

| | |
|--|---------------|
| INTRODUCTION | xix |
| STUDY BACKGROUND | xix |
| STUDY GOALS AND OBJECTIVES | xix |
| CONTRIBUTION OF THE STUDY AND FOR WHOM | xix |
| SCOPE AND FORMAT | xx |
| METHODOLOGY | xx |
| AUTHOR'S CREDENTIALS | xxi |
| RELATED BCC PUBLICATIONS | xxi |
| BCC ONLINE SERVICES | xxii |
| DISCLAIMER | xxii |
| EXECUTIVE SUMMARY | xxiii |
| <i>SUMMARY TABLE U.S. IAQ MARKET FORECAST BY SEGMENT, THROUGH 2011</i> <i>(\$ MILLIONS)</i> | XXIII |
| <i>SUMMARY FIGURE U.S. IAQ MARKET FORECAST BY SEGMENT, 2005-2011 (\$</i> <i>MILLIONS)</i> | XXIV |
| INDUSTRY OVERVIEW | 1 |
| THE IMPORTANCE OF THE INDUSTRY | 1 |
| THE IMPORTANCE OF THE INDUSTRY (CONTINUED) | 2 |
| HISTORY OF THE INDUSTRY | 3 |
| DESCRIPTION OF THE INDUSTRY | 4 |
| IAQ EQUIPMENT | 4 |
| Air Cleaners | 5 |
| HVAC Equipment | 6 |
| HVAC Replacement Filters | 6 |
| IAQ Instrumentation | 7 |
| IAQ CONSULTING SERVICES | 7 |
| ENVIRONMENTAL SERVICES | 7 |
| Environmental Services (Continued) | 8 |
| THE UNITED STATES INDOOR AIR QUALITY MARKET | 9 |
| <i>TABLE 1 U.S. IAQ MARKET FORECAST BY SEGMENT, THROUGH 2011 (\$</i> <i>MILLIONS)</i> | 9 |
| <i>FIGURE 1 U.S. IAQ MARKET FORECAST BY SEGMENT, 2005-2011 (\$ MILLIONS)</i> | 10 |
| INDOOR AIR QUALITY BACKGROUND | 10 |
| INDOOR AIR QUALITY BACKGROUND (CONTINUED) | 11 |
| CAUSES OF IAQ PROBLEMS | 12 |
| <i>TABLE 2 PERCENTAGES OF IAQ PROBLEMS FOUND IN NIOSH HHE</i> <i>INVESTIGATIONS</i> | 13 |
| INADEQUATE VENTILATION | 13 |
| CONTAMINATION FROM INSIDE A BUILDING | 13 |
| CONTAMINATION FROM OUTSIDE SOURCES | 14 |
| MICROBIAL CONTAMINATION | 14 |
| CONTAMINATION FROM BUILDING MATERIALS | 14 |
| COMMON CONTAMINANTS | 14 |
| CARBON MONOXIDE | 15 |
| NITROGEN DIOXIDE | 15 |
| COMBUSTION PRODUCTS | 15 |
| OZONE | 15 |
| FORMALDEHYDE | 16 |
| PARTICULATES | 16 |

| | |
|--|----|
| RADON..... | 16 |
| ASBESTOS | 16 |
| VOLATILE ORGANIC COMPOUNDS (VOCS) | 17 |
| ENVIRONMENTAL TOBACCO SMOKE | 17 |
| BIOLOGICAL CONTAMINANTS..... | 17 |
| THE EFFECTS OF IAQ CONTAMINANTS | 18 |
| TABLE 3 IAQ-RELATED ILLNESSES REQUIRING MEDICAL ATTENTION | 19 |
| THE COST OF IAQ PROBLEMS TO THE U.S. ECONOMY | 19 |
| TABLE 4 IAQ RELATED COSTS TO THE U.S. ECONOMY | 19 |
| FACTORS DRIVING IAQ INDUSTRY GROWTH..... | 19 |
| THE “MOLD RUSH” | 20 |
| The “Mold Rush” (Continued)..... | 21 |
| MOLD-RELATED LITIGATION..... | 22 |
| 9/11 AND BIOTERRORISM | 22 |
| 9/11 and Bioterrorism (Continued)..... | 23 |
| AMERICANS’ INCREASED AWARENESS AND OPINIONS CONCERNING IAQ ISSUES..... | 24 |
| TABLE 5 IMPORTANCE OF IAQ IN THE HOME (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. RESIDENTS)..... | 25 |
| TABLE 6 COMPARISON OF MALE AND FEMALE IAQ HEALTH WORRIES (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. RESIDENTS)..... | 26 |
| TABLE 7 LEVEL OF CONCERN ABOUT ALLERGENS IN THE HOME AND WORKPLACE, BY AGE (%)..... | 26 |
| TABLE 8 HOMEOWNERS WHO WOULD PURCHASE PRODUCTS TO IMPROVE IAQ IN THE HOME (PERCENTAGES BASED ON A SURVEY OF 1,000 U.S. RESIDENTS)..... | 27 |
