

INTRODUCTION .....	XXXII
REASONS FOR DOING THE STUDY .....	XXXII
SCOPE OF THE STUDY .....	XXXII
METHODOLOGY .....	XXXIII
ABOUT THE AUTHOR .....	XXXIII
RELATED BCC REPORTS .....	XXXIV
BCC ONLINE SERVICES .....	XXXIV
DISCLAIMER .....	XXXIV
SUMMARY .....	XXXV
<i>SUMMARY TABLE U.S. FIBER-REINFORCED PLASTIC MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	XXXV
<i>SUMMARY FIGURE U.S. FIBER-REINFORCED PLASTIC MARKET BY APPLICATION, 2006-2012 (MILLION POUNDS)</i> .....	XXXVI
FILLERS AND REINFORCEMENTS .....	1
BACKGROUND .....	1
PROPERTY PROFILES .....	1
CHARACTERISTICS OF FILLERS/REINFORCEMENTS.....	2
<i>TABLE 1 PROFILE OF CHARACTERISTICS OF FILLERS/REINFORCEMENTS</i> .....	2
<i>TABLE 2 OVERVIEW OF CHARACTERISTICS AND APPLICATIONS OF FILLERS/REINFORCEMENTS</i> .....	3
FILLER/REINFORCEMENT USAGE WITH SPECIFIC RESINS .....	3
<i>TABLE 3 OVERVIEW OF FILLER/REINFORCEMENT USAGE WITH SPECIFIC RESIN SYSTEMS</i> .....	4
FILLERS .....	4
OVERVIEW .....	4
ALUMINA TRIHYDRATE (ATH) .....	5
Background .....	5
Properties .....	5
Grades .....	5
BARIUM SULFATE.....	6
CALCIUM CARBONATE .....	6
Background .....	6
Grades .....	6
Automotive Applications .....	6
CALCIUM SULFATE .....	7
Background .....	7
Applications .....	7
KAOLINS.....	7
Background .....	7
Grades .....	7
Automotive Applications .....	8

ORGANIC FILLERS .....	8
Background .....	8
Properties and Applications .....	8
CONDUCTIVE FILLERS .....	9
REINFORCEMENTS .....	9
OVERVIEW .....	9
NON-FIBROUS .....	10
Talc .....	10
Background .....	10
Grades .....	10
Applications.....	10
New Talc Products .....	11
Mica .....	11
Background .....	11
Properties .....	12
Applications.....	12
Thermosets .....	12
Thermoplastics .....	12
Silicas .....	13
Wollastonite .....	13
Background .....	13
Applications.....	13
New Developments .....	14
New Products .....	14
MARKET ESTIMATES AND FORECASTS .....	14
<i>TABLE 4 NORTH AMERICAN MARKET FOR KEY/SELECTED</i>	
<i>FILLERS/REINFORCEMENTS, THROUGH 2012 (MILLION</i>	
<i>POUNDS).....</i>	<i>15</i>
<i>FIGURE 1 NORTH AMERICAN MARKET FOR KEY/SELECTED</i>	
<i>FILLERS/REINFORCEMENTS, 2006-2012 (MILLION POUNDS).....</i>	<i>15</i>
FIBROUS.....	16
Background .....	16
Carbon Fibers .....	16
Background .....	16
Manufacture.....	16
Product Types .....	17
Applications.....	17
Recent Developments.....	17
Supply and Demand Scenario .....	18
Producers.....	18
Recent Developments.....	19
Metallized Carbon Fibers .....	19
Market Estimates and Forecasts .....	19

<i>TABLE 5 GLOBAL CARBON FIBER MARKET, THROUGH 2012</i>	
<i>(MILLION POUNDS)</i> .....	20
<i>FIGURE 2 GLOBAL CARBON FIBER MARKET, 2006-2012 (MILLION</i>	
<i>POUNDS)</i> .....	20
Polymeric Fibers .....	21
Overview.....	21
Aramid Fibers .....	21
Background .....	21
Usage .....	21
Ceramic Fibers.....	22
Background .....	22
Applications.....	22
New Developments .....	22
Boron Fibers.....	22
Stainless Steel Fibers .....	23
Background .....	23
Recent Developments.....	23
Glass-Fiber Reinforcements .....	23
Background .....	23
Types of Glass Fibers.....	23
Sizing .....	23
Supplies .....	24
Glass Fiber Types .....	24
Overview .....	24
Background .....	25
Solid Microspheres.....	25
Hollow Microspheres .....	25
<i>TABLE 6 ADVANTAGES OF SOLID GLASS MICROSPHERES</i> .....	25
Summary of Glass Fiber Reinforcement	
Classifications.....	26
Applications.....	26
Trends.....	26
Recent Developments.....	27
Boron-Free Glass Fibers.....	27
High-Strength Glass .....	27
Thermoplastics Go After New Markets .....	28
China's Glass Fiber Industry .....	28
Fiberglass Enterprises Seek to Meet International	
Standards.....	28
New Products .....	28
Johns Manville .....	28
Owens Corning.....	29
Glass Fiber Suppliers .....	29
<i>TABLE 7 GLASS FIBER SUPPLIERS</i> .....	29

