

Contents

1 Introduction.....1

1.1 The World of Adhesives and Sealants.....1

1.2 Scope.....1

1.3 Geographical Focus1

1.4 Methodology1

1.5 Units.....2

1.6 Authorship.....2

2 Executive Summary.....3

2.1 Overview3

2.2 Market Drivers.....5

2.3 Market Restraints.....6

2.4 Market Prospects6

3 Technology.....7

3.1 Introduction to Adhesives7

3.2 Important Properties of Adhesives.....7

3.2.1 Rate of Cure.....7

3.2.2 Gap Filling Capability.....8

3.2.3 Bonding Dirty Surfaces.....8

3.2.4 Tensile Shear Strength, Peel Strength, Impact Resistance.....8

3.2.5 Load Bearing Capability8

3.2.6 Heat and Cold Resistance.....9

3.2.7 Fluid Resistance.....9

3.2.8 Weatherability.....9

3.2.9 Health and Safety Issues.....9

3.3 Introduction to Sealants.....10

3.4 Important Properties of Sealants10

3.4.1 Curing Properties11

3.4.1.1 Rate of Cure.....11

3.4.1.2 Depth of Cure11

3.4.1.3 Shrinkage on Curing.....11

3.4.2 Physical Properties of Sealants11

3.4.2.1 Hardness.....11

3.4.2.2 Modulus of Elasticity12

3.4.2.3 Compressive Strength and Compression Set12

3.4.2.4 Stress Relaxation12

3.4.2.5 Creep12

3.4.3 Thermal Properties of Sealants: Heat and Cold Resistance12

3.4.4 Chemical Properties of Sealants.....12

3.4.5 UV Resistance.....13

3.4.6 Adhesion13

3.4.7 Electrical Properties of Sealants.....14

3.5 Curing of Adhesives and Sealants.....14

References.....14

4 Adhesive and Sealant Materials.....15

4.1 Acrylic Adhesives15

4.1.1 Anaerobics15

4.1.2 Cyanoacrylates.....20

4.1.2.1 Low-Volatile Cyanoacrylates.....23

4.1.2.2 Surface-Insensitive Cyanoacrylates.....23

4.1.2.3 Thermally Resistant Cyanoacrylates.....23

4.1.2.4 Toughened Cyanoacrylates	23
4.1.2.5 Bonding of Non-Polar Plastics.....	23
4.1.2.6 Preventing Skin-Bonding.....	24
4.1.2.7 Other.....	24
4.1.3 Reactive Acrylics.....	24
4.2 Epoxies.....	27
4.3 Urethanes	30
4.3.1 Non-Reactive Adhesives	32
4.3.2 Reactive Adhesives	33
4.3.2.1 One-Component Adhesives	33
4.3.2.2 Two-Component Adhesives	33
4.3.2.3 Urethane Sealants	34
4.4 Hot Melts	34
4.4.1 Copolyamides.....	36
4.4.2 Polyesters and Copolyesters.....	37
4.4.3 Polyurethanes.....	37
4.4.4 Reactive Hot Melt Urethanes (RHMUs).....	37
4.5 Radiation Curing Systems	38
4.5.1 Basic Chemistry of UV Systems.....	38
4.5.1.1 Free-Radical Systems.....	39
4.5.1.2 Cationic Systems	40
4.5.2 Benefits of UV Systems	41
4.5.3 Advances in UV Technology	41
4.5.3.1 Shadow Curing	41
4.5.3.2 Minimising Shrinkage	41
4.5.3.3 UV Silicones.....	42
4.5.4 Applications of Radiation Curing Adhesives	42
4.6 Solvent-Based Systems.....	43
4.7 Water-Based Systems	43
4.7.1 Phenol-Formaldehyde and Amino Resins	44
4.7.1.1 Phenolic Resins	44
4.7.1.2 Amino Resins.....	45
4.7.2 Latex (Emulsion) Adhesives and Sealants	47
4.7.2.1 Styrene-Butadiene Rubber (SBR)	47
4.7.2.2 Acrylonitrile-Butadiene Copolymers (NBR Latex)	48
4.7.2.3 Polychloroprene (CR).....	49
4.7.2.4 Vinyl Ester Polymers	50
4.7.2.5 Acrylic Polymers, Including Vinyl Acrylics and Styrene Acrylics.....	51
4.7.2.6 Ethylene-Vinyl Chloride Copolymers (EVCL).....	52
4.7.2.7 Polybutadiene	53
4.7.2.8 Natural Rubber.....	53
4.7.2.9 Applications for Latices	53
4.7.3 Synthetic Polymer Solutions.....	54
4.7.4 Casein Adhesives	54
4.7.5 Starch Adhesives	55
4.8 Inorganic Adhesives	56
4.9 Pressure Sensitive Adhesives.....	58
4.10 Butyls.....	60
4.11 Silicones	61
4.12 Silyl Terminated Polyethers	65
4.13 Polysulfides	66
4.14 Plastisols	67
4.15 Other Sealants.....	67
References	68