| TABLE 9 TYPES OF SOLUTION HOMEOWNERS WOULD PURCHASE (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. RESIDENTS)..... | 27 |
| TABLE 10 COMPARISON OF RESPONDENTS INTERESTED IN TESTING FOR MOLD (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. CITIZENS) | 28 |
| TABLE 11 HOMEOWNERS PLANNING IAQ-RELATED IMPROVEMENTS (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. RESIDENTS)..... | 28 |
| TABLE 12 LEVEL OF CONCERN ABOUT IAQ IN THE WORKPLACE (PERCENTAGES BASED ON SURVEY OF 1,000 U.S. RESIDENTS)..... | 29 |
| IAQ EQUIPMENT AND SERVICES MARKET | 30 |
| IAQ EQUIPMENT..... | 30 |
| TABLE 13 U.S. MARKET VALUE OF IAQ EQUIPMENT BY TYPE, THROUGH 2011 (\$ MILLIONS)..... | 31 |
| FIGURE 2 U.S. MARKET VALUE OF IAQ EQUIPMENT BY TYPE, 2005-2011 (\$ MILLIONS)..... | 31 |
| AIR CLEANERS | 32 |
| Types of Available Air Cleaners | 33 |
| Tabletop Units | 33 |
| Room Units | 34 |
| In-Duct or Central Filtration Systems..... | 34 |
| Types of Air Cleaning Processes..... | 34 |
| Mechanical Filters..... | 35 |
| Flat or Panel Filters | 35 |
| Pleated Filters | 35 |
| HEPA Filters | 36 |
| Electronic Air Cleaners | 36 |
| Ionizers..... | 37 |

| | |
|--|-----------|
| Electrostatic Precipitators | 37 |
| Hybrid Filters | 38 |
| Gas Phase Filters | 38 |
| Ozone Generators | 39 |
| Air Cleaner Standards | 40 |
| Standards for Portable Air Cleaners..... | 40 |
| Association of Home Appliance Manufacturers | 40 |
| <i>TABLE 14 ESTIMATED PERCENTAGE OF PARTICLES REMOVED FOR PORTABLE</i> | |
| <i>UNITS BY CADR AND ROOM SIZE.....</i> | <i>41</i> |
| U.S. Food and Drug Administration | 42 |
| Standards for In-Duct Systems | 42 |
| American Society of Heating, Refrigerating, and Air- | |
| Conditioning Engineering (ASHRAE)..... | 43 |
| ASHRAE Standard 52.1-1992..... | 43 |
| ASHRAE Standard 52.2-1999..... | 44 |
| Military Standard 282 (For HEPA Filters) | 44 |
| AIR CLEANER MARKET VALUE | 45 |
| Air Cleaner Market Value: Portable versus In-Duct | 45 |
| <i>TABLE 15 U.S. AIR CLEANER MARKET FORECAST FOR VALUE: PORTABLE</i> | |
| <i>VERSUS IN-DUCT, THROUGH 2011 (\$ MILLIONS).....</i> | <i>45</i> |
| <i>FIGURE 3 U.S. AIR CLEANER MARKET VALUE: PORTABLE VERSUS IN-DUCT,</i> | |
| <i>2005-2011 (\$ MILLIONS).....</i> | <i>46</i> |
| Reasons for Air Cleaner Industry Growth | 46 |
| Sales of High-End and Low-End Portable Air Cleaners | 47 |
| <i>TABLE 16 SALES OF HIGH- AND LOW-END PORTABLE AIR CLEANERS, 2005 (\$</i> | |
| <i>MILLIONS).....</i> | <i>47</i> |
| <i>FIGURE 4 PERCENTAGE SHARE OF HIGH- AND LOW-END PORTABLE AIR</i> | |
| <i>CLEANERS, 2005 (%)</i> | <i>48</i> |
| Air Cleaner Market Value Breakdown by Technology Type | 48 |
| <i>TABLE 17 U.S. AIR CLEANING MARKET VALUE FORECAST BY TECHNOLOGY</i> | |
| <i>TYPE, THROUGH 2011 (\$ MILLIONS).....</i> | <i>49</i> |
| <i>FIGURE 5 TRENDS IN U.S. AIR CLEANER MARKET VALUE BY TECHNOLOGY</i> | |
| <i>TYPE, 2005-2011 (\$ MILLIONS).....</i> | <i>50</i> |
| Electrostatic Precipitators | 50 |