<i>TABLE 7 (CONTINUED)</i> .....	30
Natural Fibers .....	30
Background .....	30
Types of Natural Fibers.....	31
Overview .....	31
Flax Fibers.....	31
Jute Fibers.....	31
Kenaf Fibers .....	32
Hemp Fibers .....	32
Processing.....	32
Comparison with Glass Fibers .....	33
Pricing .....	33
Possible Stumbling Blocks to Natural Fiber	
Reinforcements .....	34
Suppliers of Natural Fibers.....	34
Background.....	34
Composite Products .....	34
Flexform Technologies.....	34
Quadrant Plastic Composites .....	35
Automotive Applications .....	35
Other Potential Applications.....	36
New Developments .....	36
Basalt Fibers .....	36
Market Estimates and Forecasts .....	36
NANOCOMPOSITES .....	37
BACKGROUND .....	37
PROCESSES .....	37
CHARACTERISTICS.....	38
EARLY WORK WITH PLASTICS.....	38
PRICING.....	38
CARBON NANOTUBES.....	39
COST AND PERFORMANCE ASPECTS .....	39
APPLICATIONS.....	40
Overview .....	40
Specific Automotive Applications .....	41
Overview.....	41
General Motor's Usage .....	41
RECENT DEVELOPMENTS .....	41
Vorbeck Materials.....	41
Nanosperse.....	42
Naturalnano, Inc. ....	42
DDG Cryogenics .....	42
Sud-Chemie.....	42
Dyneon LLC .....	43

DuPont .....	43
RTP.....	43
RECENT ASSESSMENTS .....	43
NANOCOMPOSITE SUPPLIERS.....	44
<i>TABLE 8 LIST OF SELECTED NANOCOMPOSITE SUPPLIERS.....</i>	<i>44</i>
MARKET ESTIMATES AND FORECASTS.....	45
<i>TABLE 9 GLOBAL NANOCOMPOSITE CONSUMPTION.....</i>	<i>45</i>
Market Estimates and Forecasts (Continued) .....	46
REINFORCED PLASTICS OVERVIEW .....	47
BACKGROUND .....	47
THERMOPLASTICS .....	47
THERMOSETS .....	48
<i>TABLE 10 SELECTED PROPERTIES AND MANUFACTURING</i>	
<i>    PROCESSES OF REINFORCED THERMOSETS.....</i>	<i>48</i>
<i>TABLE 10 (CONTINUED).....</i>	<i>49</i>
COMPOSITES.....	49
OVERVIEW .....	49
ADVANCED COMPOSITES .....	49
PROCESSING.....	50
THERMOSET BRIEF OVERVIEW .....	50
HAND LAY-UP .....	50
SPRAY-UP.....	50
PULTRUSION.....	50
SHEET MOLDING COMPOUNDS (SMC) .....	50
BULK MOLDING COMPOUNDS (BMC).....	50
REINFORCED REACTION MOLDING (RRIM).....	51
THERMOPLASTICS .....	51
PROCESSING DETAILS .....	51
THERMOSETS.....	51
Hand Lay-up .....	51
Filament Winding.....	52
Pultrusion .....	52
Reinforced Reaction Molding (RRIM) .....	52
THERMOPLASTICS.....	52
REINFORCED PLASTIC/COMPOSITE FABRICATION	
TECHNIQUES.....	53
OVERVIEW .....	53
SHEET MOLDING COMPOUNDS (SMC) .....	53
Background.....	53
SMC Process Choices.....	54
SMC Formulations .....	54
<i>TABLE 11 TYPICAL SMC FORMULATION.....</i>	<i>54</i>
Technology .....	54

SMC Compounders .....	55
Applications .....	56
New Developments .....	56
New SMC grades Could Eliminate Need for Coating Auto Parts .....	56
Suppliers Aiming to Upgrade SMC.....	57
Nanotechnology and SMC .....	57
SMC for a New Roof.....	57
SMC Technology Advantages .....	57
Specific New SMC Products .....	58
Improved Paintability.....	58
New SMCs Aim At Lighting.....	58
Meridian Begins Selling SMC .....	58
BULK MOLDING COMPOUNDS (BMC) .....	59
Background .....	59
Technology .....	59
Advantages .....	59
Applications .....	60
BMC Compounders.....	60
Recent Developments .....	60
Owens Corning, BMCI Joint Venture.....	60
Specific New BMC Products.....	61
Bulk Molding Compounds .....	61
BMC for Automotive Headlamps .....	61
Solar Panels Targeted.....	61
RESINS USED IN REINFORCED PLASTICS.....	62
OVERVIEW OF REINFORCED PLASTICS/COMPOSITES PRODUCT FLOW .....	62
<i>TABLE 12 REINFORCED PLASTICS/COMPOSITES PRODUCT FLOW.....</i>	62
THERMOPLASTICS .....	62
COMMODITY THERMOPLASTICS.....	62
Background .....	62
Polypropylene .....	63
Background .....	63
Fiber-Reinforced Polypropylene Products .....	63
<i>TABLE 13 KEY FIBER-REINFORCED POLYPROPYLENE PRODUCTS.....</i>	64
New Developments .....	64
Long-Glass Fiber (LGF) Polypropylene News .....	64
All-Polypropylene Composites .....	64
All-Polypropylene Composites (Continued).....	65
Lightweight Polypropylene/Glass Composites .....	66
Specific New Polypropylene-Based Reinforced Plastic Products .....	66

