

THE GLOBAL MARKET FOR COMPOSITES: RESINS, FILLERS, REINFORCEMENTS, NATURAL FIBERS & NANOCOMPOSITES



PLS029E
February 2016

Melvin Schlechter
Project Analyst

ISBN: 1-62296-232-X



BCC Research
49 Walnut Park, Building 2
Wellesley, MA 02481 USA
866-285-7215 (toll-free within the USA),
or (+1) 781-489-7301
www.bccresearch.com
information@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
REASONS FOR DOING THE STUDY	2
STUDY GOALS	2
SCOPE OF THE STUDY	2
INTENDED AUDIENCE	3
METHODOLOGY	3
ANALYST'S CREDENTIALS	4
RELATED BCC RESEARCH REPORTS	4
BCC RESEARCH WEBSITE	4
DISCLAIMER	4
CHAPTER 2 SUMMARY	6
<i>SUMMARY TABLE GLOBAL REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	6
<i>SUMMARY FIGURE GLOBAL REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, 2014-2020 (MILLION POUNDS)</i>	6
CHAPTER 3 REINFORCEMENTS	9
OVERVIEW	9
NONFIBROUS	9
TALCS	9
Background	9
Grades	10
Applications	10
MICA	10
Background	10
Properties	11
Applications	11
Thermosets	11
Thermoplastics	11
WOLLASTONITE	11
Background	11
Applications	12
SILICAS	12
FIBER-REINFORCED PLASTICS	13
OVERVIEW	13
FIBER	13
FIBROUS MATERIALS	13
BACKGROUND	13
REINFORCEMENT TYPES	14
Overview	14
Mats	14
Woven Fabrics	14
Knitted Fabrics	14
Braids	14
Preforms	15

TOPIC	PAGE NO.
Glass Fiber Reinforcements	15
Overview	15
Production	15
Types of Fiberglass	15
Background	16
Types of Glass Fibers	16
Sizing	16
Microspheres	17
Background	17
Solid Microspheres	17
Hollow Microspheres	17
<i>TABLE 1 ADVANTAGES OF SOLID GLASS MICROSPHERES</i>	17
Applications	18
Glass Fiber Suppliers	18
<i>TABLE 2 IMPORTANT GLASS FIBER SUPPLIERS</i>	18
Fiberglass Reinforced Plastics Institute (FRPI)	18
New Developments	19
Evonik Introduces New Glass Fiber Compound	19
Carbon Fibers	19
Background	19
Manufacture	20
<i>TABLE 3 LEADING GLOBAL CARBON FIBER PRODUCERS</i>	21
Product Types	21
<i>TABLE 4 ADVANTAGES AND DISADVANTAGES OF CARBON COMPOSITES</i>	21
Applications	22
Large Users of Carbon Fiber-Reinforced Plastics	22
The Military	22
Commercial Aircraft	22
Automotive	23
Producers	23
End-of-Life Recycling	23
Recent Developments	23
Hexcel and Toray to Expand Carbon Fiber Production in Europe	23
Carbon Fiber Materials Introduced in North America	23
One of the World's Largest Carbon Fiber Plants Gets Bigger	24
Carbon Fibers Moves onto Large-Scale Auto Production	24
Avcorp Acquires SGL Division	24
Aramid Fibers	24
Background	24
Production	25
Properties/Characteristics	25
Usage	25
Ceramic Fibers	26
Background	26
Applications	26
Suppliers	27
A New Development	27

TOPIC	PAGE NO.
Ceramic-Matrix Composites (CMCs) Heat Up	27
Boron Fibers	27
Stainless Steel Fibers	28
Natural Fibers	28
Background	28
How Much Fiber to Use	30
Types of Natural Fibers	30
Overview	30
Flax Fibers	30
Jute Fibers	30
Kenaf Fibers	31
Hemp Fibers	31
Degradation Temperatures of Natural Fibers	31
Global Cultivation of Selected Natural Fibers	31
<i>TABLE 5 KEY NATURAL FIBERS AND MAJOR CULTIVATION AREAS</i>	32
Processing	32
Comparison with Glass Fibers	32
Cellulose Fibers	33
Pricing	33
Review of Possible Stumbling Blocks to Natural Fiber Reinforcements	33
Automotive Applications	33
Other Potential Applications	34
Some Recent Developments	34
Ford Planning to Use Natural Fiber-Reinforced Resins	34
Composite Panel Systems uses Natural Fiber	34
Ford Plans to Use Wheat Straw-Reinforced Plastics	35
Kenaf Fiber-Reinforced Unsaturated Polyesters	35
Market Estimates and Forecasts	35
POLYMER NANOCOMPOSITES	36
BACKGROUND	36
CHARACTERISTICS	36
BENEFITS	37
MECHANICAL ASPECTS	37
DISADVANTAGES OF NANOSIZED ADDITIONS	37
PROCESSES	37
EARLY WORK WITH PLASTICS	38
APPLICATIONS	38
RECENT DEVELOPMENTS	39
Carbon Nanotubes Take the Load in Composites	39
CARBON NANOTUBES	39
OVERVIEW	39
POTENTIAL USE IN PLASTICS	40
A NEW DEVELOPMENT	40
NANOCOMPOSITE SUPPLIERS	41
<i>TABLE 6 KEY NANOCOMPOSITE SUPPLIERS</i>	41
CHAPTER 4 REINFORCED PLASTIC COMPOSITES	43

TOPIC	PAGE NO.
BACKGROUND	43
THERMOSETS	44
OVERVIEW	44
<i>TABLE 7 SELECTED MANUFACTURING PROCESSES AND PROPERTIES OF REINFORCED THERMOSET COMPOSITES</i>	44
PROCESSING	45
Background	45
Hand Lay-Up	45
Spray-Up	45
Pultrusion	45
Filament Winding	46
Reinforced Reaction Injection Molding (RRIM)	46
SHEET MOLDING COMPOUNDS (SMC)	46
Background	46
Advantages	47
SMC Process Choices	47
SMC Formulations	47
<i>TABLE 8 TYPICAL SMC FORMULATIONS (WEIGHT PERCENT)</i>	47
Technology	48
Advantages	48
SMC Compounders	49
<i>TABLE 9 KEY SMC PRODUCERS</i>	49
Markets	49
Other Process Challenges	49
Use of Nanoparticles	49
Applications	50
New Developments	50
Direct Process for Mixing and Molding SMC	50
SMC Products for Mass Transit	50
A New SMC Center	50
BULK MOLDING COMPOUNDS (BMC)	50
Overview	50
Background	51
Technology	51
Advantages	51
Applications	51
BMC Compounders	52
THERMOPLASTICS	52
BACKGROUND	52
REINFORCEMENT DETAILS	53
RECENT DEVELOPMENTS	53
Infusable Thermoplastics Made via In-Situ Polymerization	53
Commingleed Carbon Thermoplastic Yarns	53
Chopped Carbon Fiber/Thermoplastic Prepreg	54
Thermoplastic Composites Save Time and Labor on Small Crucial Parts	54
European Thermoplastic Composites Usage Increasing	54
COMMODITY THERMOPLASTICS	54

