



Medical Plastics

Global Markets to 2022

January 2018

Andrew McWilliams

Report Code: PLS009J



Table of Contents

Chapter 1: Introduction	1
Study Goals and Objectives	1
Reasons for Doing This Study	1
Scope of Report	1
Information Sources	1
Methodology	1
Analyst's Credentials	4
Related BCC Research Reports	4
Chapter 2: Summary and Highlights	6
Chapter 3: Market and Technology Background	10
Trends in Healthcare	10
Geographical Structure of Demand for Medical Plastics	10
Polymers Used in Medical Devices	11
Commodity Thermoplastics	12
Engineering Resins	12
Thermoset Resins	12
Summary of Resin Usage in Medical Devices	12
Chapter 4: Legislative and Regulatory Issues	15
U.S.	15
FDA Regulations	15
Plastics Testing Procedures	16
Biocompatibility Issues	16
Recent Developments	17
European Union (EU)	17
Japan	19
Other Countries	19
Canada	19
China	20
India	21
Latin American Nations	21
Chapter 5: Environmental Issues	23
Background	23
Medical Waste	23
Source Reduction	24
Recycling	24
Solid Waste Disposal	24
Chapter 6: Medical Device Plastic Processes	26
Injection Molding	26
Background	26
Details	26
Extrusion	26
Background	26
Single- and Twin-Screw Extrusion	27

Extrusion and Melt Film Fabrication	27
Blown Films	27
Film Casting	28
Solvent Casting	28
Blow Molding	28
Overview	28
Extrusion Blow Molding	29
Injection Blow Molding	29
Stretch Blow Molding	29
Thermoforming	30
History	30
Overview	30
Applications	30
Chapter 7: Sterilization Techniques	32
Overview of Methods	32
Ethylene Oxide Gas Sterilization	32
Radiation Sterilization	32
Gamma Radiation	33
E-Beam Radiation	33
Vaporized Hydrogen Peroxide	33
Dry-Heat Sterilization	33
Gamma Radiation vs. ETO	34
The Move to Global Sterilization Standards	34
Polymer Reactions to Sterilization Methods	34
Background	34
PVC	34
Polypropylene	35
Polyethylene	35
ABS and SAN	35
Polycarbonate	35
Polystyrene	35
Polyesters	35
Radiation Resistance	36
Chapter 8: Validation Tests for Medical Plastics	39
Background	39
Ratings and Tests	39
Selected Sterilization Standards for Medical Devices	40
Chapter 9: Applications	43
Background	43
Point-of-Care Testing	43
Infusion Drug Delivery Therapy	43
Other Applications	43
Waste Reduction	44
Sterilization and Biocompatibility	44
Medical Device Category Criteria	44
Application Market Estimates and Forecasts	45
Nondisposables	46
Overview	46

Market Estimates and Forecasts.....	46
Surgical Instruments	47
Testing and Diagnostic Equipment	53
Implants and Prosthetic Devices	58
Dental and Ophthalmic Products.....	63
Disposable Medical Devices	67
Overview	67
Medical Disposal Controversy	68
Market Estimates and Forecasts.....	68
Medical Bags.....	69
Syringes	73
Labware.....	79
Catheters	81
Kits	87
Tubing.....	89
Gloves.....	95
Utensils.....	98
Trays.....	99
Plastic Stents.....	103
Chapter 10: Resins Used in Medical Devices	105
Background	105
Material Selection	105
Target Areas for Medical Plastics	106
Potential Problems Encountered in Using Specific Polymers for Medical Applications in Hospital Environments	106
Resins.....	106
Background.....	106
Commodity Thermoplastics.....	107
Styrenics	107
Engineering Resins	107
Thermoset Resins.....	107
Elastomers.....	107
Miscellaneous Resins	108
Changing Requirements.....	108
Property Requirements	108
Other Developments	109
Failure of Plastic Medical Devices	109
Physical Property Effects on Resin Materials.....	110
Overview	110
Impact Strength.....	110
Stress–Strain Behavior	110
Heat Resistance	111
Chemical Resistance.....	111
Clarity or Transparency	111
Bondability	112
Summary of Physical Property Characteristics of Medical Devices	112
Use of Plastics in Medical Devices.....	113
Overview	113
Overall Resin Usage	113
Medical Plastics Market Estimates and Forecasts	114