Glass Roving for Long Glass Polypropylene.....	66
Glass Roving for Long-Glass Polypropylene.....	66
Molding of Long-Fiber Polypropylene	
Automotive Parts.....	66
Polypropylene Nanocomposites for	
Automotive Parts.....	67
New Sources of Long Fiber Glass-Reinforced	
Polypropylene .....	67
RTP Long Fiber Concentrates .....	67
Polyethylene.....	67
Overview.....	67
<i>TABLE 14 FIBER-REINFORCED COMMODITY THERMOPLASTICS,</i>	
<i>THROUGH 2012 (MILLION POUNDS) .....</i>	<i>68</i>
<i>TABLE 15 FIBER-REINFORCED POLYETHYLENE MARKET BY</i>	
<i>APPLICATION, THROUGH 2012 (MILLION POUNDS).....</i>	<i>68</i>
<i>TABLE 16 FIBER-REINFORCED POLYPROPYLENE MARKET BY</i>	
<i>APPLICATION, THROUGH 2012 (MILLION POUNDS).....</i>	<i>69</i>
<i>TABLE 17 FIBER-REINFORCED POLYPROPYLENE AUTOMOTIVE</i>	
<i>MARKET, THROUGH 2012 (MILLION POUNDS) .....</i>	<i>69</i>
POLYSTYRENE.....	70
General Purpose Polystyrene.....	70
High Impact Polystyrene (HIPS) .....	70
Background .....	70
Properties .....	70
Applications.....	71
Producer Changes .....	71
Reinforced Polystyrene Products .....	71
Market Estimates and Forecasts .....	71
<i>TABLE 18 FIBER-REINFORCED POLYSTYRENE MARKET BY</i>	
<i>APPLICATION, THROUGH 2012 (MILLION POUNDS).....</i>	<i>72</i>
<i>FIGURE 3 FIBER-REINFORCED POLYSTYRENE MARKET BY</i>	
<i>APPLICATION, 2006-2012 (MILLION POUNDS).....</i>	<i>72</i>
ACRYLONITRILE-BUTADIENE-STYRENE (ABS).....	73
Background.....	73
Properties.....	73
Grades .....	73
Applications .....	74
Examples of Reinforced ABS Products .....	74
Market Estimates and Forecasts .....	75
<i>TABLE 19 FIBER-REINFORCED ABS MARKET BY APPLICATION,</i>	
<i>THROUGH 2012 (MILLION POUNDS) .....</i>	<i>75</i>
STYRENE MALEIC ANHYDRIDE (SMA) .....	75
Background.....	75
Fiber-Reinforced SMA .....	76

Market Estimates and Forecasts .....	76
ENGINEERING THERMOPLASTICS (ETPS) .....	76
Background .....	76
Nylons .....	77
Background .....	77
Properties .....	77
Major Types.....	77
Nylon 66.....	77
Nylon 6.....	78
Fiber-Reinforced Nylons .....	78
Nylon Nanocomposites .....	78
Long Glass Adds Properties to High-Heat Nylon.....	79
Nylon With 60% Glass .....	79
Examples of Commercial Reinforced Nylons .....	79
<i>TABLE 20 EXAMPLES OF COMMERCIALY IMPORTANT</i>	
<i>REINFORCED NYLONS</i> .....	80
Market Estimates and Forecasts .....	80
<i>TABLE 21 FIBER-REINFORCED NYLON MARKET BY APPLICATION,</i>	
<i>THROUGH 2012 (MILLION POUNDS)</i> .....	81
<i>FIGURE 4 FIBER-REINFORCED NYLON MARKET BY APPLICATION,</i>	
<i>2006-2012 (MILLION POUNDS)</i> .....	81
<i>TABLE 22 FIBER-REINFORCED NYLON AUTOMOTIVE MARKET,</i>	
<i>THROUGH 2012 (MILLION POUNDS)</i> .....	82
Polybutylene Terephthalate (PBT) .....	82
Background .....	82
Properties .....	82
Applications.....	83
Fiber-Reinforced PBT Products.....	83
Recent Interest in CBT .....	83
Examples of Commercial Reinforced PBT Products .....	84
<i>TABLE 23 EXAMPLES OF REINFORCED PBT PRODUCTS</i> .....	84
Polyethylene Terephthalate (PET) .....	84
Overview.....	84
Properties and Grades .....	85
Applications.....	85
Self-Reinforced PET.....	86
Examples of Reinforced PET Products .....	86
<i>TABLE 24 KEY REINFORCED PET PRODUCTS</i> .....	86
Market Estimates and Forecasts .....	86
<i>TABLE 25 FIBER-REINFORCED THERMOPLASTIC POLYESTER</i>	
<i>MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	87
<i>TABLE 26 FIBER-REINFORCED THERMOPLASTIC POLYESTER</i>	
<i>AUTOMOTIVE MARKET, THROUGH 2012 (MILLION POUNDS)</i> .....	87
EXTERIOR.....	87