TOPIC	PAGE NO.
Background	54
Polypropylene	55
Background	55
Properties	55
Applications	55
Upgraded Polypropylene	56
Reinforced Polypropylenes	56
Overview	56
High-Impact Grades	56
Long Glass-Fiber Polypropylene	57
Reinforced Polypropylene Products	57
<i>TABLE 10 TRADE NAMES OF KEY FIBER-REINFORCED POLYPROPYLENE</i>	57
New Reinforced Polypropylene Products	58
Natural Fiber-Reinforced Polypropylene Composites	58
Borealis	58
Cellulose Fiber-Reinforced Polypropylene	58
Producers	58
<i>TABLE 11 KEY GLOBAL POLYPROPYLENE PRODUCERS AND ESTIMATED CAPACITIES (BILLION POUNDS/YEAR)</i>	58
Recent Developments	59
Biofiber-Reinforced Polypropylene Composites	59
Long-Glass Polypropylene Improves Impact at Lower Cost	59
RTP Introduces Cellulose Fiber-Reinforced Polypropylene Composites	59
Polyethylenes	59
Background	59
Need for Additives	60
High-Density Polyethylene (HDPE)	60
Overview	60
Background	60
Processing of HDPE	60
Producers	61
<i>TABLE 12 LEADING GLOBAL HDPE PRODUCERS (BILLION LBS/YEAR)</i>	61
Reinforced Polyethylenes	61
Some Details on Commercial Reinforced HDPE Composites	61
Lignocellulosic Filler/Recycled HDPE Composites Effect on Filler Type	61
Flax Fiber-Reinforced Polyethylenes	62
Cellulose Fiber HDPE Composites	62
Recent Developments	62
Coconut Fiber-Reinforced HDPE	62
Polyamide Fiber-Reinforced HDPE	62
Market Estimates and Forecasts	63
<i>TABLE 13 GLOBAL MARKET FOR REINFORCED PLASTIC COMMODITY THERMOPLASTIC COMPOSITES, THROUGH 2020 (MILLION POUNDS)</i>	63
<i>TABLE 14 GLOBAL MARKET FOR REINFORCED PLASTIC POLYETHYLENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	63
<i>TABLE 15 GLOBAL MARKET FOR REINFORCED POLYPROPYLENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	64

TOPIC	PAGE NO.
POLYSTYRENE	64
General Purpose Polystyrene	64
High-Impact Polystyrene (HIPS)	64
Background	64
Properties	64
Applications	65
Recent Styrenic Polymer Producer Changes	65
Global Market Players and Industry Leaders	65
Processing	66
Overview	66
<i>TABLE 16 FABRICATION METHODS AND USES FOR POLYSTYRENE</i>	66
Polystyrene Composite Products	66
Extruded Polystyrene Foam Composite Panels	67
Market Estimates and Forecasts	67
<i>TABLE 17 GLOBAL MARKET FOR REINFORCED POLYSTYRENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	67
ACRYLONITRILE-BUTADIENE-STYRENE (ABS)	67
Background	67
Properties	67
Processing	68
Grades	68
Production	68
Reinforced ABS Applications	69
Examples of Reinforced ABS Products	69
Market Estimates and Forecasts	69
<i>TABLE 18 GLOBAL MARKET FOR REINFORCED ABS COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	69
STYRENE MALEIC ANHYDRIDE (SMA)	70
Background	70
Reinforced SMA Composites	70
Specific Examples of Specific Reinforced Grades	71
Market Estimates and Forecasts	71
<i>TABLE 19 GLOBAL MARKET FOR REINFORCED SMA COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	71
STYRENE-ACRYLONITRILE COPOLYMERS (SAN)	71
Overview	71
Properties	72
Producers	72
Reinforced SAN Composite Products	73
ENGINEERING THERMOPLASTICS (ETPS)	73
Background	73
Polyamides	73
Background	73
Properties	74
Processing	74
Alloying/Blending of Polyamides	74
Applications	74
Major Types	75

TOPIC	PAGE NO.
Polyamide 66	75
Polyamide 6	75
Producers and Capacities	75
<i>TABLE 20 KEY GLOBAL POLYAMIDE RESIN PRODUCERS</i>	75
Capacity Additions and Other Changes	76
DSM Increases Capacity for New Polyamides	76
Arkema Increases Production of Rilsan Polyamides	76
Ube Begins Polyamide Production in South America	76
DuPont Goes Ahead with Asian Polyamide Expansion Plans	76
Lanxess Plans New Polyamide Plant	76
Evonik to Build Polyamide 12 Plants in Asia and Europe	77
Rhodia Ups Polyamide Production	77
Arkema Increases Polyamide Capacities in Asia	77
BASF Expands Polyamide Capacity	77
Reinforced Polyamide Composites	77
Examples of Commercial Reinforced Polyamide Composites	78
<i>TABLE 21 SELECTED EXAMPLES OF COMMERCIALY IMPORTANT REINFORCED POLYAMIDE COMPOSITES</i>	78
New Developments	79
Thermoformed Polyamide for Marine Applications	79
Glass-Filled Thermoformed Polyamide	79
Polyamide Photovoltaic Mounting Systems	79
Polyamides Provides Needed Requirements for Ball Bearings	80
Market Estimates and Forecasts	80
<i>TABLE 22 GLOBAL MARKET FOR REINFORCED POLYAMIDE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	80
<i>TABLE 23 GLOBAL MARKET FOR REINFORCED POLYAMIDE COMPOSITES IN THE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)</i>	81
Polybutylene Terephthalate (PBT)	81
Background	81
Properties	81
Applications	82
Reinforced PBT Products	82
<i>TABLE 24 KEY REINFORCED PBT COMPOSITES BY TRADE NAME</i>	82
Polyethylene Terephthalate (PET)	83
Overview	83
Glycol Modified PET Polyester (PETG)	83
Engineering-Grade PET	83
Reinforced PET	83
Examples of Reinforced PET Products	84
<i>TABLE 25 KEY REINFORCED PET COMPOSITES BY TRADE NAME</i>	84
Market Estimates and Forecasts	84
<i>TABLE 26 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC POLYESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	85
<i>TABLE 27 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC POLYESTER COMPOSITES IN THE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)</i>	85
Polycarbonates	85
Background	85

