

## FRACKING PROPPANTS: GLOBAL MARKETS



EGY138A  
January 2015

Tanmay Joshi  
*Project Analyst*

ISBN: 1-62296-024-6



**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](http://www.bccresearch.com)  
[information@bccresearch.com](mailto:information@bccresearch.com)

## TABLE OF CONTENTS

| TOPIC  | PAGE NO. |
|--|----------|
| CHAPTER 1 INTRODUCTION   | 2        |
| STUDY AND OBJECTIVE  | 2        |
| HYDRAULIC FRACKING PROPPANTS DESCRIPTION   | 2        |
| SCOPE OF THE REPORT  | 3        |
| MARKET STRUCTURE   | 3        |
| INTENDED AUDIENCE  | 3        |
| RESEARCH METHODOLOGY   | 3        |
| ANALYSTS' CREDENTIALS  | 4        |
| RELATED BCC RESEARCH REPORTS   | 5        |
| BCC RESEARCH WEBSITE   | 5        |
| DISCLAIMER   | 5        |
| CHAPTER 2 SUMMARY  | 7        |
| <i>SUMMARY TABLE GLOBAL HYDRAULIC PROPPANTS MARKET BY REGION, THROUGH 2019 (KILOTONS)</i>    | 8        |
| <i>SUMMARY FIGURE GLOBAL HYDRAULIC PROPPANTS MARKET BY REGION, THROUGH 2019 (KILOTONS)</i>   | 8        |
| CHAPTER 3 MARKET OVERVIEW  | 11       |
| PROPPANTS ANALYSIS   | 11       |
| PROPPANTS ANALYSIS BY REGION   | 11       |
| COMPETITIVE LANDSCAPE  | 12       |
| <i>TABLE 1 MAIN CERAMIC PROPPANT MANUFACTURERS AND CAPACITIES</i>                            | 12       |
| MARKET DYNAMICS  | 13       |
| Drivers  | 13       |
| Growing Energy Demand  | 13       |
| <i>FIGURE 1 GLOBAL GDP GROWTH BY REGION, 2009-2013 (%)</i>                                   | 14       |
| <i>FIGURE 2 ENERGY CONSUMPTION BY REGION, 2003-2013 (MILLION TONS OF OIL EQUIVALENTS)</i>    | 15       |
| <i>FIGURE 3 FORECAST WORLD ENERGY DEMAND BY SOURCE, 2008-2022 (QUADRILLION BTU)</i>          | 16       |
| Dependence on Unconventional Gas Sources for Energy  | 17       |
| <i>FIGURE 4 NATURAL GAS PRODUCTION BY REGION, 2003-2013 (MILLION TONS OF OIL EQUIVALENT)</i> | 17       |
| <i>TABLE 2 FORECAST U.S. NATURAL GAS PRODUCTION BY SOURCE, 2003-2025</i>                     | 18       |
| Regulatory Support toward Use of Gases   | 18       |
| Legislation to Remove Subsidies/Phase Out Coal   | 19       |
| G20  | 19       |
| Australia  | 19       |
| Canada   | 19       |
| U.K.   | 19       |
| U.S.   | 20       |
| Support for Exploration and Production of Natural Gas  | 20       |
| Restraints   | 21       |
| High Logistics Cost  | 21       |
| <i>FIGURE 5 PROPPANT COST BY OPERATIONS (%)</i>  | 21       |