TOTAL.....	87
Polycarbonates.....	87
Background .....	87
General Grades .....	88
Properties .....	88
Fiber-Reinforced Polycarbonates .....	89
Market Estimates and Forecasts .....	89
<i>TABLE 27 FIBER-REINFORCED POLYCARBONATE MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	89
Polyacetals .....	90
Background .....	90
Grades .....	90
Properties .....	90
Processing.....	91
Examples of Polyacetal Reinforced Products.....	91
Market Estimates and Forecasts .....	91
Polyphenylene Sulfides (PPS).....	92
Background .....	92
Properties .....	92
Advantages and Disadvantages .....	92
PPS Fiber-Reinforced Products.....	93
New Products .....	93
Market Estimates and Forecasts .....	93
<i>TABLE 28 FIBER-REINFORCED POLYPHENYLENE SULFIDE MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	93
Polyimides/PEI/PAI.....	94
Background .....	94
Properties .....	94
Polyetherimides (PEIs).....	94
Background.....	94
Properties.....	94
Polyamideimides (PAIs).....	95
Background.....	95
Properties.....	95
Polyimide Fiber-Reinforced Products .....	95
New Products .....	95
Market Estimates and Forecasts .....	96
<i>TABLE 29 FIBER-REINFORCED POLYIMIDE MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	96
Liquid Crystal Polymers (LCPs) .....	96
Background .....	96
Properties .....	96
Applications.....	97
LCP Fiber-Reinforced Products.....	97

Market Estimates and Forecasts .....	98
Polysulfones .....	98
Background .....	98
Types of Polysulfones.....	98
Polyethersulfones (PES).....	98
Polyarylsulfones .....	98
Grades .....	99
Properties .....	99
Other Applications of Polysulfones .....	99
New Products .....	100
Polysulfone Fiber-Reinforced Products.....	100
Market Estimates and Forecasts .....	100
Polymer Alloys/Blends.....	100
Background .....	100
PC/ABS .....	101
Background.....	101
Grades and Properties .....	101
Applications .....	101
Polyphenylene Oxide (PPO)-Based Alloys/Blends.....	102
PPO/HIPS .....	102
Background .....	102
Grades .....	102
Applications.....	103
PPO/Nylon .....	103
Background and Properties .....	103
Grades and Applications .....	103
PC/PBT .....	103
Background .....	103
Properties .....	104
Applications.....	104
PC/PET .....	104
Fiber-Reinforced Polymer Alloy/Blend Grades.....	105
Market Estimates and Forecasts .....	105

**TABLE 30 FIBER-REINFORCED POLYMER ALLOYS/BLENDS**

**MARKET BY APPLICATION, THROUGH 2012 (MILLION POUNDS) ..... 105**

Other Engineering Thermoplastics .....	106
Styrene-Acrylonitrile (SAN) .....	106
Background.....	106
Properties.....	106
Fiber-Reinforced SAN Products.....	107
Polyketones .....	107
Background.....	107
Properties.....	107
Applications .....	108

	Polyketone Composites .....	108
	New Products .....	108
	Long-Fiber PEEK.....	108
	Glass-Filled PEEK.....	108
	Market Estimates and Forecasts .....	109
<i>TABLE 31 MISCELLANEOUS FIBER-REINFORCED</i>		
<i>THERMOPLASTICS MARKET BY APPLICATION, THROUGH 2012</i>		
<i>(MILLION POUNDS).....</i>		<i>109</i>
	MARKET SUMMARY FOR FIBER-REINFORCED	
	THERMOPLASTICS .....	109
<i>TABLE 32 FIBER-REINFORCED THERMOPLASTIC MARKET,</i>		
<i>THROUGH 2012 (MILLION POUNDS) .....</i>		<i>110</i>
	GLASS MAT THERMOPLASTICS (GMT) .....	110
	Overview .....	110
	Technology .....	111
	Supplier Scenario.....	111
	Applications .....	111
	LONG-FIBER REINFORCED THERMOPLASTICS (LFRTS).....	112
	Background .....	112
	Properties.....	112
	Technology .....	112
	Background .....	112
	Twintex Products .....	113
	Advantages .....	113
	Limitations.....	114
	Resin Matrices .....	114
	Suppliers .....	114
	StaMax .....	114
	Ticona and LNP .....	115
	RTP .....	115
	Applications .....	115
	Down the Road.....	116
	Recent Developments .....	116
	Increased Use of LFRT Concentrates .....	116
	Another Source of Long-Glass Thermoplastic Pellets.....	116
	New PEEK Long Fiber Compounds.....	116
	Ticona LFRT Unit in China .....	117
	Advanced Fiber Compounds.....	117
	Overview.....	117
	Product Characteristics .....	117
	MARKET ESTIMATES AND FORECASTS .....	118
<i>TABLE 33 LONG FIBER REINFORCED THERMOPLASTIC MARKET</i>		
<i>BY GEOGRAPHIC REGION, THROUGH 2012 (MILLION POUNDS).....</i>		<i>118</i>
	THERMOSET RESINS .....	118