| HEPA Filters | 51 |
| Ozone Generators | 52 |
| Ionizers..... | 53 |
| Air Cleaner Market Value by Application | 54 |
| <i>TABLE 18 U.S. AIR CLEANER MARKET VALUE BY END-USER CATEGORY, 2005 (\$</i> | |
| <i>MILLIONS).....</i> | <i>55</i> |
| <i>FIGURE 6 SHARE OF U.S. AIR CLEANERS MARKET VALUE BY END-USER</i> | |
| <i>CATEGORY, 2005 (%).....</i> | <i>55</i> |
| Air Cleaner Market Leaders | 56 |
| <i>TABLE 19 LEADING AIR CLEANER MANUFACTURERS SALES AND MARKET</i> | |
| <i>SHARE, 2005 (\$ MILLIONS/%)</i> | <i>56</i> |
| REPLACEMENT FILTERS..... | 57 |
| Replacement Filter Technologies | 57 |
| Fiberglass | 57 |
| Pleated paper | 57 |
| Media Filters..... | 58 |
| Electrostatic Filters..... | 58 |
| Electronic Air Filters..... | 58 |
| Washable/Reusable Filters | 58 |

| | |
|--|----|
| Additional Commercial Grade HVAC Filters | 59 |
| ASHRAE Filters..... | 59 |
| HEPA Filters..... | 59 |
| Carbon Filters | 59 |
| Bag Filters..... | 59 |
| Filter Efficiency | 60 |
| Filter Performance | 60 |
| <i>TABLE 20 EFFICIENCY OF REMOVING PARTICLES 0.3 TO 1 MICRON IN SIZE</i> | |
| <i>FROM INDOOR AIR</i> | 61 |
| Pressure Drop | 61 |
| <i>TABLE 21 PRESSURE DROP RATINGS OF RESIDENTIAL HVAC FILTERS</i> | 61 |
| REPLACEMENT FILTER MARKET..... | 62 |
| <i>TABLE 22 U.S. HVAC REPLACEMENT FILTER MARKET VALUE FORECAST BY</i> | |
| <i>END-USER CATEGORY, THROUGH 2011 (\$ MILLIONS)</i> | 62 |
| <i>FIGURE 7 U.S. HVAC REPLACEMENT FILTER MARKET VALUE BY END-USER</i> | |
| <i>CATEGORY, 2005-2011 (\$ MILLIONS)</i> | 63 |
| Reasons for Replacement Filter Growth | 63 |
| Replacement Filter Market Breakdown | 64 |
| <i>TABLE 23 U.S. RESIDENTIAL REPLACEMENT FILTER MARKET BY FILTER TYPE,</i> | |
| <i>2005 (\$ MILLIONS)</i> | 64 |
| <i>FIGURE 8 U.S. RESIDENTIAL REPLACEMENT FILTER SHARE BY FILTER TYPE,</i> | |
| <i>2005 (%)</i> | 64 |
| <i>TABLE 24 U.S. COMMERCIAL REPLACEMENT FILTER MARKET BY</i> | |
| <i>CONFIGURATION, 2005 (\$ MILLIONS)</i> | 65 |
| <i>FIGURE 9 U.S. COMMERCIAL REPLACEMENT FILTER MARKET SHARE BY</i> | |
| <i>FILTER CONFIGURATION, 2005 (%)</i> | 66 |
| HVAC Replacement Filter Market Leaders | 66 |
| HVAC Replacement Filter ... (Continued)..... | 67 |
| <i>TABLE 25 COMMERCIAL HVAC REPLACEMENT FILTER MARKET LEADERS</i> | |
| <i>SALES AND MARKET SHARE, 2005 (\$ MILLIONS/%)</i> | 68 |
| VENTILATION SYSTEMS..... | 68 |
| <i>TABLE 26 CAUSES OF SICK BUILDING SYNDROME</i> | 68 |
| <i>TABLE 27 IAQ PROBLEMS NOTED IN 104 OFFICE BUILDINGS STUDIED BY</i> | |
| <i>NIOSH</i> | 69 |
| Ventilation Systems Market Value | 69 |
| <i>TABLE 28 U.S. VENTILATION SYSTEMS MARKET VALUE FORECAST AND</i> | |
| <i>GROWTH, THROUGH 2011 (\$ MILLIONS)</i> | 70 |
| <i>FIGURE 10 U.S. VENTILATION SYSTEMS MARKET VALUE AND GROWTH, 2005-</i> | |
| <i>2011 (\$ MILLIONS)</i> | 70 |
| Most Promising Ventilation Technologies | 71 |
| Demand Control Ventilation..... | 71 |
| Demand Control Ventilation Technology Manufacturers | 71 |
| Energy Recovery Ventilation | 72 |