TOPIC	PAGE NO.
General Grades	86
Impact of Bisphenol A on Polycarbonate Usage	86
Processing	86
Properties	86
Property Advantages and Disadvantages	87
Brief Review of Applications	87
Polymer Alloys/Blends	87
Major Polycarbonate Producers	88
<i>TABLE 28 SELECTED MAJOR POLYCARBONATE PRODUCERS AND TRADE-NAMED PRODUCTS</i>	88
Reinforced Polycarbonates	88
<i>TABLE 29 SELECTED COMMERCIALY IMPORTANT REINFORCED POLYCARBONATE COMPOSITES BY TRADE NAME AND SUPPLIER</i>	89
Recent Development	89
Bayer Reinforced Polycarbonates Have Lighter, Thinner Laptops	89
Market Estimates and Forecasts	89
<i>TABLE 30 GLOBAL MARKET FOR REINFORCED POLYCARBONATE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	89
Polyacetals	90
Background	90
Grades	90
Properties	90
Processing	91
Producers	91
<i>TABLE 31 KEY GLOBAL POLYACETAL TRADE-NAMED PRODUCTS AND PRODUCERS</i>	92
Typical Applications	92
<i>TABLE 32 TYPICAL APPLICATIONS OF POLYACETALS</i>	92
Examples of Polyacetal Reinforced Products	93
Examples of Reinforced Polyactals	93
Long Glass-Reinforced Polyacetals	93
Market Estimates and Forecasts	93
<i>TABLE 33 GLOBAL REINFORCED POLYACETAL COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	93
Polyphenylene Sulfides (PPS)	94
Background	94
Properties	94
Advantages and Disadvantages	95
Producers	95
Applications	95
PPS Reinforced Products	96
<i>TABLE 34 KEY REINFORCED POLYPHENYLENE SULFIDE COMPOSITE PRODUCTS AND SUPPLIERS</i>	96
Market Estimates and Forecasts	97
<i>TABLE 35 GLOBAL REINFORCED POLYPHENYLENE SULFIDE COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	97
New Developments	97
Blowmolded PPS for High-Temperature Auto Applications	97
Chevron Phillips Product Line Expansion	97

TOPIC	PAGE NO.
Celanese's Fortron Reinforced Grades	97
Polyimides/PEI/PAI	98
Properties	98
Polyetherimides (PEIs)	98
Background	98
Properties	98
Producers	99
Applications	99
Polyamides/-imides	99
Overview	99
Properties	100
Applications	100
Key Polyimide Products and Producers	100
Market Estimates and Forecasts	101
<i>TABLE 36 GLOBAL MARKET FOR REINFORCED POLYIMIDE COMPOSITES, BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	101
New Polyimide Developments	101
Braid-Reinforced Polyimide Tubing	101
Carbon-Fiber PEI Replaces Aluminum	101
Liquid Crystal Polymers	102
Background	102
Properties	102
Applications	103
Background	103
Electronic/Electrical	103
LCP Reinforced Products	103
Producers	104
<i>TABLE 37 KEY GLOBAL LIQUID CRYSTAL POLYMER PRODUCERS AND ESTIMATED CAPACITIES</i>	104
Market Estimates and Forecasts	104
<i>TABLE 38 GLOBAL REINFORCED LIQUID CRYSTAL POLYMER COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	105
New Developments and Products	105
DuPont Zenite 7130 BK LCP Glass Reinforced Liquid Crystal Polymer	105
Polysulfones	105
Background	105
Types of Polysulfones	106
Grades	106
Further Application Details	106
Polysulfone Producers and Trade-named Products	107
Reinforced Polysulfone Products	107
Market Estimates and Forecasts	107
<i>TABLE 39 GLOBAL REINFORCED POLYSULFONE COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	107
A New Development	108
Carbon Fiber Reinforced Polysulfone-A New Implant Material	108
Polymer Alloys/Blends	108

TOPIC	PAGE NO.
Background	108
PC/ABS	108
Background	108
Grades and Properties	108
Applications	109
Reinforced Grades	109
PPO/HIPS	110
Background	110
Properties and Advantages	110
Grades	110
Processing	110
Specific Applications of Reinforced Noryl Grades	110
Other Applications	111
PPO/Polyamides	111
Background and Properties	111
Grades and Applications	111
PC/PBT	112
Background	112
Properties	112
Applications	113
PC/PET	113
Other Polymer Alloys/Blends	114
Market Estimates and Forecasts	114
<i>TABLE 40 GLOBAL REINFORCED POLYMER ALLOYS/BLENDS COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	114
New Products and Developments of Polymer Alloys/Blends	114
PBT/ASA Low Warpage Resins	114
OTHER REINFORCED THERMOPLASTICS	115
Polyketones	115
Background	115
Properties	115
Polyketone Composites	115
Applications	116
Producers	116
New PEEK Products and Developments	116
Reinforced Polyketone Polymer Compositions	116
Customized High-Performance Polyketones	117
Kadel Polyketones	117
PEEK Masterbatches	117
Carbon-Fiber PEEK Compounds	117
Market Estimates and Forecasts	117
<i>TABLE 41 GLOBAL MARKET FOR OTHER REINFORCED THERMOPLASTIC COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	117
MARKET SUMMARY FOR REINFORCED THERMOPLASTICS/COMPOSITES	118
<i>TABLE 42 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	118
CHAPTER 5 OTHER IMPORTANT GROUPINGS OF REINFORCED PLASTICS/COMPOSITES	120

TOPIC	PAGE NO.
OVERVIEW	120
GLASS MAT THERMOPLASTICS (GMTS)	120
OVERVIEW	120
BACKGROUND	120
TECHNOLOGY	120
APPLICATIONS	121
MARKET SIZE	121
LONG FIBER-REINFORCED THERMOPLASTICS (LFRTS)	121
BACKGROUND	121
OTHER FACTORS	122
PROCESSING	122
PROPERTIES	123
BENEFITS	123
LIMITATIONS	124
RESIN MATRICES	124
SUPPLIERS	124
SUMMARY	124
CELSTRAN'S PRODUCTS	125
IMPORTANT GLOBAL PLAYERS IN LFRTS	125
MARKET SIZE	126
<i>TABLE 43 GLOBAL LFRT DEMAND BY INDUSTRY (%)</i>	126
RECENT DEVELOPMENTS	127
Production of LFRT Long Fiber Reinforced Thermoplastics via Pultrusion	127
Increased Long Fiber Reinforced Thermoplastics Automotive Usage	127
Very Long Fibers	127
Celstran Long Fiber Advantages	127
Other Auto Advances with LFRTs	127
New Polypropylene LFRT for Automotive Parts	128
THERMOSET RESINS	128
OVERVIEW	128
FIBER-REINFORCED GRADES	128
OUTLOOK	128
GENERAL PROPERTIES	129
<i>TABLE 44 REINFORCED THERMOSET PLASTIC COMPOSITE PROPERTIES AND MANUFACTURING PROCESSES</i>	129
UNSATURATED POLYESTERS	129
Background	129
Ingredients of Unsaturated Polyester Formulations	130
<i>TABLE 45 KEY INGREDIENTS OF UNSATURATED POLYESTER RESIN FORMULATIONS IN DESCENDING ORDER OF COMMERCIAL USE</i>	130
Types of Unsaturated Polyesters	131
Applications	131
Overview	131
Construction/Infrastructure	131
Bathroom Products	131
Corrosion-Resistant Products	131
Marine Products	132