OVERVIEW .....	118
FIBER-REINFORCED GRADES .....	119
GENERAL PROPERTIES .....	119
<i>TABLE 34 FIBER-REINFORCED THERMOSET PROPERTIES AND MANUFACTURING PROCESSES</i> .....	<i>119</i>
UNSATURATED POLYESTERS .....	120
Background .....	120
Ingredients of Unsaturated Polyester Formulations .....	120
<i>TABLE 35 INGREDIENTS OF UNSATURATED POLYESTER RESIN FORMULATIONS IN DESCENDING ORDER OF COMMERCIAL USE</i> .....	<i>120</i>
Types of Unsaturated Polyesters .....	121
Applications .....	121
Construction/Infrastructure .....	121
Bathroom Products .....	121
Corrosion-Resistant Products.....	121
Marine Products.....	122
Transportation .....	122
Other Applications .....	122
Non-Reinforced Unsaturated Polyesters .....	122
Examples of Commercial Reinforced Unsaturated Polyesters.....	122
<i>TABLE 36 KEY COMMERCIAL REINFORCED UNSATURATED POLYESTERS</i> .....	<i>123</i>
Market Estimates and Forecasts .....	123
<i>TABLE 37 FIBER-REINFORCED UNSATURATED POLYESTERS BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	<i>123</i>
<i>TABLE 38 FIBER-REINFORCED UNSATURATED POLYESTER CONSTRUCTION MARKET, THROUGH 2012 (MILLION POUNDS)</i> .....	<i>124</i>
<i>TABLE 39 FIBER-REINFORCED UNSATURATED POLYESTER AUTOMOTIVE MARKET, THROUGH 2012 (MILLION POUNDS)</i> .....	<i>124</i>
VINYL ESTERS .....	125
Background .....	125
Properties.....	125
Characteristics.....	125
Applications .....	125
Differences between Unsaturated Polyesters and Vinyl Esters .....	126
New Products.....	126
AOC .....	126
Reichhold.....	126
Commercially Important Reinforced Vinyl Esters.....	127
The following represent important commercial reinforced vinyl esters: .....	127

Market Estimates and Forecasts .....	127
<i>TABLE 40 FIBER-REINFORCED VINYLESTERS BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	127
EPOXY RESINS .....	127
Background .....	127
Chemical Epoxy Types .....	128
Epoxy Systems .....	128
Background .....	128
Non-Molded .....	128
Laminating Systems .....	129
Molded Epoxies .....	129
Advanced Epoxy Composites .....	129
Other Applications .....	130
Fiber-Reinforced Epoxy Grades .....	130
Market Estimates and Forecasts .....	130
<i>TABLE 41 FIBER-REINFORCED EPOXIES BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	131
<i>FIGURE 5 FIBER-REINFORCED EPOXIES BY APPLICATION, 2006- 2012 (MILLION POUNDS)</i> .....	131
PHENOLICS .....	132
Background .....	132
Grades .....	132
Molding Compounds .....	133
Fiber-Reinforced Phenolic Grades .....	133
New Products .....	133
Market Estimates and Forecasts .....	133
<i>TABLE 42 FIBER-REINFORCED PHENOLICS BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	134
POLYURETHANES .....	134
Background .....	134
Polyureas .....	134
RIM Products .....	135
RRIM Products .....	135
SRIM Products .....	135
Competing Products .....	136
Advantages .....	137
Recent Developments .....	137
Overview .....	137
Bayer .....	137
BASF .....	138
Creative Pultrusions .....	138
RS Technologies .....	138
Polyurethane Long Fiber Injection .....	138
Fiber-Reinforced Polyurethane Products .....	138

Market Estimates and Forecasts .....	139
<i>TABLE 43 FIBER-REINFORCED POLYURETHANES BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	139
<i>TABLE 44 FIBER-REINFORCED POLYURETHANE AUTOMOTIVE MARKET, THROUGH 2012 (MILLION POUNDS)</i> .....	140
MISCELLANEOUS FIBER-REINFORCED THERMOSETS.....	140
Diallyl Phthalate (DAP) .....	140
Background and Applications .....	140
Thermoplastic Elastomers (TPEs) .....	141
Overview.....	141
Market Estimates and Forecasts .....	141
<i>TABLE 45 FIBER-REINFORCED MISCELLANEOUS THERMOSETS BY APPLICATION, THROUGH 2012 (MILLION POUNDS)</i> .....	142
MARKET SUMMARY OF FIBER-REINFORCED THERMOSETS .....	142
<i>TABLE 46 MARKET SUMMARY OF FIBER-REINFORCED THERMOSETS, THROUGH 2012 (MILLION POUNDS)</i> .....	142
APPLICATIONS .....	143
OVERVIEW .....	143
AUTOMOTIVE INDUSTRY .....	143
OVERVIEW .....	143
<i>TABLE 47 HISTORICAL, CURRENT AND PROJECTED U.S. AUTOMOTIVE SALES, 1997-2007 (MILLION UNITS)</i> .....	143
CAFE ISSUES.....	144
AUTOMAKER'S CHOICES .....	145
A NEW DAWN FOR PLASTICS/COMPOSITES IN AUTOMOBILES .....	145
REINFORCED PLASTICS/COMPOSITES IN AUTOS AND TRUCKS .....	146
Background .....	146
Historical Perspective.....	146
Summary of Reinforced Plastics/Composites Advantages in Automotive Applications.....	146
Other SMC Applications .....	147
Hybrid Technologies—Plastic/Metal Parts.....	147
Composites Still Challenged by Metals .....	148
Use of Natural Fiber Composites.....	148
Composite Trunk .....	148
New Concept Car .....	149
AUTOMOTIVE UNDER-THE-HOOD .....	149
Overview .....	149
Key Factors of UTH Resin Market .....	149
<i>TABLE 48 SELECTED AUTOMOTIVE UNDER-THE-HOOD FIBER-REINFORCED RESINS BY PART</i> .....	150