| <b>TOPIC</b>   | <b>PAGE NO.</b> |
|--|-----------------|
| <i>TABLE 3 VARIATION IN TOTAL WATER COST AMONG PRODUCTION AREAS IN THE U.S. (\$)</i> | 23              |
| Stringent Regulation of Hydraulic Fracturing   | 23              |
| Regulation of Hydraulic Fracturing Under the Safe Drinking Water Act                 | 24              |
| Fracturing Responsibility and Awareness of Chemicals (FRACKING) Act, 2013            | 24              |
| Opportunities  | 25              |
| Potential Explorable Reserves of Shale Gas   | 25              |
| <i>TABLE 4 GLOBAL RECOVERABLE SHALE GAS RESERVES BY REGION, 2013 (TCF)</i>           | 25              |
| HISTORY OF HYDRAULIC FRACKING  | 26              |
| PROCESS OF HYDRAULIC FRACKING  | 28              |
| <i>FIGURE 6 HYDRAULIC FRACTURING WORKINGS</i>  | 28              |
| FRACKING FLUIDS  | 29              |
| LINEAR GELLING FLUIDS  | 30              |
| CROSS-LINKED GELS  | 30              |
| FOAMED GELS  | 30              |
| PLAIN WATER AND POTASSIUM CHLORIDE (KCL) WATER                                       | 31              |
| ACIDS  | 31              |
| FLUID ADDITIVES  | 31              |
| BREAKERS   | 31              |
| BIOCIDES   | 31              |
| FRICTION REDUCERS  | 31              |
| ACID CORROSION INHIBITORS  | 32              |
| TYPES OF HYDRAULIC FRACKING  | 32              |
| VERTICAL AND HORIZONTAL  | 32              |
| HYDRAULIC FRACTURING FLUIDS COMPOSITION  | 33              |
| <i>TABLE 5 HYDRAULIC FRACTURING FLUID COMPOSITION (%)</i>                            | 34              |
| FRACKING FLUIDS AND ADDITIVES  | 34              |
| <i>TABLE 6 TYPES OF HYDRAULIC FRACTURING FLUIDS USED</i>                             | 35              |
| PROPPANTS  | 35              |
| Fracturing Sand  | 35              |
| Resin-Coated Proppants (Ceramic and Sand)  | 36              |
| Resin-Coated Sand  | 36              |
| Resin-Coated Ceramics  | 36              |
| Ceramics   | 36              |
| FLUIDS   | 37              |
| Gelled Fluids  | 37              |
| Linear Gels  | 37              |
| Cross-linked Gels  | 37              |
| FOAMED GELS  | 38              |
| PLAIN WATER AND POTASSIUM CHLORIDE (KCL) WATER                                       | 38              |
| GUAR GUM   | 38              |
| ACIDS  | 39              |
| Sodium Chloride  | 39              |
| Borate Salts   | 39              |
| Citric Acid  | 39              |
| POLYACRYLAMIDE AND OTHER FRICTION REDUCERS   | 39              |

| <b>TOPIC</b>   | <b>PAGE NO.</b> |
|--|-----------------|
| ETHYLENE GLYCOL  | 40              |
| SODIUM AND POTASSIUM CARBONATES  | 40              |
| GLUTARALDEHYDE   | 40              |
| ENVIRONMENTAL IMPACT OF FRACTURING   | 40              |
| WATER  | 42              |
| Sources of Water Contamination   | 42              |
| Water Acquisition  | 43              |
| On-site Chemical Mixing  | 43              |
| Well Injection   | 43              |
| Flowback and Produced Water  | 43              |
| Wastewater Treatment and Waste Disposal  | 43              |
| Water Sources  | 44              |
| Surface Water  | 44              |
| Groundwater  | 45              |
| Reservoir Water and Recycled Flowback Water  | 46              |
| Disposal of the Fracking Fluid   | 46              |
| AIR  | 46              |
| Factors Responsible for Air Emissions  | 47              |
| SEISMIC ACTIVITY   | 47              |
| Reducing the Risk of Fracking-Related Tremors  | 48              |
| CHAPTER 4 HYDRAULIC FRACTURING PROPPANTS BY TYPE   | 50              |
| <i>FIGURE 7 CLASSIFICATION OF PROPPANTS</i>  | 50              |
| FRACTURING SAND  | 51              |
| CERAMIC PROPPANTS  | 51              |
| RESIN-COATED PROPPANTS   | 51              |
| <i>FIGURE 8 STRENGTH OF DIFFERENT TYPES OF PROPPANTS</i>   | 51              |
| <i>TABLE 7 PROPERTIES OF VARIOUS PROPPANT TYPES</i>  | 52              |
| SILICA SAND  | 53              |
| Specification for Silica Sand Used for Fracking  | 53              |
| <i>TABLE 8 SILICA SAND SPECIFICATIONS</i>  | 53              |
| Capacity and Production of Silica Sand   | 54              |
| <i>FIGURE 9 GLOBAL SILICA SAND PRODUCTION BY COUNTRY, 2013 (%)</i>   | 54              |
| Demand for Fracking Sand   | 55              |
| <i>TABLE 9 GLOBAL SAND PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019, (KILOTONS/\$ MILLIONS)</i>   | 55              |
| <i>TABLE 10 GLOBAL SAND PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)</i>                    | 56              |
| <i>TABLE 11 GLOBAL SAND PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)</i>                | 57              |
| Price  | 57              |
| CERAMIC  | 58              |
| Classification of Ceramic Proppants  | 58              |
| <i>TABLE 12 TYPES OF CERAMIC PROPPANTS</i>   | 59              |
| Capacity and Production  | 59              |
| Demand   | 60              |
| <i>TABLE 13 GLOBAL CERAMIC PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS)</i> | 60              |