5 Additives for Adhesives and Sealants.....	71
5.1 Catalysts	71
5.2 Stabilisers	72
5.3 Colourants.....	72
5.4 Fillers	72
5.5 Plasticisers.....	72
5.6 Rheology Control Additives	73
5.7 Tougheners.....	73
5.8 Adhesion Promoters.....	74
5.9 Tackifiers.....	74
5.10 Fungicides.....	74
5.11 Additive Suppliers	74
6 Classification and Comparison of Adhesives and Sealants	75
6.1 Commodity, General Purpose and Speciality Adhesives	75
6.2 Bonding of Metals	76
6.2.1 Adhesive Bonding Versus Alternative Techniques.....	76
6.2.2 Bonding of Lightweight Metals.....	77
6.2.3 Recent Developments in Aluminium Bonding	78
6.2.4 Bonding of Dissimilar Metals	79
6.2.5 Adhesive Technologies for the Bonding of Dissimilar Metals	80
6.3 Bonding of Plastics.....	80
6.3.1 Problems Unique to Plastics.....	81
6.3.2 Types of Adhesives for Plastics.....	82
6.3.3 Bonding of Some Specific Plastics	83
6.3.4 Bonding of Non-Polar Plastics	85
6.3.4.1 Thermal Methods.....	86
6.3.4.2 Chemical Surface Treatment	86
6.3.4.3 Plasma Treatment	86
6.3.4.4 Other Surface Treatments	87
6.3.4.5 Polymer Modification	87
6.3.4.6 Surface Primers.....	87
6.3.4.7 Conclusions.....	89
6.4 Bonding of Wood.....	89
6.5 Comparison of Sealants	92
References.....	93
7 Applications and Markets for Adhesives and Sealants.....	97
7.1 Packaging and Labelling	97
7.2 Construction.....	100
7.3 Textiles and Carpets	102
7.3.1 Nonwoven Fabrics.....	102
7.3.1.1 Important Characteristics of Latexes for Nonwoven Applications	103
7.3.1.2 Types of Latex Binders	103
7.3.1.3 Manufacturing of Nonwovens	105
7.3.1.4 Applications for Latex-Bonded Nonwovens.....	106
7.3.1.5 Future Developments in Nonwovens	106
7.3.2 Carpet Bonding	106
7.4 Consumer	108
7.4.1 Consumer Adhesives	108
7.4.2 Consumer Sealants.....	109
7.5 Product Assembly	109
7.5.1 Appliances.....	109
7.5.2 Electrical and Electronic	110
7.5.3 Medical Devices	114
7.5.4 Footwear	116
7.5.5 Furniture.....	117

7.5.6 Graphic Arts and Books	118
7.6 Transportation	120
7.6.1 OEM Automotive.....	120
7.6.1.1 Powertrain Applications.....	122
7.6.1.2 Body Applications.....	124
7.6.1.3 Electrical Applications	126
7.6.1.4 Trim Applications.....	127
7.6.2 Automotive Aftermarket.....	128
7.6.3 Aerospace.....	128
7.6.4 Marine.....	130
7.7 Surgical Adhesives	131
7.7.1 Advances.....	132
7.8 Plumbing.....	134
7.9 Gas Pipelines	134
7.10 Porosity Sealing.....	135
References	136
8 Consumption by Global Region and Material Type.....	137
8.1 Global Demand for Adhesives and Sealants.....	137
8.1.1 Global Adhesives	137
8.1.2 Global Sealants.....	139
8.2 North America.....	139
8.3 Western Europe.....	141
8.4 Far East.....	143
8.4.1 Japan.....	143
8.4.2 China	144
8.6 Latin America.....	146
Reference.....	146
9 Industry Structure and Key Players	147
9.1 Raw Material Suppliers	147
9.1.1 Acrylics	147
9.1.2 Epoxies	147
9.1.3 Latex.....	147
9.1.4 Formaldehyde Resins	148
9.1.5 Silicones	148
9.1.6 Polyurethanes	148
9.2 Adhesive and Sealant Manufacturers	148
9.2.1 The Big Companies	149
9.2.1 2nd Tier Companies.....	150
9.2.3 Other Leading Companies	151
9.3 Distribution.....	153
10 International Trends and Conclusions.....	155
10.1 Market Drivers	155
10.2 Market Restraints.....	155
10.3 Individual Market Sectors.....	156
11 Associations and Media.....	161
11.1 Associations	161
11.2 Media.....	161
Abbreviations and Acronyms	162