<i>TABLE 48 (CONTINUED)</i> .....	151
Recent Developments in Auto UTH.....	151
More and More Metals Being Replaced .....	151
Carbon-Fiber for Manifolds .....	152
Reinforced Plastic Fuel Tank .....	152
PBT for Engine Components .....	152
Market Estimates and Forecasts .....	152
<i>TABLE 49 FIBER-REINFORCED PLASTIC AUTOMOTIVE UNDER-</i> <i>THE-HOOD MARKET BY RESIN, THROUGH 2012 (MILLION</i> <i>POUNDS)</i> .....	152
<i>TABLE 49 (CONTINUED)</i> .....	153
AUTOMOTIVE INTERIORS .....	153
Background .....	153
Fiber-reinforced plastic applications include the	
following:.....	153
Overview of Specific Fiber-Reinforced Plastic Applications ....	154
Seat Structures .....	154
Background .....	154
Front Seat Bases.....	154
Front Seat Shells .....	155
Seat Backs.....	155
Rear Seats .....	155
Child Safety Seats.....	156
Instrument Panel Structures (IPs) .....	156
Overview.....	156
Specific Resin Usage .....	157
Background.....	157
ABS.....	157
PC/ABS .....	157
Polycarbonates .....	158
Polypropylene .....	158
Polyurethanes.....	158
PPO/HIPS .....	159
SMA.....	159
Door Panels and Trim .....	160
Background .....	160
Modular Doors.....	160
Background.....	160
Door Modules Becoming More Complex .....	160
Consoles .....	161
Overview.....	161
Background .....	161
Resin Usage.....	161
Flooring.....	162

Package Shelves/Trays .....	162
Headliners.....	163
Background .....	163
Resin Usage.....	163
Modular Headliners .....	163
Modular Manufacturing .....	164
Background .....	164
Technology.....	164
Recent Developments.....	164
Examples of Cockpits in Recent Cars .....	165
Market Estimates and Forecasts .....	165
<i>TABLE 50 FIBER-REINFORCED PLASTICS IN AUTOMOTIVE</i> <i>INTERIORS, THROUGH 2012 (MILLION POUNDS)</i> .....	<i>166</i>
AUTOMOTIVE EXTERIORS .....	166
Background .....	166
Use of Reinforced Plastics/Composites .....	166
Fuel Efficiency Scenario .....	167
Bumper Systems.....	168
Background .....	168
Products.....	168
Bumper Beams.....	169
Doors .....	169
Other Exterior Trim .....	170
Body Panels .....	170
Overview.....	170
Steel Industry Advances.....	171
Horizontal vs. Vertical Body Panels (Steel vs. SMC)....	171
Specific Thermoplastics .....	172
Competitive Scenario Summary.....	172
General Decision Factors for Body Panels.....	173
Overview .....	173
Process and Polymer Options for Body Panels.....	173
Carbon Fiber SMC .....	174
Weight Reduction Concepts .....	174
Class A Finishes.....	175
Other SMC Competition.....	175
Other Considerations.....	176
Innovation Driving Automotive SMC .....	176
Overview.....	176
Details .....	177
Lowering Density on Class A SMCs.....	177
Paint-Free SMCs? .....	177
Environmentally Friendly SMCs? .....	178
Market Estimates and Forecasts .....	178



<i>TABLE 51 FIBER-REINFORCED PLASTICS AUTOMOTIVE EXTERIOR MARKET, THROUGH 2012 (MILLION POUNDS)</i> .....	178
<i>FIGURE 6 FIBER-REINFORCED PLASTICS AUTOMOTIVE EXTERIOR MARKET, 2006-2012 (MILLION POUNDS)</i> .....	179
CONSTRUCTION/INFRASTRUCTURE.....	179
BACKGROUND .....	179
ADVANTAGES OF REINFORCED PLASTICS/COMPOSITES .....	180
SOME BARRIERS TO REINFORCED PLASTICS/COMPOSITE USAGE .....	180
SOME PROGRESS IN EASING CODES AND STANDARDS SCENARIO.....	181
INFRASTRUCTURE APPLICATIONS .....	181
Background .....	181
Advantages of Composites.....	182
Roadblocks .....	182
Infrastructure Repair .....	183
Jacketing .....	183
Concrete Reinforcement .....	183
Background.....	183
Rebars/Plate Bonding .....	183
Concrete Highway Pavement.....	184
BRIDGES.....	184
Background .....	184
Bridge Cables from Composites .....	185
PIPE.....	185
Background .....	185
Fiberglass Reinforced Thermoset Plastic Pipe.....	185
Background .....	185
Allyl Resins .....	185
Bismaleimides and Furan Resins .....	186
Phenolic Resins .....	186
Epoxy Resins .....	186
Unsaturated Polyester Resins.....	186
Water-Pipe Systems .....	187
Overview.....	187
Composites Used in Offshore Drain Pipe Repair .....	187
Recent Developments.....	187
Increasing Strength of Fiber-Reinforced Pipe .....	187
Largest Composite Sewer Pipe Installed .....	188
Glass Fiber/Epoxy Pipe Wrap .....	188
Culvert and Pipe Liners .....	188
PANELS.....	188
Overview .....	188
Thermoformable Composite Panels .....	189