| <b>TOPIC</b>   | <b>PAGE NO.</b> |
|--|-----------------|
| <i>TABLE 14 GLOBAL CERAMIC PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)</i>                       | 61              |
| <i>TABLE 15 GLOBAL CERAMIC PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)</i>                   | 61              |
| RESIN-COATED PROPPANTS   | 62              |
| Types of Resin-Coated Proppants  | 62              |
| Demand   | 63              |
| <i>TABLE 16 GLOBAL RESIN-COATED PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i> | 63              |
| <i>TABLE 17 GLOBAL RESIN-COATED PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)</i>                  | 64              |
| <i>TABLE 18 GLOBAL RESIN-COATED PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)</i>              | 65              |
| CHAPTER 5 GLOBAL MARKET FOR HYDRAULIC FRACTURING TECHNOLOGIES  | 67              |
| NATURAL HYDRAULIC FRACTURING   | 67              |
| INDUCED HYDRAULIC FRACTURING   | 67              |
| PLA-(POLYLACTIC ACID) BASED FIBER TECHNOLOGY   | 68              |
| CHAPTER 6 HYDRAULIC FRACTURING APPLICATIONS MARKET   | 70              |
| SHALE GAS  | 70              |
| FRACTURING FLUIDS USED IN SHALE GAS  | 70              |
| <i>TABLE 19 GLOBAL SHALE GAS RESERVES, 2013 (TCF)</i>  | 72              |
| GLOBAL SHALE BY REGION   | 72              |
| United States  | 72              |
| Canada   | 73              |
| Western Europe   | 73              |
| Eastern Europe   | 74              |
| Australia  | 74              |
| China  | 75              |
| South America  | 75              |
| SHALE GAS PRODUCTION   | 75              |
| SHALE GAS GROWTH PERSPECTIVE   | 76              |
| TIGHT OIL AND TIGHT GAS  | 77              |
| TIGHT OIL AND TIGHT GAS RESERVES   | 78              |
| <i>TABLE 20 GLOBAL TIGHT OIL RESERVES</i>  | 78              |
| TIGHT OIL PRODUCTION   | 79              |
| TIGHT OIL AND TIGHT GAS GROWTH PERSPECTIVE   | 80              |
| CHARACTERIZATION OF TIGHT GAS SAND RESERVOIR   | 81              |
| ROLE OF PERFORATIONS IN HYDRAULIC FRACTURING   | 81              |
| FRACTURING OF A WELLBORE   | 81              |
| PROPPANTS SELECTION IN TIGHT GAS   | 82              |
| COAL BED METHANE   | 82              |
| CBM PRODUCTION   | 83              |
| CBM RESERVES   | 83              |
| CBM GROWTH PERSPECTIVE   | 84              |
| HYDRAULIC FRACTURING IN CBM  | 85              |
| FRACTURING LIQUIDS IN CBM  | 86              |