TOPIC	PAGE NO.
Transportation	132
Other Applications	132
Nonreinforced Unsaturated Polyesters	132
Examples of Commercial Reinforced Unsaturated Polyesters	133
<i>TABLE 46 KEY COMMERCIAL REINFORCED UNSATURATED POLYESTERS COMPOSITE TRADE NAMES AND SUPPLIERS</i>	133
Recent Developments	133
Characterization and Synthesis of Graphene-Based Unsaturated Polyester Composites	133
Unsaturated Polyester Composites Reinforced with Peach Palm	133
Mixing Organic Peroxides into Composite Materials	134
Market Estimates and Forecasts	134
<i>TABLE 47 GLOBAL MARKET FOR REINFORCED UNSATURATED POLYESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	134
<i>TABLE 48 GLOBAL MARKET OF UNSATURATED POLYESTER COMPOSITE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)</i>	135
VINYL ESTERS	135
Background	135
Technologies	135
Properties	136
Characteristics	136
Applications	136
Differences between Unsaturated Polyesters and Vinyl Esters	137
Commercially Important Reinforced Vinyl Esters	137
<i>TABLE 49 KEY COMMERCIAL REINFORCED VINYL ESTER COMPOSITES AND SUPPLIERS</i>	137
Market Estimates and Forecasts	137
<i>TABLE 50 GLOBAL MARKET FOR REINFORCED VINYL ESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	138
New Developments/Products	138
Styrene-Free Vinyl Hybrids	138
Epoxy Vinyl Ethers Used for Carbon Fiber Composites	138
EPOXY RESINS	139
Background	139
Chemistry	139
Chemical Epoxy Types	139
Technology	140
Epoxy Systems	140
Background	140
Nonmolded	140
Laminating Systems	140
Molded Epoxies	141
Epoxy Composites	141
Other Applications	142
Manufacturing Methods	142
Making Epoxy Composites Recyclable by Design	142
Prepreg Compression Molding	143
Snap Cures via Epoxy Systems	143
Epoxy, BMI Fabric Prepreg "Tiles"	143

TOPIC	PAGE NO.
Advanced Epoxy Composites	143
Other Applications	144
Manufacturing Methods	144
Key Reinforced Epoxy Resin Trade-Named Products	144
New Developments	144
Dow Develops an Advanced Epoxy for Composite Uses	144
Carbon Fiber, Prepreg, Epoxy Resin	145
Two Component Epoxy for Aerospace Applications	145
New Epoxy for Automated Fiber Placement	145
Dow Chemical Shortens Time for Epoxy Cures	145
Epoxy, BMI Fabric Prepreg Tiles	146
Market Estimates and Forecasts	146
<i>TABLE 51 GLOBAL MARKET FOR REINFORCED EPOXY COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	146
PHENOLICS	147
Background	147
Technology	147
Grades	147
Molding Compounds	148
Applications	148
Composite Usage	148
Examples of Reinforced Phenolic Grades	149
Recent Developments	149
Phenolics Move into Mass Transit	149
Reinforced Phenolic Nano-Composites	149
Phenolic Armoring Prepreg	149
Fire-Safe Phenolic Composite Marine Products	149
Reinforced Phenolic Resin Suppliers	150
<i>TABLE 52 KEY REINFORCED PHENOLIC COMPOSITES TRADE NAMES AND SUPPLIERS</i>	150
Market Estimates and Forecasts	150
<i>TABLE 53 GLOBAL MARKET FOR REINFORCED PHENOLIC COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	150
POLYURETHANES	151
Overview	151
Background	151
Polyureas	152
RIM Products	152
RRIM Products	152
SRIM Products	153
Competing Products	153
Advantages	154
Reinforced Polyurethane Products	154
More about Polyurethane Composites in the Automotive Industry	154
Market Estimates and Forecasts	155
<i>TABLE 54 GLOBAL MARKET FOR REINFORCED POLYURETHANE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	155
Recent Developments	155

TOPIC	PAGE NO.
Structural Polyurethanes	155
Pultruded Polyurethane Pallets	155
A Lighter Alternative to Plywood	156
MISCELLANEOUS FIBER-REINFORCED THERMOSETS	156
Diallyl Phthalate (DAP)	156
Thermoplastic Elastomers (TPEs)	157
Cyanate Esters	157
Polybutadiene Resins	157
Market Estimates and Forecasts	157
<i>TABLE 55 GLOBAL MARKET FOR REINFORCED OTHER THERMOSET COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	158
MARKET SUMMARY OF REINFORCED THERMOSET COMPOSITES	158
<i>TABLE 56 GLOBAL MARKET SUMMARY OF REINFORCED THERMOSET COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	158
MARKET SUMMARY OF REINFORCED PLASTICS BY RESIN	159
<i>TABLE 57 GLOBAL MARKET SUMMARY OF REINFORCED THERMOSET COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	159
<i>TABLE 58 GLOBAL COMPOSITE RESIN MARKET BY REGION, THROUGH 2020 (BILLION POUNDS)</i>	160
CHAPTER 6 APPLICATIONS	162
OVERVIEW	162
AUTOMOTIVE	162
BACKGROUND	162
CAFE ISSUES	163
Overview	163
Another Important Automotive Survey on Composites	164
COMPARATIVE AUTOMOTIVE MATERIALS	164
<i>TABLE 59 EXPECTED TOTAL AUTOMOTIVE CONSUMPTION BY MATERIAL, THROUGH 2020 (%)</i>	165
RECENT VOLKSWAGEN DISCLOSURE	166
AUTOMOTIVE UNDER-THE-HOOD SEGMENT	166
Overview	166
Background	166
Key Factors of the UTH Resin Market	167
<i>TABLE 60 SELECTED AUTOMOTIVE UNDER-THE-HOOD REINFORCED RESIN COMPOSITES BY PART</i>	167
Overview of Electronic Components	168
Material Usage	169
Expanded Use of Encapsulated Components	169
Switches/Sockets	170
Ignition Components	170
Bobbins/Connectors	170
Plastic Rocker Covers	171
Catalytic Converters	171
Valve Covers	171
Intake Manifolds	171
Reservoirs	172
Heating/Air-Conditioning Equipment	172