| Heat Recovery Ventilation Technologies | 73 |
| Drivers for Energy Recovery Ventilation Technology | 73 |
| Benefits of Energy Recovery Ventilation | |
| Technology | 73 |
| Safety and Performance Certification | 74 |
| Equipment Availability | 74 |
| Residential Use of Energy Recovery Ventilation..... | 74 |
| Manufacturers of Energy Recovery Ventilation Systems | 75 |
| Similarities Between Energy Recovery and Heat | |
| Recovery Ventilation Technologies..... | 76 |

| | |
|---|----|
| Displacement Ventilation | 76 |
| Displacement Ventilation Manufacturers | 77 |
| Air Quality-Related Ventilation Equipment Market Value Breakdown by Type..... | 77 |
| <i>TABLE 29 U.S. VENTILATION TECHNOLOGY MARKET FORECAST BREAKDOWN BY TYPE, THROUGH 2011 (\$ MILLIONS)</i> | 78 |
| <i>FIGURE 11 U.S. VENTILATION TECHNOLOGY MARKET BREAKDOWN BY TYPE, 2005-2011 (\$ MILLIONS)</i> | 78 |
| Ventilation System Market Value by Application..... | 79 |
| <i>TABLE 30 U.S. VENTILATION SYSTEM MARKET VALUE BY END USER CATEGORY, 2005 (\$ MILLIONS)</i> | 79 |
| <i>FIGURE 12 U.S. VENTILATION SYSTEM MARKET SHARE BY END USER CATEGORY, 2005 (%)</i> | 80 |
| HVAC Equipment-Related Standards | 80 |
| ASHRAE Standard 55..... | 81 |
| <i>TABLE 31 ASHRAE TEMPERATURE RECOMMENDATIONS</i> | 81 |
| ASHRAE Standard 62..... | 82 |
| <i>TABLE 32 EXAMPLES OF CFM/PERSON IN PARTICULAR TYPES OF SPACES ACCORDING TO ASHRAE 62</i> | 83 |
| ASHRAE Standard 62.2 | 83 |
| ASHRAE Standard 90.1..... | 84 |
| IAQ INSTRUMENTATION | 84 |
| IAQ Instrumentation Applications..... | 85 |
| Measurements Used to Determine Air Quality..... | 85 |
| Comfort Issues | 85 |
| Temperature | 85 |
| Humidity | 86 |
| Air Velocity | 86 |
| Volume | 86 |
| Ventilation | 87 |
| Health and Safety Issues | 87 |
| Carbon Monoxide | 87 |
| Airborne Particles | 88 |
| Biological Contaminants..... | 88 |
| Chemicals in Aerosol Form | 89 |
| IAQ Instrumentation Market | 90 |
| <i>TABLE 33 IAQ INSTRUMENTATION APPLICATIONS</i> | 90 |
| <i>TABLE 34 U.S. IAQ INSTRUMENTATION MARKET VALUE FORECAST, THROUGH 2011 (\$ MILLIONS)</i> | 91 |
| <i>FIGURE 13 U.S. IAQ INSTRUMENTATION MARKET VALUE, 2005-2011 (\$ MILLIONS)</i> | 91 |
| IAQ Instrumentation Market Breakdown by Type: Common Instrumentation | 92 |
| <i>TABLE 35 U.S. COMMON IAQ INSTRUMENTATION MARKET VALUE BREAKDOWN BY TYPE, 2005 (\$ MILLIONS)</i> | 93 |
| <i>FIGURE 14 U.S. COMMON IAQ INSTRUMENTATION MARKET SHARE BY TYPE, 2005 (%)</i> | 93 |
| IAQ Instrumentation Market Breakdown by Type: Specialty Instrumentation | 94 |
| <i>TABLE 36 U.S. SPECIALTY IAQ INSTRUMENTATION MARKET BREAKDOWN BY TYPE, 2005 (\$ MILLIONS)</i> | 94 |
| <i>FIGURE 15 U.S. SPECIALTY IAQ INSTRUMENTATION MARKET, BREAKDOWN BY TYPE, 2005 (%)</i> | 95 |

| | |
|--|-----|
| IAQ Instrumentation Market Value Breakdown by Application | 95 |
| <i>TABLE 37 U.S. IAQ INSTRUMENTATION MARKET VALUE BREAKDOWN BY APPLICATION, 2003 (\$ MILLIONS)</i> | 96 |