Chapter 11: Commodity Thermoplastics	118
Polyvinyl Chloride	118
Overview	118
Forms of PVC	118
A Versatile Resin	118
Processing.....	119
Consumption Patterns	119
Environmental Issues	119
Producers and Capacities	120
PVC Medical Device History	120
Medical Applications	121
Sterilization of PVC.....	121
PVC Still a Favorite for Medical Disposable Devices	122
The PVC Replacement Issue	122
Polypropylene	124
Background.....	124
Overview	125
Properties	125
Advances in Polypropylene Technologies	126
Highly Crystalline Grades	126
Random Copolymer Polypropylenes.....	126
Techniques Used to Impart Clarity	126
Polypropylene Films	127
Sterilization of Polypropylene	127
Advantageous Medical Properties	128
Producers and Capacities	128
Examples of Polypropylene Medical Devices	128
Polyethylenes	129
Background.....	129
High-Density Polyethylene (HDPE)	129
Low-Density Polyethylene (LDPE).....	131
Chapter 12: Styrenic Resins	140
Overview	141
Polystyrene	141
Overview	141
General Purpose Polystyrene (GPPS).....	141
High-Impact Polystyrene (HIPS).....	142
Market Players and Industry Leaders	142
Processing.....	143
Medical Applications of Polystyrene and HIPS	143
Styrene Copolymers	144
Overview	144
Styrene Block Copolymers.....	144
Acrylonitrile-Butadiene-Styrene (ABS).....	146
Styrene-Acrylic Copolymers	149
Styrene-Acrylonitrile Copolymers (SAN)	150
Chapter 13: Engineering Resins	157
Introduction	157
Polycarbonates.....	157

Overview	157
Impact of Bisphenol A on Polycarbonate Usage.....	157
Processing.....	157
Property Advantages and Disadvantages.....	158
General Grades	158
Alloys/Blends	158
Producers	159
Medical Properties and Applications	159
Nylon	160
Background.....	160
Properties	161
Major Types of Nylons	161
Processing.....	162
Producers	162
Nylon Sterilization	163
Medical Applications	163
Thermoplastic Polyesters.....	164
Polyethylene Terephthalate—PET	164
Polybutylene Terephthalate (PBT)	165
Medical Applications	166
Sterilization and Disposal	166
Polyacetals	166
Grades	167
Properties	167
Processing.....	167
Medical Products	168
Specific Polyacetals Aimed at Medical Products	168
Polysulfones	168
Properties	168
Types of Polysulfones.....	169
Medical Applications	169
Specific Polysulfone Medical Products.....	170
Polyimides.....	170
Polyetherimides (PEI).....	171
Producers	171
Polyketones.....	172
Properties	172
Medical Applications	172
Producers	172
Liquid Crystal Polymers.....	173
Properties	173
Applications	174
Producers	174
Engineering Resin Market Estimates and Forecasts.....	175
Chapter 14: Thermoset Resins	179
Acrylics	180
Properties	180
Manufacture of Acrylic Polymers	180
Properties	181
Important Acrylic-Producing Companies	181

