moisture.....	115
7.2.3	Drying.....	117
7.2.3.1	Faster Corrosion during the Wet-Dry Transition.....	117
7.2.3.2	Zinc Corrosion — Atmospheric Exposure vs. Wet Conditions.....	118
7.2.3.3	Differences in Absorption and Desorption Rates.....	120
7.2.4	Temperature.....	120
7.2.5	Chemical Stress.....	121
7.2.6	Abrasion and Other Mechanical Stresses.....	123
7.2.7	Implications for Accelerated Testing.....	123
7.3	Why There is No Single Perfect Test.....	123
7.3.1	Different Sites Induce Different Aging Mechanisms.....	124
7.3.2	Different Coatings Have Different Weaknesses.....	125
7.3.3	Stressing the Achilles' Heel.....	126
	References.....	126

Chapter 8 Corrosion Testing — Practice..... 129

8.1	Some Recommended Accelerated Aging Methods.....	129
8.1.1	General Corrosion Tests.....	130
8.1.1.1	ASTM D5894.....	130
8.1.1.2	NORSOK.....	130
8.1.2	Condensation or Humidity.....	131
8.1.3	Weathering.....	131
8.1.4	Corrosion Tests from the Automotive Industry.....	131
8.1.4.1	VDA 621-415.....	132
8.1.4.2	Volvo Indoor Corrosion Test or Volvo-cycle.....	132
8.1.4.3	SAE 52334.....	133
8.1.5	A Test to Avoid: Kesternich.....	133
8.2	Evaluation after Accelerated Aging.....	134
8.2.1	General Corrosion.....	135
8.2.1.1	Creep from Scribe.....	135
8.2.1.2	Other General Corrosion.....	135

8.2.2	Adhesion.....	136
8.2.2.1	The Difficulty of Measuring Adhesion	136
8.2.2.2	Direct Pull-off Methods.....	137
8.2.2.3	Lateral Stress Methods	138
8.2.2.4	Important Aspects of Adhesion	140
8.2.3	Bamer Properties.....	140
8.2.4	Scanning Kelvin Probe	142
8.2.5	Scanning Vibrating Electrode Technique.....	143
8.2.6	Advanced Analytical Techniques.....	144
8.2.6.1	Scanning Electron Microscopy.....	144
8.2.6.2	Atomic Force Microscopy.....	144
8.2.6.3	Infrared Spectroscopy.....	144
8.2.6.4	Electron Spectroscopy	146
8.2.6.5	Electrochemical Noise Measurement.....	147
8.3	Calculating Amount of Acceleration and Correlations	147
8.3.1	Acceleration Rates	148
8.3.2	Correlation Coefficients or Linear Regressions	148
8.3.3	Mean Acceleration Ratios and Coefficient of Variation.....	149
8.4	Salt Spray Test	149
8.4.1	The Reputation of the Salt Spray Test	150
8.4.2	Specific Problems with the Salt Spray Test	150
8.4.3	Importance of Wet/Dry Cycling	151
	References.....	152
	Index.....	155