| <i>FIGURE 16 U.S. IAQ INSTRUMENTATION MARKET VALUE BREAKDOWN BY APPLICATION, 2003 (%)</i> | 96 |
| Leading Manufacturers of IAQ Instrumentation | 97 |
| <i>TABLE 38 -MARKET SHARES OF IAQ INSTRUMENTATION MARKET LEADERS, 2005 (%)</i> | 97 |
| Stationary IAQ Instrumentation | 97 |
| <i>TABLE 39 COMPARISON OF PORTABLE AND STATIONARY IAQ EQUIPMENT SALES, 2005 (\$ MILLIONS)</i> | 98 |
| <i>FIGURE 17 COMPARISON OF PORTABLE IAQ AND STATIONARY IAQ EQUIPMENT SALES, 2003 (%)</i> | 99 |
| IAQ CONSULTING MARKET | 99 |
| <i>TABLE 40 U.S. IAQ CONSULTING INDUSTRY MARKET VALUE AND GROWTH, THROUGH 2011 (\$ MILLIONS)</i> | 100 |
| IAQ ENVIRONMENTAL SERVICES MARKET | 100 |
| THE MOLD REMEDIATION INDUSTRY | 100 |
| Mold Background..... | 100 |
| Mold-Related Health Effects..... | 101 |
| Mold Remediation Practices | 102 |
| Remediation Plan | 102 |
| Mold Sampling..... | 102 |
| Remediation Equipment | 103 |
| Moisture Meters..... | 103 |
| Humidity Gauges..... | 103 |
| Boroscope..... | 104 |
| Mold Remediation Clean Up Methods | 104 |
| Wet Vacuum..... | 104 |
| Damp Wipe..... | 104 |
| HEPA Vacuum..... | 105 |
| Disposal of Damaged Materials..... | 105 |
| Biocides..... | 105 |
| UV Lights | 106 |
| Mold Remediation Guidelines..... | 107 |
| S520 Standard and Reference Guide for Mold Remediation | 107 |
| S520 Standard and Reference (Continued) | 108 |
| Mold Certifications | 109 |
| Indoor Air Quality Association Certifications | 110 |
| American Indoor Air Quality Council Certifications | 110 |
| Institute of Inspection, Cleaning, and Restoration Certifications | 111 |
| Association of Energy Engineers Certifications | 111 |
| American Industrial Hygiene Association Certifications | 111 |
| Mold Legislation | 111 |
| Federal Legislation..... | 111 |
| State Legislation..... | 111 |
| Arizona..... | 112 |
| California..... | 112 |
| Connecticut..... | 112 |
| Idaho | 112 |
| Illinois | 112 |
| Indiana..... | 113 |

| | | |
|--|-------------------|------------|
| | Louisiana | 113 |
| | Maryland | 113 |
| | New Jersey | 113 |
| | New York..... | 113 |
| | Nevada..... | 113 |
| | Oklahoma | 114 |
| | Pennsylvania..... | 114 |
| | Tennessee | 114 |
| | Texas..... | 114 |
| ASBESTOS ABATEMENT | | 115 |
| Asbestos Background | | 115 |
| Asbestos Health Effects | | 116 |
| Asbestos in the Home | | 117 |
| How to Identify Materials that Contain Asbestos..... | | 117 |
| How to Manage an Asbestos Problem | | 118 |
| Asbestos Professionals | | 118 |
| History of the Asbestos Abatement Industry | | 119 |
| Asbestos Removal Industry Set Backs..... | | 119 |
| Current State of the Asbestos Abatement Industry..... | | 120 |
| RADON REMOVAL | | 120 |
| Radon Background | | 121 |
| Radon-Related Health Effects | | 121 |
| The U.S. Radon Problem..... | | 122 |
| Testing for Radon | | 122 |
| Short-Term Testing | | 122 |
| Long-Term Testing..... | | 123 |
| Reducing Indoor Radon Levels | | 123 |
| Slowing of the Radon Repair Industry | | 123 |
| IAQ ENVIRONMENTAL SERVICES MARKET | | 124 |