TOPIC	PAGE NO.
Market Estimates and Forecasts	172
<i>TABLE 61 GLOBAL REINFORCED PLASTIC COMPOSITE AUTOMOTIVE UTH MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	173
AUTOMOTIVE EXTERIORS	173
Use of Reinforced Plastics Composites	173
Body Panels	174
Horizontal vs. Vertical Body Panels (Steel vs. SMC)	174
General Decision Factors for Body Panels	175
Carbon-Fiber SMC	175
Need for Class A Finishes	175
Other SMC Competition	175
Other Considerations	176
Paint-Free SMCs?	176
Fenders	177
Background	177
Thermoplastics in Fenders	177
Bumper Systems	177
Background	177
Bumper Systems and Products	177
Side Molding/Trim	178
Radiator/Grilles	178
Overall Usage of Resins in Exterior Auto Parts	178
<i>TABLE 62 RESINS USED FOR SPECIFIC EXTERIOR AUTOMOTIVE PARTS</i>	178
A Recent Development	179
Carbon Fiber Body Panels: Class A Paint?	179
Market Estimates and Forecasts	179
<i>TABLE 63 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE AUTOMOTIVE EXTERIOR MARKET, THROUGH 2020 (MILLION POUNDS)</i>	180
AUTOMOTIVE INTERIORS	180
Background	180
Overview of Specific Fiber-Reinforced Plastic Auto Interior Applications	181
<i>TABLE 64 RESINS USED FOR SPECIFIC INTERIOR AUTOMOTIVE PARTS</i>	181
Seat-Related Auto Interior Parts	181
Background	181
Front Seat Bases	182
Front Seat Shells	182
Front Seat Backs	182
Rear Seats	183
Child Safety Seats	183
Rear Seat Backs	183
Tough Resins Needed for Airbag Doors	183
Instrument Panels	184
Overview	184
Instrument Panel Structures	184
Knee Bolsters	184
Background	184
Resins Used	185

TOPIC	PAGE NO.
Consoles	185
Headliners	185
Overview	185
Resin Usage	185
Flooring	186
Package Shelves/Trays	186
Market Estimates and Forecasts	186
<i>TABLE 65 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES IN AUTOMOTIVE INTERIORS BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	186
<i>TABLE 66 GLOBAL REINFORCED PLASTIC COMPOSITE AUTOMOTIVE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	187
RECENT DEVELOPMENTS OF REINFORCED PLASTICS COMPOSITES IN AUTOMOTIVE	188
BASF Program to Manufacture Semi-finished Auto Composites	188
Automotive Carbon Fiber: Looking for Moderation	188
Fiber Sizing for Automotive Composites	188
Composites Leaf Springs: Saving Weight in Production Suspension Systems	188
Composite Engine Piston Cylinder Housings	188
Composite Air Brakes	189
Carbon Fiber Reinforced Plastic in Mass-Production Cars	189
Carbon Fiber Springs	189
Questions of Economic Viability of Carbon Fiber Composites in Autos	189
Are Large Automakers Being Too Cautious?	190
New Group to Foster Use of Composites in Autos	190
New Continuous-Fiber Laminate Overmolding Compound for Automotive Uses	190
Dow Automotive Opens Several Composite Centers	190
Composite Car Floors	191
Rice-Hull Reinforced Plastics in Trucks	191
Composites Reduce Wheel Weight	191
Reinforced Polyamides Used for Front-End Carrier	191
Polyamides Polyester Replace SMC in Modular Trucks	191
What about Engine Design Changes?	191
Lightweight Suspension Systems	192
Fiber-Reinforced Plastics Seeing Increased Use in Engine Parts	192
Composite Future for Cylinder Housings	192
FUEL CELLS IN AUTOMOTIVE	192
Background	192
Possible Future Scenario	193
Types of Fuel Cells and Components	193
Materials and Processes	193
What Does the Future Hold?	194
<i>TABLE 67 FUEL CELL PRODUCERS</i>	194
Recent Developments	195
Fuel Cell Vehicles	195
Electrocatalyst Approaches and Challenges for Automotive Fuel Cells	195
A Recent Development	196

TOPIC	PAGE NO.
CONSTRUCTION/INFRASTRUCTURE	196
BACKGROUND	196
OVERVIEW	196
ADVANTAGES OF REINFORCED PLASTIC COMPOSITES IN CONSTRUCTION	197
INFRASTRUCTURE APPLICATIONS	197
Structural Shapes	198
Pre-Engineered Structural Systems	198
SOME BARRIERS TO REINFORCED PLASTIC COMPOSITE USAGE	198
ADVANTAGES OF REINFORCED PLASTIC COMPOSITES	198
ROADBLOCKS	199
INFRASTRUCTURE REPAIR	199
Jacketing	199
Concrete Reinforcement	200
Background	200
Rebars/Plate Bonding	200
Concrete Highway Pavement	200
BRIDGES	200
Overview	200
Bridge Cables from Composites	201
Domestic Scenario	201
Other Scenarios	202
Recent Developments	202
Composite Advantage Develops New Wear Surfaces for Bridges	202
Progress in Building Codes	202
Composite pontoons Used on Floating Bridge	202
European Project	203
U.S. Project	203
BATHROOM PRODUCTS	203
Overview	203
Development of Fiberglass-Reinforced Plastics in Bathrooms	203
PANELS	204
Overview	204
Natural Fibers for Panels	204
MARKET ESTIMATES AND FORECASTS	205
<i>TABLE 68 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE CONSTRUCTION/INFRASTRUCTURE BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	205
RECENT DEVELOPMENTS	205
Composites UK Launches Construction Sector Group (CSG)	205
Replacing Stainless Steel	206
Storing Water Underground	206
ANTI-CORROSION MARKETS	206
BACKGROUND	206
USE OF REINFORCED PLASTIC COMPOSITES	206
RESURGENCE IN CORROSION-RESISTANT COMPOSITES	207
EXAMPLE OF INDUSTRIES IMPACTED BY CORROSION-UNDERGROUND STORAGE TANKS	207
FURTHER DETAILS ON FACILITIES USING REINFORCED PLASTIC COMPOSITES FOR ANTI-CORROSION	208