Natural Fibers for Panels.....	189
New Products.....	190
Use of Foam Cores .....	190
Lightweight Composites for Rail Interiors .....	190
BATHROOM FIXTURES AND COMPONENTS .....	190
Overview .....	190
Recent Developments .....	191
ANTI-CORROSION MARKETS .....	191
Background.....	191
Types of Corrosion-Resistant Resins .....	191
Markets.....	192
Water-and Air-Treatment Plant Usage of Composites.....	192
Overview.....	192
Examples .....	193
Kansas Unit.....	193
Replacement of Coated Steel Fans .....	193
California Water Treatment Plant.....	193
New Reinforced Plastic Developments .....	194
Resurgence in Corrosion-Resistant Composites.....	194
Examples of Several other Industries Impacted by	
Corrosion.....	195
Underground Storage Tanks .....	195
Food Processing.....	196
Views from the 2007 Conference on Construction,	
Corrosion and Infrastructure.....	196
Market Estimates and Forecasts .....	196
<i>TABLE 52 FIBER-REINFORCED PLASTIC</i>	
<i>CONSTRUCTION/INFRASTRUCTURE MARKET BY RESIN,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>197</i>
<i>TABLE 53 FIBER-REINFORCED PLASTIC</i>	
<i>CONSTRUCTION/INFRASTRUCTURE MARKET BY SEGMENT,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>197</i>
<i>TABLE 54 FIBER-REINFORCED UNSATURATED POLYESTER</i>	
<i>CONSTRUCTION/INFRASTRUCTURE MARKET BY SEGMENT,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>198</i>
<i>TABLE 55 FIBER-REINFORCED EPOXY</i>	
<i>CONSTRUCTION/INFRASTRUCTURE MARKET BY SEGMENT,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>198</i>
MARINE MARKETS .....	198
OVERVIEW .....	198
GENERAL MATERIAL USAGE .....	199
Glass.....	199
Carbon.....	200
Aramid .....	200

Epoxy/Vinyl Ester.....	200
LEGISLATIVE ISSUES.....	200
TRENDS IN MARINE COMPOSITES.....	200
NEW PRODUCTS .....	201
BASF.....	201
MARKET ESTIMATES AND FORECASTS .....	201
<i>TABLE 56 FIBER-REINFORCED PLASTICS MARINE MARKET,</i>	
<i>THROUGH 2012 (MILLION POUNDS) .....</i>	<i>201</i>
ELECTRONIC COMPONENTS.....	202
OVERVIEW .....	202
MARKETS .....	202
GROWTH.....	202
TECHNOLOGIES .....	202
COMPETITIVE SCENARIO .....	203
REINFORCED PLASTICS MOVE AHEAD IN ELECTRONICS .....	203
CELLULAR PHONE USAGE.....	204
PRINTED CIRCUIT BOARDS (PCBS) .....	204
Background .....	204
Definitions.....	204
Production.....	204
Types of Rigid Boards.....	205
Assembly Technologies.....	205
E-Glass Suppliers .....	205
Issues Facing Plastics Usage .....	205
PCB Substrates.....	206
Overview.....	206
Rigid PCBs .....	206
Background.....	206
Current Material Usage .....	207
Standard FR-4 Epoxy Resin .....	207
Higher-Performance Epoxies.....	207
Other Materials .....	207
Types of Reinforcements.....	208
An Update on Composite PCBs.....	208
CONNECTORS .....	209
Background.....	209
Function of Connectors.....	209
Trends .....	209
Resin Selection.....	209
Market Estimates and Forecasts .....	210
<i>TABLE 57 FIBER-REINFORCED PLASTICS ELECTRONIC</i>	
<i>COMPONENT MARKET, THROUGH 2012 (MILLION POUNDS).....</i>	<i>211</i>
CONSUMER PRODUCTS.....	211
BACKGROUND .....	211

SPORTS/RECREATION EQUIPMENT.....	211
Background .....	211
General Resin Usage .....	212
Skis and Other Winter Sports Equipment .....	212
Recreation Boards.....	213
Decking .....	213
Bicycles.....	214
TRENDS AND DEVELOPMENTS .....	214
Bicycle Frames.....	214
New Kayak Materials.....	214
LAWN/GARDEN EQUIPMENT.....	215
Overview .....	215
Resin Usage .....	215
<i>TABLE 58 SELECTED LAWN/GARDEN EQUIPMENT RESINS.....</i>	<i>215</i>
MARKET ESTIMATES AND FORECASTS .....	216
<i>TABLE 59 FIBER-REINFORCED PLASTICS CONSUMER PRODUCTS</i>	
<i>MARKET, THROUGH 2012 (MILLION POUNDS) .....</i>	<i>216</i>
APPLIANCES .....	217
OVERVIEW .....	217
APPLIANCE USAGE IN U.S. HOUSEHOLDS.....	217
KEY APPLICATIONS FOR PLASTICS IN APPLIANCES .....	217
FIBER-REINFORCED PLASTIC USAGE.....	218
Market Estimates and Forecasts .....	218
<i>TABLE 60 FIBER-REINFORCED PLASTIC APPLIANCE MARKET,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>218</i>
AEROSPACE .....	219
OVERVIEW .....	219
HISTORICAL BACKGROUND .....	219
Overview .....	219
Military Aircraft .....	220
Interior Parts .....	220
Composition of Reinforced Plastic Parts .....	220
MATERIAL USAGE.....	220
NEW DEVELOPMENTS .....	221
Boeing's and Airbus Composites .....	221
Background .....	221
Potential Problems.....	221
COMPOSITES BEGINNING TO PENETRATE ENGINE	
PARTS .....	222
SUPPLIERS .....	222
MARKET ESTIMATES AND FORECASTS .....	222
<i>TABLE 61 FIBER-REINFORCED PLASTIC AEROSPACE MARKET,</i>	
<i>THROUGH 2012 (MILLION POUNDS).....</i>	<i>223</i>
MISCELLANEOUS APPLICATIONS .....	223