| IAQ Environmental Services Market Breakdown: Services and Equipment | | 124 |
| <i>TABLE 41 U.S. IAQ ENVIRONMENTAL SERVICES MARKET VALUE FORECAST AND GROWTH, THROUGH 2011 (\$ MILLIONS)</i> | | <i>125</i> |
| <i>FIGURE 18 U.S. ENVIRONMENTAL SERVICES MARKET VALUE, 2005-2011 (\$ MILLIONS).....</i> | | <i>125</i> |
| Environmental Services Market Breakdown by Type | | 125 |
| <i>TABLE 42 U.S. ENVIRONMENTAL SERVICES MARKET BREAKDOWN, BY TYPE, 2005 (\$ MILLIONS).....</i> | | <i>126</i> |
| <i>FIGURE 19 U.S. ENVIRONMENTAL SERVICES MARKET BREAKDOWN, BY TYPE, 2005 (%)</i> | | <i>126</i> |
| Comparison of Environmental Services Industry and Overall U.S. Remediation Industry | | 127 |
| <i>TABLE 43 COMPARISON OF ENVIRONMENTAL SERVICES INDUSTRY AND OVERALL U.S. REMEDIATION INDUSTRY, THROUGH 2011 (\$ MILLIONS)</i> | | <i>127</i> |
| <i>FIGURE 20 COMPARISON OF IAQ ENVIRONMENTAL SERVICES INDUSTRY AND OVERALL U.S. REMEDIATION INDUSTRY, 2005-2011 (\$ MILLIONS).....</i> | | <i>128</i> |
| Reasons for Environmental Services Industry Growth | | 128 |
| IAQ END-USE APPLICATIONS AND MARKET POTENTIAL | | 129 |
| <i>FIGURE 21 IAQ MARKET SHARES BY END-USER SEGMENT, 2005-2011 (PERCENTAGE OF TOTAL SALES)</i> | | <i>129</i> |
| <i>TABLE 44 IAQ MARKET FORECAST BY END-USER SEGMENT, THROUGH 2011 (\$ MILLION).....</i> | | <i>130</i> |

| | |
|--|-----|
| RESIDENTIAL DWELLINGS..... | 130 |
| POLLUTANTS COMMONLY FOUND IN THE HOME | 130 |
| Respirable Particles..... | 131 |
| Organic Pollutants | 131 |
| Formaldehyde | 131 |
| Pesticides..... | 132 |
| Lead..... | 132 |
| Asbestos..... | 133 |
| Biological Pollutants | 133 |
| Nitrogen Dioxide..... | 133 |
| Carbon Monoxide..... | 134 |
| Radon..... | 134 |
| Environmental Tobacco Smoke | 134 |
| RESIDENTIAL INDOOR AIR POLLUTION AND HEALTH..... | 135 |
| Immediate Effects..... | 135 |
| Long-Term Effects | 135 |
| RESIDENTIAL END-USE MARKET POTENTIAL..... | 136 |
| TABLE 45 COMMON RESIDENTIAL AIR POLLUTANTS AND CONTROL METHODS..... | 136 |
| TABLE 45 (CONTINUED) | 137 |
| TABLE 46 POTENTIAL U.S. RESIDENTIAL SETTING END-USE MARKET, 2005 (MILLION)..... | 138 |
| FIGURE 22 POTENTIAL U.S. RESIDENTIAL SETTING END-USE MARKET, 2005 (MILLION)..... | 138 |
| IAQ Equipment Market Value in Residential End-Use Settings..... | 138 |
| TABLE 47 U.S. IAQ EQUIPMENT MARKET VALUE FORECAST FOR RESIDENTIAL END-USE SETTINGS, THROUGH 2011 (\$ MILLIONS)..... | 139 |
| FIGURE 23 U.S. IAQ EQUIPMENT MARKET VALUE IN RESIDENTIAL END-USE SETTINGS, 2005-2011 (\$ MILLIONS)..... | 139 |
| CONSULTING AND SERVICES MARKET VALUE FOR RESIDENTIAL END-USE SETTINGS | 140 |
| TABLE 48 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE FORECAST IN RESIDENTIAL END-USE SETTINGS, THROUGH 2011 (\$ MILLIONS)..... | 140 |
| FIGURE 24 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN RESIDENTIAL END-USE SETTINGS, 2005-2011 (\$ MILLIONS)..... | 141 |
| COMMERCIAL BUILDINGS | 141 |
| HEALTH PROBLEMS AND VENTILATION | 141 |