TOPIC	PAGE NO.
Chemical Water Treatment Plants	208
Chemical Plants	208
Markets	208
Key Products	208
Other Applications for Anticorrosion Products	209
An Example of an Important Standard	209
Chinese Activities	209
Plasticon's Anti-Corrosion Composites	209
MARKET ESTIMATES AND FORECASTS	209
<i>TABLE 69 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES ANTI-CORROSION MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	209
RECENT DEVELOPMENTS	210
Polynt Anti-Corrosion Products	210
Marine Anti-Corrosion Products in China	210
ASTM C582	210
MARINE MARKETS	211
OVERVIEW	211
MATERIALS	211
Glass	211
Carbon	212
Aramid	212
Epoxy/Vinyl Ester	212
TRENDS IN MARINE COMPOSITES	212
MARINE REINFORCED PLASTIC COMPOSITES ADVANTAGES AND DISADVANTAGES	212
MARKET SIZE	213
MARKET ESTIMATES AND FORECASTS	213
<i>TABLE 70 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE MARINE PRODUCTS BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	213
RECENT DEVELOPMENTS	214
Aston Martin Produces a Carbon Fiber Powerboat	214
Yacht Building Composites	214
ELECTRONICS	214
OVERVIEW	214
MARKETS	214
GROWTH	215
TECHNOLOGIES	215
REINFORCED PLASTIC COMPOSITES MOVE AHEAD IN ELECTRONICS	215
PRINTED CIRCUIT BOARDS (PCBS)	216
Background	216
Physical Composition	216
Types of Rigid Boards	216
Assembly Technologies	216
E-Glass Suppliers	216
Issues Facing Plastics Usage	217
PCB Substrates	217
<i>TABLE 71 IMPORTANT TECHNICAL FACTORS TO CONSIDER WHEN SELECTING PCB SUBSTRATE MATERIALS</i>	217

TOPIC	PAGE NO.
Rigid PCBs	218
Background	218
Standard FR-4 Epoxy Resin	218
Types of Reinforcements	218
EPOXIES	219
Overview	219
Important Epoxy Grades and Producers	220
POLYURETHANE RIM PRODUCTS	220
Overview	220
RRIM Products	220
SRIM Products	221
Additional Details	221
Applications	221
Key Polyurethane Suppliers	221
PHENOLICS ELECTRIC/ELECTRONIC APPLICATIONS	221
Overview	221
Producers	222
REINFORCED UNSATURATED POLYESTERS	222
THERMOPLASTICS	223
Overview	223
Reinforced Polyamides	223
Background	223
Electric/Electronic Applications	223
Reinforced Polyesters	224
PBT Usage	224
PET Electronic Products	225
Polyphenylene Sulfide (PPS)	225
Polyimides	225
Polycarbonates	226
Liquid Crystal Polymers (LCPs)	226
Polysulfones	226
Polymer Alloys/Blends	227
MARKET ESTIMATE AND FORECASTS	227
<i>TABLE 72 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES ELECTRONICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	227
CHANGES IN ELECTRONIC COMPONENT MANUFACTURE THAT COULD IMPACT REINFORCED COMPOSITE RESIN CHOICES	228
RECENT DEVELOPMENTS	229
Epoxy Resin Composition, Prepreg, Fiber Reinforced Composites for Electrical or Electronic Equipment	229
Resin for Electronics	229
Structural and Electronic Properties of Carbon Nanotube Epoxy Resins	229
Recycling of Comminuted Glass-Fiber Reinforced Resin from Electronic Waste	230
Ignition Loss of Cured Reinforced Resins	230
APPLIANCES	230
BACKGROUND	230

TOPIC	PAGE NO.
APPLIANCE CATEGORIES	231
KEY APPLICATIONS OF PLASTICS IN APPLIANCES	231
<i>TABLE 73 SELECTED MAJOR APPLICATIONS FOR POLYMERS IN APPLIANCES</i>	232
FIBER-REINFORCED PLASTIC USAGE	232
MARKET ESTIMATES AND FORECASTS	232
<i>TABLE 74 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE APPLIANCE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	233
RECENT DEVELOPMENTS	233
Chinese Fiber Reinforced Appliance Parts	233
Fiberglass Reinforced Plastic Orthotic Appliances	233
AEROSPACE	234
OVERVIEW	234
BACKGROUND	234
MILITARY AIRCRAFT	235
INTERIOR AIRCRAFT PARTS	235
COMPOSITION OF REINFORCED AIRCRAFT PLASTIC PARTS	235
MATERIAL USAGE	235
Overview	235
Aramid Fiber Composites	236
POTENTIAL PROBLEMS WITH FUSELAGE COMPONENTS	236
COMPOSITE SUPPLIERS	236
MARKET ESTIMATES AND FORECASTS	236
<i>TABLE 75 GLOBAL REINFORCED PLASTIC COMPOSITE AEROSPACE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	236
RECENT DEVELOPMENTS	237
TenCate Supplies Molded Parts to Helicopter Program	237
Largest Civil Aircraft Composite Parts	237
Ascent Aerospace to Produce Largest-ever Wing Skin Tool for Boeing	237
New Process Allows for Quick Composite Repair	238
Spirit AeroSystems Completes First Composite Fuselage for Bell V-280	238
Weight Reduction with Carbon Fiber Door	238
Composites in Commercial Aircraft Engines are Increasing	238
The Aircraft of the Future?	238
CONSUMER PRODUCTS	239
BACKGROUND	239
MEDICAL DEVICES	239
Status of the Healthcare Industry	239
Overall Plastic Usage	239
Polymers Used	239
Commodity Thermoplastics	239
Engineering Resins	240
Thermoset Resins	240
Orthopedic Implants and Prostheses	240
Recent Developments	241
Reinforced Medical Tubing	241
Reinforced Clear PVC Tubing Polyester Braid	241
Carbon Fibers Used for Foot Prosthetics	241

TOPIC	PAGE NO.
New Composite Bone Implant Approved	242
Composite Lumbar Spacer Implant Developed	242
Surgical Seals	242
SPORTS/RECREATION EQUIPMENT	242
Background	242
General Resin Usage	243
Skis and Other Winter Sports Equipment	243
Recreation Boards	243
Bicycles	244
Specific Reinforced Plastics Products Used in Sports and Recreation Products	244
A Recent Development	244
LAWN AND GARDEN EQUIPMENT	245
Overview	245
Resin Usage	245
Market Estimates and Forecasts	246
<i>TABLE 76 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE CONSUMER PRODUCTS BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	246
Ridan Composites	247
POWER MARKET	247
Overview	247
Distribution/Utility Poles	247
Cross Arms	248
Summary of Benefits Derived from Composites in the Power Market	248
RECENT DEVELOPMENTS	249
Composite Manhole Covers	249
Designing Pressure Vessels for Seawater Desalination Plants	249
OTHER TRANSPORTATION MARKETS	249
Overview	249
Rail Applications	250
Background	250
Monorails	250
Composites Being Used for Railroad Interiors	250
Phenolic Composite Usage in Mass Transit	251
Recent Development	251
Eurorail Standards Cause Changes	251
WIND ENERGY PRODUCTS	251
Background	251
Technology	252
Opportunities and Limits	252
Wind Turbine Blade Manufacture	252
Building Larger Blades to Increase Share of the Wind May Not be the Best Option	252
New Developments	253
Brazil Leads South American Wind Energy Market	253
European 2015 Offshore Mid-Year Growth Tops Previous Full-Year Record	253
Wind Turbine Rotor Blade Market Said to be Increasing Rapidly	253