Medical Products and Sterilization	182
Use in Medical Devices.....	182
Silicones	182
Technology	183
Medical Applications.....	183
Silicone Medical Device Producers	184
Polyurethanes	184
General Medical Applications.....	185
Market Estimates.....	185
Chapter 15: Thermoplastic Elastomers (TPEs)	189
Overview	190
Advantages	190
Disadvantages.....	190
Processing.....	191
Applications.....	191
Thermoplastic Olefins (TPOs).....	191
Ingredients and Properties.....	191
Medical Applications.....	192
Competitive Scenario	192
COPEs (Copolyesters)	193
Properties and Medical Applications	193
Thermoplastic Polyurethanes (TPUs)	193
Medical Properties and Sterilization.....	193
Medical Applications.....	194
TPU–Silicone Copolymers.....	194
Market Estimates and Forecasts.....	195
Chapter 16: Polymer Alloys and Blends	197
Background	198
PPO/HIPS.....	198
Overview	198
Grades	199
Processing.....	199
Properties and Advantages	199
Medical Products	199
PC/ABS	199
Background.....	199
Producers	200
Use in Medical Devices.....	200
Chapter 17: Biopolymers and Biodegradable Polymers	201
Overview	202
Expected Growth of Biodegradable Polymer Sutures	202
Types of Biodegradable Polymers Used in Medical Applications	202
Polymers for Controlled Delivery	204
Background.....	204
PLLA-Based Wound Dressings.....	204
Market Estimates and Forecasts	204
Chapter 18: Miscellaneous Resins.....	206
Overview	206

Fluoropolymers	206
Background.....	206
Medical Products	206
Fluoropolymer Medical Device Suppliers.....	207
Market Estimates and Forecasts	207
Chapter 19: Industry Structure	209
Background	210
Companies	210
Injection Molders.....	210
Medical Film and Sheet Manufacturers.....	211
Medical Blow Molders	212
Medical Thermoformers	212
Medical Resin Producers	213
Recent Mergers and Acquisitions	215
Chapter 20: Patent Review	217
Crush Recoverable Polymer Scaffolds	218
Covalently Attached Antimicrobial Polymers	218
Bioabsorbable Polymer Compositions.....	218
Polyisobutylene, Urea, and Urethane/Urea Copolymers and Medical Leads	218
Medical Devices and Materials Containing Isobutylene Polymer	219
Side-Chain Crystallizable Polymers for Medical Application	219
Medical Polymers Containing Radiation-Resistant Polymers	219
Coatings for Manufacture and Application of Polyhydroxy-Alkanoate Medical Devices.....	219
Low Friction Polymeric Compositions as Well as Devices and Fabrication Methods	219
Thermal Responsive Polymer Siloxanes, Compositions and Methods, and Applications	220
Monomers and Phase-Separated Biocompatible Polymer Compositions.....	220
Modified Hyaluronic Acid Polymer Compositions.....	220
Method of Manufacturing Antimicrobial Implants of Polyetherether Ketones	220
Mono Ethylenically Unsaturated Polymerizable Group Containing Polycarbosiloxane Monomers	220
Copolymers and Dihydroxyphenyl Moieties and Medical Devices Coated with Copolymers	221
Methods for Making Oxidation Resistant Polymeric Material.....	221
Medical Devices and Coatings Comprising Biodegradable Polymers with Enhanced Functionality	221
Polymeric Materials for Medical Devices	221
Chapter 21: New Technologies	222
Electrically Stimulated Polymers for Medical Devices.....	223
Synthetic Bioabsorbables Aimed at New Medical Applications	223
3D Bioprinted Organs	223
Wearable Lung	223
Spinal Prosthesis	224
Plastic-Coated Platelets to Reduce Internal Bleeding	224
Plastic-Handled Acupuncture Needles	224
Polysulfone Brain Implants	224
Stretchable Hydrogels for Artificial Muscles	225
Biocidal Plastics	225
Chapter 22: Company Profiles	226
Appendix: Selected Acronyms	242