| <b>TOPIC</b>  | <b>PAGE NO.</b> |
|---|-----------------|
| OIL AND NATURAL GAS   | 87              |
| PRODUCTION  | 88              |
| Onshore   | 88              |
| Offshore  | 88              |
| Floating Production Storage and Offloading (FPSO)   | 89              |
| Tension Leg Platforms (TLPs)  | 89              |
| Semisubmersible Platforms   | 89              |
| SPAR  | 90              |
| Subsea Production Systems   | 90              |
| NATURAL GAS CONSUMPTION   | 90              |
| OIL AND GAS PRODUCTION AND CONSUMPTION TO INCREASE DEMAND FOR HYDRAULIC FRACKING                    | 90              |
| CHAPTER 7 HYDRAULIC FRACTURING REGULATIONS  | 93              |
| U.S.  | 93              |
| SAFE DRINKING WATER ACT   | 93              |
| RESOURCE CONSERVATION AND RECOVERY ACT  | 94              |
| EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT  | 95              |
| CLEAN WATER ACT   | 95              |
| CLEAN AIR ACT   | 96              |
| COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT                                | 97              |
| NATIONAL ENVIRONMENTAL POLICY ACT   | 97              |
| FRACTURING RESPONSIBILITY AND AWARENESS OF CHEMICALS ACT  | 97              |
| EUROPE  | 98              |
| CHAPTER 8 HYDRAULIC FRACTURING PROPPANTS REGIONAL MARKETS   | 101             |
| NORTH AMERICA   | 101             |
| TABLE 21 NORTH AMERICAN PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS) | 101             |
| TABLE 22 NORTH AMERICAN MARKET VOLUMES OF PROPPANTS BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)       | 104             |
| TABLE 23 NORTH AMERICAN PROPPANTS MARKET REVENUE BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)       | 104             |
| ASIA-PACIFIC  | 105             |
| TABLE 24 ASIA-PACIFIC PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS)   | 105             |
| TABLE 25 ASIA-PACIFIC MARKET VOLUMES OF PROPPANTS BY TYPE, THROUGH 2019 (KILOTONS)                  | 106             |
| TABLE 26 ASIA-PACIFIC'S MARKET FOR PROPPANTS BY TYPE, THROUGH 2019 (\$ MILLIONS)                    | 107             |
| MIDDLE EAST AND NORTH AFRICA (MENA)   | 108             |
| TABLE 27 MENA PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)          | 108             |
| TABLE 28 MENA PROPPANTS MARKET VOLUMES BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)                    | 109             |
| TABLE 29 MENA PROPPANTS MARKET REVENUES BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)                | 111             |
| ROW   | 111             |