TOPIC	PAGE NO.
OILFIELD-RELATED APPLICATIONS	254
WATER DESALINATION	254
REINFORCED PLASTICS IN-GROUND TANKS	254
NASA's Composite Cryogenic Tank Passes Pressurized Temperature Tests	255
MISCELLANEOUS APPLICATIONS	255
Background	255
MARKET ESTIMATES AND FORECASTS	255
<i>TABLE 77 GLOBAL REINFORCED PLASTIC COMPOSITE MISCELLANEOUS MARKETS BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	255
SUMMARY OF REINFORCED PLASTICS APPLICATIONS MARKET	256
<i>TABLE 78 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	256
OBSERVATIONS AND ISSUES CONCERNING THE FUTURE OF THE GLOBAL REINFORCED PLASTIC COMPOSITE MARKET	257
COMPOSITES INDUSTRY STILL FACES SIGNIFICANT CHALLENGES	257
OTHER RECENT DEVELOPMENTS IN THE COMPOSITES MARKET	258
New Composites Processing Enterprise	258
SGL and BASF Develop Cost-effective Composites	258
Bayer Material Science Buys Composite Materials Specialist	258
Core Molding Technologies Moves into Long Fiber Composites	258
NASA and Large Aerospace Companies Join Forces to Develop Lightweight Composites	259
Curing Composites Using Carbon Nanotube Film	259
Composite Molding Times Reduced	259
Prepreg Compression Molding Makes Commercial Debut	259
Dow Introduced Polyurethane for Pultrusion of Composites	260
New TenCate Composites	260
Composites Tackle Concussions	260
CHAPTER 7 ENVIRONMENTAL AND RECYCLING ISSUES	262
ENVIRONMENTAL BENEFITS OF REINFORCED PLASTIC COMPOSITES	262
BRIEF SUMMARY	262
WEIGHT REDUCTION	262
LIFE CYCLE ANALYSIS	262
RECYCLING	262
OVERVIEW	262
SPECIAL CONCERNS	263
DO REINFORCED PLASTIC COMPOSITES REQUIRE A BETTER SOLUTION FOR THEIR END-LIFE?	263
EFFORTS IN THERMOSET RECYCLING	263
Background	263
Pyrolysis	264
Glass Separation	264
Grinding	264
Carbon-Fiber Recycling	264
COMPOSITES CAN BE RECYCLED	264
COMPOSITE STRUCTURE END-OF-LIFE ISSUES	265
RECENT DEVELOPMENTS	266

TOPIC	PAGE NO.
Recycling Center Promotes New Life for Scrap Carbon Fiber	266
Carbon Recycling Coming to the Forefront in Europe	266
DSM Composite Resins' Recycling Technologies for Composites	266
Making Epoxy Composites Recyclable by Design	267
CHAPTER 8 COMPANY PROFILES	269
ADVANCED COMPOSITES INC.	269
ALBANY ENGINEERED COMPOSITES	269
AOC LLC	269
ASHLAND SPECIALTY CHEMICAL COMPANY	270
BULK MOLDING COMPOUNDS INC.	270
THE COMPOSITES GROUP	271
CONTINENTAL STRUCTURAL PLASTICS	271
COOK COMPOSITES AND POLYMERS (CCP)	272
CORE MOLDING TECHNOLOGIES	273
DSM ENGINEERING PLASTICS NORTH AMERICA	273
FERRO CORP.	274
GEORGIA-PACIFIC CHEMICALS LLC	274
GLASFORMS INC.	275
GURIT SERVICES AG	275
HANWHA AZDEL SPECIALTIES	276
HAYSITE REINFORCED PLASTICS	276
HEXCEL CORP.	277
HEXION	277
IDI COMPOSITES INTERNATIONAL	278
INTERPLASTIC CORP.	278
KRINGLAN COMPOSITES AG	279
LNP ENGINEERING PLASTICS	279
OWENS CORNING	280
PLASAN CARBON COMPOSITES	280
QUADRANT PLASTIC COMPOSITES	281
REICHHOLD CHEMICAL	281
RTP COMPANY	282
SAERTEX GMBH & COMPANY	283
SGL CARBON GROUP	283
TEIJIN, LIMITED	283
TORAY INDUSTRIES INC.	284
CHAPTER 9 ACRONYMS	286
CHAPTER 10 GLOSSARY OF TERMS	290

LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE GLOBAL REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	6
TABLE 1 ADVANTAGES OF SOLID GLASS MICROSPHERES	17
TABLE 2 IMPORTANT GLASS FIBER SUPPLIERS	18
TABLE 3 LEADING GLOBAL CARBON FIBER PRODUCERS	21
TABLE 4 ADVANTAGES AND DISADVANTAGES OF CARBON COMPOSITES	21
TABLE 5 KEY NATURAL FIBERS AND MAJOR CULTIVATION AREAS	32
TABLE 6 KEY NANOCOMPOSITE SUPPLIERS	41
TABLE 7 SELECTED MANUFACTURING PROCESSES AND PROPERTIES OF REINFORCED THERMOSET COMPOSITES	44
TABLE 8 TYPICAL SMC FORMULATIONS (WEIGHT PERCENT)	47
TABLE 9 KEY SMC PRODUCERS	49
TABLE 10 TRADE NAMES OF KEY FIBER-REINFORCED POLYPROPYLENE	57
TABLE 11 KEY GLOBAL POLYPROPYLENE PRODUCERS AND ESTIMATED CAPACITIES (BILLION POUNDS/YEAR)	58
TABLE 12 LEADING GLOBAL HDPE PRODUCERS (BILLION LBS/YEAR)	61
TABLE 13 GLOBAL MARKET FOR REINFORCED PLASTIC COMMODITY THERMOPLASTIC COMPOSITES, THROUGH 2020 (MILLION POUNDS)	63
TABLE 14 GLOBAL MARKET FOR REINFORCED PLASTIC POLYETHYLENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	63
TABLE 15 GLOBAL MARKET FOR REINFORCED POLYPROPYLENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	64
TABLE 16 FABRICATION METHODS AND USES FOR POLYSTYRENE	66
TABLE 17 GLOBAL MARKET FOR REINFORCED POLYSTYRENE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	67
TABLE 18 GLOBAL MARKET FOR REINFORCED ABS COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	69
TABLE 19 GLOBAL MARKET FOR REINFORCED SMA COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	71
TABLE 20 KEY GLOBAL POLYAMIDE RESIN PRODUCERS	75
TABLE 21 SELECTED EXAMPLES OF COMMERCIALY IMPORTANT REINFORCED POLYAMIDE COMPOSITES	78
TABLE 22 GLOBAL MARKET FOR REINFORCED POLYAMIDE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	80
TABLE 23 GLOBAL MARKET FOR REINFORCED POLYAMIDE COMPOSITES IN THE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)	81
TABLE 24 KEY REINFORCED PBT COMPOSITES BY TRADE NAME	82
TABLE 25 KEY REINFORCED PET COMPOSITES BY TRADE NAME	84
TABLE 26 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC POLYESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	85
TABLE 27 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC POLYESTER COMPOSITES IN THE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)	85
TABLE 28 SELECTED MAJOR POLYCARBONATE PRODUCERS AND TRADE-NAMED PRODUCTS	88
TABLE 29 SELECTED COMMERCIALY IMPORTANT REINFORCED POLYCARBONATE COMPOSITES BY TRADE NAME AND SUPPLIER	89
TABLE 30 GLOBAL MARKET FOR REINFORCED POLYCARBONATE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	89
TABLE 31 KEY GLOBAL POLYACETAL TRADE-NAMED PRODUCTS AND PRODUCERS	92