About BCC Research	246
About BCC Research	247
BCC Custom Research.....	247

List of Tables

Summary Table Global Medical Plastics Market, by Resin, Through 2022 (Million Pounds)	6
Table 1 Leading Global Medical Device Companies, 2017	10
Table 2 Selected Resin Usage by Type of Medical Device	13
Table 3 Radiation Resistances of Key Medical Plastics	36
Table 4 Selected Tests for Plastics Used in Medical Applications	40
Table 5 Selected Examples of Sterilization Standards for Medical Devices	41
Table 6 Global Medical Plastics Market, by Overall Application, Through 2022 (Million Pounds)	46
Table 7 Global Nondisposable Medical Plastic Market, by Application, Through 2022 (Million Pounds) .	47
Table 8 Selected Key Manufacturers of Surgical Instruments	51
Table 9 Global Surgical Instruments and Related Equipment Market, by Resin, Through 2022 (Million Pounds).....	52
Table 10 Global Commodity Thermoplastic Surgical Instruments and Related Equipment Market, by Type, Through 2022 (Million Pounds)	52
Table 11 Global Styrenic Resins Surgical Instruments and Related Equipment Market, by Type, Through 2022 (Million Pounds)	53
Table 12 Global Surgical Instruments and Related Equipment Market, by Other Resins, Through 2022 (Million Pounds)	53
Table 13 Key Selected Medical Testing and Diagnostic Companies.....	54
Table 14 Global Testing and Diagnostic Equipment Market, by Resin, Through 2022 (Million Pounds) ...	57
Table 15 Global Commodity Thermoplastic Testing and Diagnostic Equipment Market, by Type, Through 2022 (Million Pounds)	57
Table 16 Global Styrenic Resin Testing and Diagnostic Equipment Market, by Type, Through 2022 (Million Pounds)	58
Table 17 Global Testing and Diagnostic Equipment Market, by Other Resins, Through 2022 (Million Pounds).....	58
Table 18 Global Prostheses and Implants Market, by Resin, Through 2022 (Million Pounds).....	62
Table 19 Global Commodity Thermoplastic Prostheses and Implants Market, by Type, Through 2022 (Million Pounds)	63
Table 20 Global Prostheses and Implants Market, by Other Resins, Through 2022 (Million Pounds)	63
Table 21 Global Dental and Ophthalmic Market, by Resin Type, Through 2022 (Million Pounds).....	66
Table 22 Global Dental and Ophthalmic Market, by Specific Resin Used, Through 2022 (Million Pounds)	67
Table 23 Global Disposable Medical Plastic Market, by Application, Through 2022 (Million Pounds).....	68
Table 24 Selected Medical Bag Manufacturers.....	72
Table 25 Global Medical Bag Market, by Resin, Through 2022 (Million Pounds).....	72
Table 26 Other Selected Syringe Manufacturers	78
Table 27 Global Syringes Market, by Resin, Through 2022 (Million Pounds)	78
Table 28 Examples of Disposable Medical Plastic Labware	79
Table 29 Selected Plastic Medical Labware Suppliers	80
Table 30 Global Medical Labware Market, by Resin, Through 2022 (Million Pounds)	81
Table 31 Resin Property Criteria for Catheters	83
Table 32 Selected Catheter Manufacturers	85
Table 33 Global Catheter and IV Unit Market, by Resin, Through 2022 (Million Pounds)	86
Table 34 Material Property Criteria for Kits.....	88
Table 35 Global Kits Market, by Resin, Through 2022 (Million Pounds)	89
Table 36 Common Features of Selected Applications of Primary Resins Used in Medical Tubing	91
Table 37 Sample Applications of Flexible Medical Tubing by Major Category	92