| <b>TOPIC</b>   | <b>PAGE NO.</b> |
|--|-----------------|
| <i>TABLE 30 ROW PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>                         | 111             |
| <i>TABLE 31 ROW PROPPANTS MARKET VOLUMES BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)</i>                                   | 112             |
| <i>TABLE 32 ROW PROPPANTS MARKET REVENUES BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)</i>                               | 114             |
|  |                 |
| <b>CHAPTER 9 COMPETITIVE LANDSCAPE</b>   | 116             |
| <i>FIGURE 10 GROWTH STRATEGIES OF KEY PLAYERS IN THE HYDRAULIC FRACTURING PROPPANTS MARKET, 2011 TO SEPT. 2014 (NO.)</i> | 116             |
| <b>INDUSTRY GROWTH STRATEGIES</b>  | 117             |
| <i>TABLE 33 ACQUISITIONS AND EXPANSION IN THE HYDRAULIC PROPPANTS MARKET, 2011 TO SEPT. 2014</i>                         | 117             |
| <i>TABLE 34 HYDRAULIC PROPPANT COMPANY STRATEGIES, 2011 TO SEPT. 2014</i>  | 118             |
|  |                 |
| <b>CHAPTER 10 COMPANY PROFILES</b>   | 121             |
| <b>ATLAS RESIN PROPPANTS LP</b>  | 121             |
| <i>TABLE 35 ATLAS RESIN PROPPANTS' PRODUCT PORTFOLIO</i>   | 121             |
| <b>BAKER HUGHES</b>  | 121             |
| <i>TABLE 36 BAKER HUGHES' PRODUCT PORTFOLIO</i>  | 122             |
| <b>CANYON TECHNICAL SERVICES</b>   | 122             |
| <i>TABLE 37 CANYON TECHNICAL SERVICES' PRODUCT PORTFOLIO</i>   | 123             |
| <i>TABLE 38 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i>  | 123             |
| <b>CARBO CERAMICS</b>  | 123             |
| <i>TABLE 39 CARBO CERAMICS' PRODUCT PORTFOLIO</i>  | 124             |
| <b>CHINA GENGSHENG MINERALS INC.</b>   | 124             |
| <i>TABLE 40 CHINA GENGSHENG MINERAL'S PRODUCT PORTFOLIO</i>  | 125             |
| <i>TABLE 41 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i>  | 125             |
| <b>FAIRMOUNT SANTROL</b>   | 125             |
| <i>TABLE 42 FAIRMOUNT SANTROL'S PRODUCT PORTFOLIO</i>  | 126             |
| <i>TABLE 43 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i>  | 126             |
| <b>FORES LLC</b>   | 127             |
| <i>TABLE 44 FORES' PRODUCT PORTFOLIO</i>   | 127             |
| <b>HALLIBURTON</b>   | 128             |
| <i>TABLE 45 HALLIBURTON'S PRODUCT PORTFOLIO</i>  | 128             |
| <b>JSC BOROVICHI REFRACTORIES</b>  | 129             |
| <i>TABLE 46 JSC BOROVICHI REFRACTORIES' PRODUCT PORTFOLIO</i>  | 129             |
| <b>MINERACAO CURIMBABA</b>   | 129             |
| <i>TABLE 47 MINERACAO CURIMBABA'S PRODUCT PORTFOLIO</i>  | 130             |
| <b>MOMENTIVE</b>   | 130             |
| <i>TABLE 48 MOMENTIVE'S PRODUCT PORTFOLIO</i>  | 131             |
| <i>TABLE 49 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i>  | 131             |
| <b>SAINT-GOBAIN PROPPANTS</b>  | 132             |
| <i>TABLE 50 SAINT-GOBAIN PROPPANTS' PRODUCT PORTFOLIO</i>  | 132             |
| <i>TABLE 51 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i>  | 133             |
| <b>SANJEL CORP.</b>  | 133             |
| <i>TABLE 52 SANJEL'S PRODUCT PORTFOLIO</i>   | 133             |
| <b>SCHLUMBERGER</b>  | 134             |

| <b>TOPIC</b>   | <b>PAGE NO.</b> |
|--|-----------------|
| <i>TABLE 53 SCHLUMBERGER'S PRODUCT PORTFOLIO</i>   | 134             |
| <i>TABLE 54 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i><br>SINTEX MINERALS AND SERVICES INC.         | 135             |
| <i>TABLE 55 SINTEX MINERALS AND SERVICES' PRODUCT PORTFOLIO</i>                                      | 136             |
| <i>TABLE 56 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i><br>SUPERIOR SILICA SANDS LLC                 | 136             |
| <i>TABLE 57 SUPERIOR SILICA SANDS' PRODUCT PORTFOLIO</i><br>TRICAN WELL SERVICE                      | 137             |
| <i>TABLE 58 TRICAN WELL SERVICES PRODUCT PORTFOLIO</i><br>U.S. SILICA CO.                            | 137             |
| <i>TABLE 59 U.S. SILICA'S PRODUCT PORTFOLIO</i>  | 138             |
| <i>TABLE 60 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014</i><br>YIXING ORIENT PETROLEUM PROPPANT CO. LTD. | 139             |
| <i>TABLE 61 YIXING ORIENT PETROLEUM PROPPANT'S PRODUCT PORTFOLIO</i>                                 | 140             |
|  |                 |
| CHAPTER 11 PATENT ANALYSIS   | 142             |
| LIST OF PATENTS  | 142             |
| UNITED STATES  | 142             |
| <i>TABLE 62 U.S. PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014</i><br>EUROPE                     | 142             |
| <i>TABLE 63 EUROPEAN PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014</i><br>JAPAN                  | 145             |
| <i>TABLE 64 JAPANESE PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014</i>                           | 147             |