TABLE HEADING	PAGE NO.
TABLE 32 TYPICAL APPLICATIONS OF POLYACETALS	92
TABLE 33 GLOBAL REINFORCED POLYACETAL COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	93
TABLE 34 KEY REINFORCED POLYPHENYLENE SULFIDE COMPOSITE PRODUCTS AND SUPPLIERS	96
TABLE 35 GLOBAL REINFORCED POLYPHENYLENE SULFIDE COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	97
TABLE 36 GLOBAL MARKET FOR REINFORCED POLYIMIDE COMPOSITES, BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	101
TABLE 37 KEY GLOBAL LIQUID CRYSTAL POLYMER PRODUCERS AND ESTIMATED CAPACITIES	104
TABLE 38 GLOBAL REINFORCED LIQUID CRYSTAL POLYMER COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	105
TABLE 39 GLOBAL REINFORCED POLYSULFONE COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	107
TABLE 40 GLOBAL REINFORCED POLYMER ALLOYS/BLENDS COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	114
TABLE 41 GLOBAL MARKET FOR OTHER REINFORCED THERMOPLASTIC COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	117
TABLE 42 GLOBAL MARKET FOR REINFORCED THERMOPLASTIC COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)	118
TABLE 43 GLOBAL LFRT DEMAND BY INDUSTRY (%)	126
TABLE 44 REINFORCED THERMOSET PLASTIC COMPOSITE PROPERTIES AND MANUFACTURING PROCESSES	129
TABLE 45 KEY INGREDIENTS OF UNSATURATED POLYESTER RESIN FORMULATIONS IN DESCENDING ORDER OF COMMERCIAL USE	130
TABLE 46 KEY COMMERCIAL REINFORCED UNSATURATED POLYESTERS COMPOSITE TRADE NAMES AND SUPPLIERS	133
TABLE 47 GLOBAL MARKET FOR REINFORCED UNSATURATED POLYESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	134
TABLE 48 GLOBAL MARKET OF UNSATURATED POLYESTER COMPOSITE AUTOMOTIVE MARKET BY SEGMENT, THROUGH 2020 (MILLION POUNDS)	135
TABLE 49 KEY COMMERCIAL REINFORCED VINYL ESTER COMPOSITES AND SUPPLIERS	137
TABLE 50 GLOBAL MARKET FOR REINFORCED VINYL ESTER COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	138
TABLE 51 GLOBAL MARKET FOR REINFORCED EPOXY COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	146
TABLE 52 KEY REINFORCED PHENOLIC COMPOSITES TRADE NAMES AND SUPPLIERS	150
TABLE 53 GLOBAL MARKET FOR REINFORCED PHENOLIC COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	150
TABLE 54 GLOBAL MARKET FOR REINFORCED POLYURETHANE COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	155
TABLE 55 GLOBAL MARKET FOR REINFORCED OTHER THERMOSET COMPOSITES BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	158
TABLE 56 GLOBAL MARKET SUMMARY OF REINFORCED THERMOSET COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)	158
TABLE 57 GLOBAL MARKET SUMMARY OF REINFORCED THERMOSET COMPOSITES BY RESIN, THROUGH 2020 (MILLION POUNDS)	159
TABLE 58 GLOBAL COMPOSITE RESIN MARKET BY REGION, THROUGH 2020 (BILLION POUNDS)	160

TABLE HEADING	PAGE NO.
TABLE 59 EXPECTED TOTAL AUTOMOTIVE CONSUMPTION BY MATERIAL, THROUGH 2020 (%)	165
TABLE 60 SELECTED AUTOMOTIVE UNDER-THE-HOOD REINFORCED RESIN COMPOSITES BY PART	167
TABLE 61 GLOBAL REINFORCED PLASTIC COMPOSITE AUTOMOTIVE UTH MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	173
TABLE 62 RESINS USED FOR SPECIFIC EXTERIOR AUTOMOTIVE PARTS	178
TABLE 63 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE AUTOMOTIVE EXTERIOR MARKET, THROUGH 2020 (MILLION POUNDS)	180
TABLE 64 RESINS USED FOR SPECIFIC INTERIOR AUTOMOTIVE PARTS	181
TABLE 65 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES IN AUTOMOTIVE INTERIORS BY RESIN, THROUGH 2020 (MILLION POUNDS)	186
TABLE 66 GLOBAL REINFORCED PLASTIC COMPOSITE AUTOMOTIVE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	187
TABLE 67 FUEL CELL PRODUCERS	194
TABLE 68 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE CONSTRUCTION/INFRASTRUCTURE BY RESIN, THROUGH 2020 (MILLION POUNDS)	205
TABLE 69 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES ANTI-CORROSION MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	209
TABLE 70 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE MARINE PRODUCTS BY RESIN, THROUGH 2020 (MILLION POUNDS)	213
TABLE 71 IMPORTANT TECHNICAL FACTORS TO CONSIDER WHEN SELECTING PCB SUBSTRATE MATERIALS	217
TABLE 72 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITES ELECTRONICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	227
TABLE 73 SELECTED MAJOR APPLICATIONS FOR POLYMERS IN APPLIANCES	232
TABLE 74 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE APPLIANCE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	233
TABLE 75 GLOBAL REINFORCED PLASTIC COMPOSITE AEROSPACE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	236
TABLE 76 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE CONSUMER PRODUCTS BY RESIN, THROUGH 2020 (MILLION POUNDS)	246
TABLE 77 GLOBAL REINFORCED PLASTIC COMPOSITE MISCELLANEOUS MARKETS BY RESIN, THROUGH 2020 (MILLION POUNDS)	255
TABLE 78 GLOBAL MARKET FOR REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	256

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE GLOBAL REINFORCED PLASTIC COMPOSITE MARKET BY APPLICATION, 2014-2020 (MILLION POUNDS)	6