Table 38 Selected Plastic Medical Tubing Extruders	94
Table 39 Global Tubing Market, by Resin, Through 2022 (Million Pounds)	95
Table 40 Selected Key Medical Glove Manufacturers and Major Products	97
Table 41 Global Medical Glove Market, by Resin, Through 2022 (Million Pounds).....	98
Table 42 Global Medical Utensil Market, by Resin, Through 2022 (Million Pounds).....	99
Table 43 Resin Property Criteria for Trays	100
Table 44 Selected Plastic Medical Tray Manufacturers	102
Table 45 Global Trays Market, by Resin, Through 2022 (Million Pounds).....	102
Table 46 Physical Property Advantages and Disadvantages of Medical Plastics	112
Table 47 Resin Usage by Type of Medical Device	113
Table 48 Global Medical Plastics Market, by Resin, Through 2022 (Million Pounds)	114
Table 49 Global Disposable Medical Market, by Resin, Through 2022 (Million Pounds).....	115
Table 50 Global Nondisposable Medical Market, by Resin, Through 2022 (Million Pounds).....	116
Table 51 Leading Global PVC Producers	120
Table 52 Leading Global Polypropylene Producers.....	128
Table 53 Leading Global HDPE Producers (Billion Pounds/Year)	130
Table 54 Global LDPE Producers and Applications.....	131
Table 55 Global Commodity Thermoplastic Medical Market, by Type, Through 2022 (Million Pounds)	133
Table 56 Global Commodity Thermoplastics, by Disposable Medical Application, Through 2022 (Million Pounds).....	134
Table 57 Global Disposable Commodity Thermoplastic Medical Market, by Type, Through 2022 (Million Pounds).....	135
Table 58 Global Disposable PVC Medical Market, by Application, Through 2022 (Million Pounds)	135
Table 59 Global Disposable Polypropylene Medical Market, by Application, Through 2022 (Million Pounds).....	136
Table 60 Global Disposable HDPE Medical Market, by Application, Through 2022 (Million Pounds)	136
Table 61 Global Disposable LDPE/LLDP Medical Market, by Application, Through 2022 (Million Pounds)	137
Table 62 Global Nondisposable Medical Commodity Thermoplastics Market, by Application, Through 2022 (Million Pounds)	137
Table 63 Global Nondisposable Commodity Thermoplastic Medical Market, by Type, Through 2022 (Million Pounds)	138
Table 64 Global Nondisposable PVC Medical Market, by Application, Through 2022 (Million Pounds) .	138
Table 65 Global Nondisposable Polypropylene Medical Market, by Application, Through 2022 (Million Pounds).....	139
Table 66 Global Nondisposable HDPE Medical Market, by Application, Through 2022 (Million Pounds)	139
Table 67 Fabrication Methods and Uses for Polystyrene	143
Table 68 SBC Major Products Segmented by Polymer Process	145
Table 69 Global Styrenic Resin Medical Market, by Type. Through 2022 (Million Pounds).....	152
Table 70 Global Disposable Styrenic Resin Medical Market, by Type, Through 2022 (Million Pounds) .	152
Table 71 Global Disposable Styrenic Resins Medical Market, by Application, Through 2022 (Million Pounds).....	153
Table 72 Global Disposable Polystyrene or HIPS Medical Market, by Application, Through 2022 (Million Pounds).....	153
Table 73 Global Nondisposable Styrenic Resin Medical Market, by Type, Through 2022 (Million Pounds)	154
Table 74 Global Nondisposable Styrenic Resins Medical Market, by Application, Through 2022 (Million Pounds).....	154
Table 75 Global Nondisposable Polystyrene or HIPS Medical Market, by Application, Through 2022 (Million Pounds)	155
Table 76 Global Nondisposable ABS Medical Market, by Application, Through 2022 (Million Pounds) .	155