| CONTROLLING INDOOR AIR POLLUTION IN COMMERCIAL BUILDINGS | 141 |
| COMMERCIAL VENTILATION SYSTEMS PROBLEMS AND SOLUTIONS | 142 |
| Common Problems with HVAC System Design | 143 |
| Intermittent Air Flow..... | 143 |
| Distribution of Air | 143 |
| Building Supply and Exhaust Locations | 143 |
| Outdoor Air | 143 |
| Periods of Operation..... | 143 |
| Maintenance | 144 |
| Air Cleaners | 144 |
| POTENTIAL COMMERCIAL BUILDING END-USE MARKET | 144 |
| Potential Commercial Building ... (Continued)..... | 145 |
| Potential Commercial Building ... (Continued)..... | 146 |
| TABLE 49 POTENTIAL COMMERCIAL SETTING END-USE MARKET (MILLION)..... | 147 |
| FIGURE 25 POTENTIAL COMMERCIAL SETTING END-USE MARKET (MILLION)..... | 147 |

| | |
|--|-----|
| IAQ EQUIPMENT MARKET VALUE IN COMMERCIAL END-USE SETTINGS..... | 147 |
| <i>TABLE 50 U.S. IAQ EQUIPMENT MARKET VALUE FORECAST IN COMMERCIAL SETTINGS, THROUGH 2011 (\$ MILLIONS)</i> | 148 |
| <i>FIGURE 26 U.S. IAQ EQUIPMENT MARKET VALUE IN COMMERCIAL SETTINGS, 2005-2011 (\$ MILLIONS)</i> | 148 |
| IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN COMMERCIAL END-USE SETTINGS | 149 |
| <i>TABLE 51 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN COMMERCIAL SETTINGS, THROUGH 2011 (\$ MILLIONS)</i> | 149 |
| <i>FIGURE 27 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN COMMERCIAL SETTINGS, 2005-2011 (\$ MILLIONS)</i> | 149 |
| SCHOOLS | 150 |
| IAQ ISSUES UNIQUE TO SCHOOLS | 150 |
| WHY ADDRESSING IAQ ISSUES IN SCHOOLS IS IMPORTANT..... | 150 |
| INDOOR AIR POLLUTANTS OF CONCERN IN SCHOOLS | 151 |
| Biological Contaminants | 151 |
| Carbon Dioxide | 152 |
| Carbon Monoxide..... | 152 |
| Dust | 153 |
| Second-Hand Smoke..... | 153 |
| Lead..... | 154 |
| Nitrogen Oxides | 154 |
| Pesticides..... | 155 |
| Radon..... | 155 |
| Volatile Organic Compounds | 156 |
| FILTRATION FOR IMPROVED SCHOOL IAQ | 157 |
| <i>TABLE 52 AIR QUALITY RECOMMENDATIONS FOR EDUCATION FACILITIES</i> | 157 |
| <i>TABLE 52 (CONTINUED)</i> | 158 |
| POTENTIAL FOR SCHOOLS AS END-USE MARKET | 158 |
| IAQ EQUIPMENT MARKET VALUE IN SCHOOL END-USE SETTINGS..... | 158 |
| <i>TABLE 53 U.S. IAQ EQUIPMENT MARKET VALUE FORECAST IN SCHOOL END-USE SETTINGS, THROUGH 2011 (\$ MILLIONS)</i> | 159 |
| <i>FIGURE 28 U.S. IAQ EQUIPMENT MARKET VALUE IN SCHOOL SETTINGS, 2005-2011 (\$ MILLIONS)</i> | 159 |
| CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN SCHOOLS SETTINGS | 159 |
| <i>TABLE 54 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE FORECAST IN SCHOOLS, THROUGH 2011 (\$ MILLIONS)</i> | 160 |
| <i>FIGURE 29 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN SCHOOLS, 2005-2011 (\$ MILLIONS)</i> | 160 |
| HEALTHCARE FACILITIES | 161 |
| THE IMPORTANCE OF GOOD INDOOR AIR QUALITY IN HEALTH CARE FACILITIES | 161 |
| SARS and Other Infectious Diseases | 162 |
| Controlling the Spread of SARS and Other Infectious Diseases in Medical Facilities | 162 |
| AIA GUIDELINES ON HEALTH CARE FACILITY AIR QUALITY..... | 163 |