**LIST OF TABLES**

| <b>TABLE HEADING</b>  | <b>PAGE NO.</b> |
|---|-----------------|
| SUMMARY TABLE GLOBAL HYDRAULIC PROPPANTS MARKET BY REGION, THROUGH 2019 (KILOTONS)                        | 8               |
| TABLE 1 MAIN CERAMIC PROPPANT MANUFACTURERS AND CAPACITIES  | 12              |
| TABLE 2 FORECAST U.S. NATURAL GAS PRODUCTION BY SOURCE, 2003-2025   | 18              |
| TABLE 3 VARIATION IN TOTAL WATER COST AMONG PRODUCTION AREAS IN THE U.S. (\$)                             | 23              |
| TABLE 4 GLOBAL RECOVERABLE SHALE GAS RESERVES BY REGION, 2013 (TCF)                                       | 25              |
| TABLE 5 HYDRAULIC FRACTURING FLUID COMPOSITION (%)  | 34              |
| TABLE 6 TYPES OF HYDRAULIC FRACTURING FLUIDS USED   | 35              |
| TABLE 7 PROPERTIES OF VARIOUS PROPPANT TYPES  | 52              |
| TABLE 8 SILICA SAND SPECIFICATIONS  | 53              |
| TABLE 9 GLOBAL SAND PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019, (KILOTONS/\$ MILLIONS)         | 55              |
| TABLE 10 GLOBAL SAND PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)                          | 56              |
| TABLE 11 GLOBAL SAND PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)                      | 57              |
| TABLE 12 TYPES OF CERAMIC PROPPANTS   | 59              |
| TABLE 13 GLOBAL CERAMIC PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS)       | 60              |
| TABLE 14 GLOBAL CERAMIC PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)                       | 61              |
| TABLE 15 GLOBAL CERAMIC PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)                   | 61              |
| TABLE 16 GLOBAL RESIN-COATED PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS) | 63              |
| TABLE 17 GLOBAL RESIN-COATED PROPPANTS MARKET VOLUMES BY REGION, THROUGH 2019 (KILOTONS)                  | 64              |
| TABLE 18 GLOBAL RESIN-COATED PROPPANTS MARKET REVENUES BY REGION, THROUGH 2019 (\$ MILLIONS)              | 65              |
| TABLE 19 GLOBAL SHALE GAS RESERVES, 2013 (TCF)  | 72              |
| TABLE 20 GLOBAL TIGHT OIL RESERVES  | 78              |
| TABLE 21 NORTH AMERICAN PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS)       | 101             |
| TABLE 22 NORTH AMERICAN MARKET VOLUMES OF PROPPANTS BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)             | 104             |
| TABLE 23 NORTH AMERICAN PROPPANTS MARKET REVENUE BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)             | 104             |
| TABLE 24 ASIA-PACIFIC PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$MILLIONS)         | 105             |
| TABLE 25 ASIA-PACIFIC MARKET VOLUMES OF PROPPANTS BY TYPE, THROUGH 2019 (KILOTONS)                        | 106             |
| TABLE 26 ASIA-PACIFIC'S MARKET FOR PROPPANTS BY TYPE, THROUGH 2019 (\$ MILLIONS)                          | 107             |
| TABLE 27 MENA PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)                | 108             |
| TABLE 28 MENA PROPPANTS MARKET VOLUMES BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)                          | 109             |
| TABLE 29 MENA PROPPANTS MARKET REVENUES BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)                      | 111             |