Table 77 Key Global Polycarbonate Trade-Named Products and Producers	159
Table 78 Key Global Nylon Resin Producers	163
Table 79 Key Global Polyacetal Producers and Trade-Named Products	168
Table 80 Global Producers of Polyketones	173
Table 81 Global Liquid Crystal Polymer Producers.....	175
Table 82 Global Engineering Resin Medical Market, by Type, Through 2022 (Million Pounds)	175
Table 83 Global Disposable Engineering Resin Medical Market, by Type, Through 2022 (Million Pounds)	176
Table 84 Global Disposable Engineering Resins Medical Market, by Application, Through 2022 (Million Pounds).....	177
Table 85 Global Disposable Polycarbonate Medical Market, by Application, Through 2022 (Million Pounds).....	177
Table 86 Global Disposable Polyester Medical Market, by Application, Through 2022 (Million Pounds)	178
Table 87 Global Nondisposable Engineering Resins Medical Market, by Application, Through 2022 (Million Pounds)	178
Table 88 Key Silicone Medical Device Producers	184
Table 89 Global Thermoset Medical Market, by Type, Through 2022 (Million Pounds).....	185
Table 90 Global Disposable Thermoset Medical Market, by Resin, Through 2022 (Million Pounds)	186
Table 91 Global Disposable Thermoset Resins Medical Market, by Application, Through 2022 (Million Pounds).....	186
Table 92 Global Disposable Acrylic Medical Market, by Application, Through 2022 (Million Pounds) ...	187
Table 93 Global Disposable Silicone Medical Market, by Application Through 2022 (Million Pounds) ...	187
Table 94 Global Nondisposable Thermoset Resins Medical Market, by Application, Through 2022 (Million Pounds)	188
Table 95 Selected Medical Silicone-Polyurethane Copolymer Products	195
Table 96 Global TPE Medical Market, by Type, Through 2022 (Million Pounds).....	195
Table 97 Global Disposable TPE Medical Market, by Application, Through 2022 (Million Pounds)	196
Table 98 Selected Fluoropolymer Medical Device Suppliers	207
Table 99 Global Miscellaneous Medical Resins Market, by Application Type, Through 2022 (Million Pounds).....	207
Table 100 Global Nondisposable Miscellaneous Medical Resins Market, by Application, Through 2022 (Million Pounds)	208
Table 101 Global Disposable Miscellaneous Medical Resins Market, by Application, Through 2022 (Million Pounds)	208
Table 102 Leading Medical Injection Molders	210
Table 103 Leading Medical film and Sheet Manufacturers	211
Table 104 Leading Medical Blow Molders	212
Table 105 Leading Medical Thermoformers	212
Table 106 Selected Medical Trade Named Products, Types of Resins, and Producers.....	213

List of Figures

Summary Figure Global Medical Plastics Market, by Resin, 2016–2022 (Million Pounds)	7
---	---



About BCC Research

About BCC Research

With our unparalleled 45-year history, BCC Research provides comprehensive analysis of global market sizing, forecasting and industry intelligence, covering markets where advances in science and technology are improving the quality, standard and sustainability of businesses, economies and lives.

BCC Membership

From market sizing and forecasts, to opportunity assessments and competitive analyses, our ever-expanding library gives you the data, insights and intelligence required to ensure your project is a success. Members benefit from ongoing, unlimited access to the category or collections of their choice, and most membership packages pay for themselves within two to three reports being accessed.

Did you buy this report? You may qualify to apply your purchase price toward a full membership. Call 866/285-7215 or e-mail info@bccresearch.com to request a demo.

BCC Custom Research

Our experts provide custom research projects to those working to identify new markets, introduce new products, validate existing market share, analyze competition and assess the potential for products to impact existing markets. With impressive academic credentials and broad and deep knowledge of global industrial markets, our independent analysts and consultants develop the facts, figures, analysis and assessments to inform the decisions that will move your company ahead. Confidential inquiries to: custom@bccresearch.com or 781/205-2429.

DISCLAIMER

The information developed in this report is intended to be as reliable as possible at the time of publication and is of a professional nature. This information does not constitute managerial, legal or accounting advice, nor should it be considered as a corporate policy guide, laboratory manual or an endorsement of any product, as much of the information is speculative in nature. BCC Research and the author assume no responsibility for any loss or damage that might result from reliance on the reported information or from its use.

ISBN: 978-1-62296-609-7
January 2018