| AIA Guidelines on Health Care ... (Continued) | 164 |
| HEALTHCARE-RELATED MARKET FOR IAQ EQUIPMENT | 165 |
| <i>TABLE 55 U.S. IAQ EQUIPMENT MARKET VALUE IN HOSPITAL END-USE SETTINGS, THROUGH 2011 (\$ MILLIONS)</i> | 165 |

| | |
|--|-----|
| FIGURE 30 U.S. IAQ EQUIPMENT MARKET VALUE IN HOSPITAL END-USE SETTINGS, 2005-2011 (\$ MILLIONS)..... | 166 |
| CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN HEALTHCARE FACILITIES | 166 |
| TABLE 56 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN HOSPITAL END-USE SETTINGS, THROUGH 2011 (\$ MILLIONS)..... | 167 |
| FIGURE 31 U.S. IAQ CONSULTING AND ENVIRONMENTAL SERVICES MARKET VALUE IN HOSPITAL END-USE SETTINGS, 2005-2011 (\$ MILLIONS)..... | 167 |
| PATENT ANALYSIS..... | 168 |
| SEARCH CRITERIA | 168 |
| TABLE 57 INDOOR AIR QUALITY EQUIPMENT, TOTAL NUMBER OF RELEVANT U.S. PATENTS FOUND, 2000 TO 2004..... | 169 |
| GENERAL TRENDS | 169 |
| PATENTS BY YEAR..... | 169 |
| TABLE 58 INDOOR AIR QUALITY EQUIPMENT, NUMBER OF RELEVANT U.S. PATENTS BY YEAR, 2000 THROUGH JUNE 2006..... | 169 |
| PATENTS BY EQUIPMENT TYPE..... | 170 |
| TABLE 59 INDOOR AIR QUALITY EQUIPMENT, U.S. PATENTS BY EQUIPMENT TYPE, 2000 THROUGH JUNE 2006..... | 170 |
| INDOOR AIR QUALITY EQUIPMENT PATENT TRENDS BY EQUIPMENT TYPE: | |
| 2000 TO 2004 | 170 |
| TABLE 60 U.S. PATENTS ISSUED FOR VENTILATION TECHNOLOGIES, 2000 THROUGH JUNE 2006..... | 170 |
| TABLE 60 (CONTINUED) | 171 |
| TABLE 61 U.S. PATENTS ISSUED FOR AIR CLEANING TECHNOLOGIES, 2000 THROUGH JUNE 2006..... | 171 |
| TABLE 61 (CONTINUED) | 172 |
| TABLE 62 U.S. PATENTS ISSUED FOR REPLACEMENT FILTER TECHNOLOGIES, 2000 THROUGH JUNE 2006..... | 172 |
| TABLE 62 (CONTINUED) | 173 |
| TABLE 63 U.S. PATENTS ISSUED FOR IAQ INSTRUMENTATION TECHNOLOGIES, 2000 THROUGH JUNE 2006..... | 173 |
| PATENTS BY COMPANY, 2000 TO MARCH 2004 | 173 |
| TABLE 64 COMPANIES WITH MULTIPLE PATENTS RECEIVED 2000 TO MARCH 2004 RELATED TO INDOOR AIR QUALITY EQUIPMENT..... | 174 |
| COMPANY PROFILES | 175 |
| 3M | 175 |
| AMERICAN AIR FILTER COMPANY (AAF) | 175 |
| AMERICAN ENERGY EXCHANGE | 176 |
| APRILAIRE..... | 176 |
| CAMFIL FARR | 176 |
| CARRIER CORPORATION | 177 |
| CLARCOR INC. | 178 |
| FILTRATION GROUP | 178 |
| FRIEDRICH AIR CONDITIONING CO. | 179 |
| GRAY WOLF SENSING SOLUTIONS..... | 179 |
| HALTON COMPANY..... | 179 |
| THE HOLMES GROUP | 180 |
| HONEYWELL | 180 |
| HUNTER FAN COMPANY | 181 |
| KD ENGINEERING..... | 181 |

| | |
|--|-----|
| LENNOX INTERNATIONAL..... | 181 |
| LUMIDOR..... | 182 |
| NU-AIR VENTILATION SYSTEMS..... | 182 |
| QUEST TECHNOLOGIES | 183 |
| RENEWAIRE..... | 183 |
| SHARPER IMAGE CORP..... | 184 |
| TESTO..... | 184 |
| TRANE | 184 |
| TSI INCORPORATED | 185 |
| UNITED AIR SPECIALISTS..... | 185 |
| WHIRLPOOL CORP. | 186 |
| APPENDIX..... | 187 |
| IAQ COMPANIES AND SIGNIFICANT PRODUCTS | 187 |
| <i>TABLE 65 IAQ COMPANIES AND SIGNIFICANT PRODUCTS</i> | 187 |
| <i>TABLE 65 (CONTINUED)</i> | 188 |
| <i>TABLE 65 (CONTINUED)</i> | 189 |