| <b>TABLE HEADING</b>  | <b>PAGE NO.</b> |
|---|-----------------|
| TABLE 30 ROW PROPPANTS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS) | 111             |
| TABLE 31 ROW PROPPANTS MARKET VOLUMES BY PROPPANT TYPE, THROUGH 2019 (KILOTONS)           | 112             |
| TABLE 32 ROW PROPPANTS MARKET REVENUES BY PROPPANT TYPE, THROUGH 2019 (\$ MILLIONS)       | 114             |
| TABLE 33 ACQUISITIONS AND EXPANSION IN THE HYDRAULIC PROPPANTS MARKET, 2011 TO SEPT. 2014 | 117             |
| TABLE 34 HYDRAULIC PROPPANT COMPANY STRATEGIES, 2011 TO SEPT. 2014                        | 118             |
| TABLE 35 ATLAS RESIN PROPPANTS' PRODUCT PORTFOLIO   | 121             |
| TABLE 36 BAKER HUGHES' PRODUCT PORTFOLIO  | 122             |
| TABLE 37 CANYON TECHNICAL SERVICES' PRODUCT PORTFOLIO                                     | 123             |
| TABLE 38 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 123             |
| TABLE 39 CARBO CERAMICS' PRODUCT PORTFOLIO  | 124             |
| TABLE 40 CHINA GENGSHENG MINERAL'S PRODUCT PORTFOLIO                                      | 125             |
| TABLE 41 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 125             |
| TABLE 42 FAIRMOUNT SANTROL'S PRODUCT PORTFOLIO  | 126             |
| TABLE 43 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 126             |
| TABLE 44 FORES' PRODUCT PORTFOLIO   | 127             |
| TABLE 45 HALLIBURTON'S PRODUCT PORTFOLIO  | 128             |
| TABLE 46 JSC BOROVICHI REFRACTORIES' PRODUCT PORTFOLIO                                    | 129             |
| TABLE 47 MINERACAO CURIMBABA'S PRODUCT PORTFOLIO  | 130             |
| TABLE 48 MOMENTIVE'S PRODUCT PORTFOLIO  | 131             |
| TABLE 49 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 131             |
| TABLE 50 SAINT-GOBAIN PROPPANTS' PRODUCT PORTFOLIO  | 132             |
| TABLE 51 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 133             |
| TABLE 52 SANJEL'S PRODUCT PORTFOLIO   | 133             |
| TABLE 53 SCHLUMBERGER'S PRODUCT PORTFOLIO   | 134             |
| TABLE 54 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 135             |
| TABLE 55 SINTEX MINERALS AND SERVICES' PRODUCT PORTFOLIO                                  | 136             |
| TABLE 56 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 136             |
| TABLE 57 SUPERIOR SILICA SANDS' PRODUCT PORTFOLIO   | 137             |
| TABLE 58 TRICAN WELL SERVICES PRODUCT PORTFOLIO   | 137             |
| TABLE 59 U.S. SILICA'S PRODUCT PORTFOLIO  | 138             |
| TABLE 60 RECENT DEVELOPMENTS, 2011 TO SEPT. 2014  | 139             |
| TABLE 61 YIXING ORIENT PETROLEUM PROPPANT'S PRODUCT PORTFOLIO                             | 140             |
| TABLE 62 U.S. PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014                           | 142             |
| TABLE 63 EUROPEAN PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014                       | 145             |
| TABLE 64 JAPANESE PATENTS ON FRACKING PROPPANTS, 2011 TO SEPT. 2014                       | 147             |

**LIST OF FIGURES**

| <b>FIGURE TITLE</b>   | <b>PAGE NO.</b> |
|---|-----------------|
| SUMMARY FIGURE GLOBAL HYDRAULIC PROPPANTS MARKET BY REGION, THROUGH 2019 (KILOTONS)                               | 8               |
| FIGURE 1 GLOBAL GDP GROWTH BY REGION, 2009-2013 (%)   | 14              |
| FIGURE 2 ENERGY CONSUMPTION BY REGION, 2003-2013 (MILLION TONS OF OIL EQUIVALENTS)                                | 15              |
| FIGURE 3 FORECAST WORLD ENERGY DEMAND BY SOURCE, 2008-2022 (QUADRILLION BTU)                                      | 16              |
| FIGURE 4 NATURAL GAS PRODUCTION BY REGION, 2003-2013 (MILLION TONS OF OIL EQUIVALENT)                             | 17              |
| FIGURE 5 PROPPANT COST BY OPERATIONS (%)  | 21              |
| FIGURE 6 HYDRAULIC FRACTURING WORKINGS  | 28              |
| FIGURE 7 CLASSIFICATION OF PROPPANTS  | 50              |
| FIGURE 8 STRENGTH OF DIFFERENT TYPES OF PROPPANTS   | 51              |
| FIGURE 9 GLOBAL SILICA SAND PRODUCTION BY COUNTRY, 2013 (%)   | 54              |
| FIGURE 10 GROWTH STRATEGIES OF KEY PLAYERS IN THE HYDRAULIC FRACTURING PROPPANTS MARKET, 2011 TO SEPT. 2014 (NO.) | 116             |