BACKGROUND .....	223
MEDICAL.....	223
Overview .....	223
Orthopedic Implants and Prostheses.....	223
Overview.....	223
Composites May Move Into Orthopedics .....	224
Recent Developments .....	224
PEEK Products .....	224
Implant-Grade Polymers .....	224
POWER MARKET.....	225
Overview .....	225
Utility Poles .....	225
Cross Arms.....	225
Summary of Benefits that can be Derived from	
Composites in the Power Market .....	226
OTHER TRANSPORTATION MARKETS .....	226
Overview .....	226
Rail Applications .....	227
Background .....	227
Monorails.....	227
Rail Bodies Made from Reinforced Plastics .....	227
Phenolic Composite Usage in Mass Transit .....	227
Composite Crossties Move in the Rail Industry .....	228
Recreational Vehicle Market (RVs) .....	228
WIND ENERGY PRODUCTS .....	229
OILFIELD RELATED APPLICATIONS .....	229
MARKET ESTIMATES AND FORECASTS .....	230
<i>TABLE 62 FIBER-REINFORCED PLASTICS MISCELLANEOUS</i>	
<i>MARKET, THROUGH 2012 (MILLION POUNDS).....</i>	<i>230</i>
SUMMARY OF FIBER-REINFORCED PLASTICS APPLICATIONS	
MARKET.....	231
<i>TABLE 63 SUMMARY OF FIBER-REINFORCED PLASTICS</i>	
<i>APPLICATIONS MARKET, THROUGH 2012 (MILLION POUNDS).....</i>	<i>231</i>
TECHNOLOGIES TO WATCH.....	232
NEW POWDER IMPREGNATION TECHNOLOGY.....	232
BRAIDED REINFORCEMENT APPLICATIONS .....	232
REINFORCED MAT LOWERS RESIN FILL TIME.....	232
SELF-REINFORCING POLYMERS.....	232
NOVEL COMPRESSION MOLDING PROCESS .....	233
POLYPROYLENE FIBERS REPLACE GLASS FIBERS IN	
REINFORCED PLASTICS.....	233
NEW LIGHTER AND STRONGER THERMOPLASTIC COMPOSITES....	233
WHAT ABOUT FUEL CELLS?.....	234
BACKGROUND .....	234

MATERIALS AND PROCESSES .....	234
WHAT DOES THE FUTURE HOLD?.....	235
REINFORCED PLASTICS/COMPOSITES OFFSHORE .....	236
EUROPE.....	236
RECYCLING PROBLEM.....	236
EASTERN EUROPE MOVES AHEAD .....	236
Czech Republic.....	237
Hungary .....	237
Romania .....	237
Bulgaria .....	237
Poland .....	237
Ukraine .....	238
Slovakia.....	238
CHINESE COMPOSITE INDUSTRY.....	238
ENVIRONMENTAL ISSUES .....	239
BACKGROUND .....	239
STYRENE EMISSION PROBLEM.....	239
OVERVIEW .....	239
CHANGES IN MACT DIRECT FINAL RULE .....	240
METHODS TO LOWER STYRENE EMISSIONS.....	240
SUMMARY OF OPTIONS TO REDUCE STYRENE	
EMISSIONS AND MAINTAIN PRODUCT QUALITY .....	241
RECENT DEVELOPMENTS .....	241
Boats.....	241
Underground Tanks .....	242
RECYCLING.....	243
OVERVIEW.....	243
EFFORTS IN THERMOSET RECYCLING .....	244
BACKGROUND .....	244
PYROLYSIS.....	244
GLASS SEPARATION .....	244
GRINDING .....	244
CARBON FIBER RECYCLING.....	244
AUTOMOTIVE INDUSTRY .....	245
COMPANY PROFILES .....	246
AZDEL, INC. ....	246
A SCHULMAN .....	246
AOC LLC .....	247
ASAHI KASEI PLASTICS NORTH AMERICA .....	248
ASHLAND COMPOSITE POLYMERS.....	248
BAYER MATERIAL SCIENCE.....	249

COOK COMPOSITES AND POLYMERS.....	249
CYTEC INDUSTRIES .....	250
DOW PLASTICS .....	250
DSM ENGINEERING PLASTICS AMERICA.....	251
DUPONT ENGINEERING POLYMERS .....	251
FERRO CORPORATION.....	252
GE PLASTICS.....	252
LANXESS.....	253
LNP CORPORATION.....	254
OWENS CORNING .....	254
PREMIX, INC.....	255
QUADRANT PLASTIC COMPOSITES .....	256
REICHHOLD CHEMICAL.....	256
RTP COMPANY.....	257
SOLVAY ADVANCED POLYMERS LLC.....	257
TICONA.....	258
VETROTEXN NORTH AMERICA.....	259
ACRONYMS.....	260
ACRONYMS.....	260
ACRONYMS (CONTINUED) .....	261
GLOSSARY OF TERMS.....	262
GLOSSARY OF TERMS .....	262
GLOSSARY OF TERMS (CONTINUED).....	263
GLOSSARY OF TERMS (CONTINUED).....	264