

## MINING CHEMICALS: APPLICATIONS AND GLOBAL MARKETS



**AVM119A**  
**November 2014**

Amruta Behere  
***Project Analyst***

ISBN: 1-62296-002-5



**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**

<b>TOPIC</b>	<b>PAGE NO.</b>
CHAPTER 1 INTRODUCTION	2
INTRODUCTION	2
STUDY'S OBJECTIVES	2
SCOPE OF THE REPORT	2
INTENDED AUDIENCE	3
RESEARCH METHODOLOGY	3
ANALYST'S CREDENTIALS	3
RELATED BCC RESEARCH REPORTS	3
BCC RESEARCH WEBSITE	3
DISCLAIMER	4
CHAPTER 2 SUMMARY	6
<i>SUMMARY TABLE GLOBAL MARKET FOR MINING CHEMICALS, THROUGH 2019 (\$ MILLIONS)</i>	6
<i>SUMMARY FIGURE GLOBAL MARKET FOR MINING CHEMICALS, 2013-2019 (\$ MILLIONS)</i>	7
CHAPTER 3 MARKET OVERVIEW	9
MINING CHEMICALS	9
MINING CHEMICALS TYPES	9
Frothers	9
Flocculants	9
<i>TABLE 1 APPLICATIONS OF FLOCCULANTS IN MINING</i>	10
Collectors	11
<i>FIGURE 1 CATEGORIES OF COLLECTORS</i>	11
<i>TABLE 2 MINERALS BASED ON COLLECTOR TYPE</i>	12
Solvent Extractants	12
<i>FIGURE 2 PROCESS OF SEPARATION, PURIFICATION AND RECOVERY OF METALS</i>	12
Modifiers	13
Depressants	13
Activators	13
MARKET DYNAMICS	14
Drivers	14
Declining Ore Quality	14
<i>FIGURE 3 DECLINING ORE GRADES (%)</i>	14
Increase in Mining Activity in Developing Countries	16
<i>FIGURE 4 BAUXITE PRODUCTION AND CAGRS OVER THE PAST 10 YEARS, BY COUNTRY, 2003-2013 (MILLION TONS/%)</i>	16
<i>FIGURE 5 COPPER PRODUCTION AND CAGR OVER THE PAST 10 YEARS, 2003-2013 (KILOTONS/%)</i>	17
<i>FIGURE 6 IRON ORE PRODUCTION AND CAGR OVER THE PAST 10 YEARS, 2003-2013 (MILLION TONS/%)</i>	18
Mineral Reserves in Emerging Economies	19
<i>FIGURE 7 GLOBAL DISTRIBUTION OF MINERAL RESERVES, 2013 (%)</i>	19
Rationalization of Policies	20
Increased Chinese Investments in Other Markets	20

<b>TOPIC</b>	<b>PAGE NO.</b>
Restraints	20
Difficulties in Logistics and Transportation of Mining Chemicals	20
<i>FIGURE 8 PROJECTED GROWTH IN CONTAINER SHIP FLEET (NO. OF SHIPS/MILLION TEU)</i>	20
<i>FIGURE 9 GLOBAL LOGISTICS MARKET BY SEGMENT, 2013 (%)</i>	21
Opportunities	23
Mining Reserves in Latin America and Africa	23
<i>TABLE 3 FACTORS AFFECTING MINING ACTIVITIES IN AFRICA</i>	24
<i>TABLE 4 FACTORS AFFECTING MINING ACTIVITIES IN LATIN AMERICA</i>	25
<i>TABLE 5 PROJECT PIPELINE, MINE INVESTMENT BY REGION, 2013 (\$ BILLIONS/%)</i>	26
<b>MINERAL PROCESSING OPERATION</b>	27
Mining	27
Mining Processes	27
Open Pit Mining	27
Underground Mining	28
In Situ Solution Mining	28
Beneficiation	28
<b>MILLING PROCESSES</b>	28
Floatation	29
Beneficiation: Leaching	30
Mineral Processing	30
Processes Associated with Leaching	30
Preleaching Activities	30
Roasting	31
Autoclaving	31
Leaching Operations	31
Dump Leaching	31
Heap Leaching	31
Tank Leaching	31
Leachants	32
Acid Leaching	32
Cyanide Leaching	32
Dissolution	32
Recovery Processes	32
Precipitation	32
Electrowinning	32
Carbon Adsorption	32
Cementation	33
Solvent Extraction	33
<b>TYPES OF MINERAL PROCESSING</b>	33
Smelting	33
Roasting	33
Retorting	33
Fire Refining	34
Drossing	34
Electrolytic Refining	34
Digestion	34
<b>VALUE CHAIN ANALYSIS</b>	34

<b>TOPIC</b>	<b>PAGE NO.</b>
<i>FIGURE 10 MINING CHEMICALS: VALUE CHAIN ANALYSIS</i>	35
COMPETITIVE LANDSCAPE	35
<i>FIGURE 11 MINING CHEMICALS MARKET: COMPANY MARKET SHARE ANALYSIS (%)</i>	36
Competitive Insights	37
CHAPTER 4 GLOBAL MINING CHEMICALS MARKET BY PRODUCT	40
OVERVIEW OF MINING CHEMICALS PRODUCTS	40
FROTHERS	40
Technical Analysis of Frothers	40
Pine Oil	41
MIBC	41
Polyglycols	41
TEB	41
Cresylic Acid	41
<i>TABLE 6 COMPARISON OF COMMERCIALY AVAILABLE FROTHERS</i>	42
Frothers Market	42
<i>TABLE 7 GLOBAL MINING CHEMICALS DEMAND FOR FROTHERS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	42
<i>TABLE 8 MINING CHEMICALS MARKET VOLUME FOR FROTHERS BY REGION, THROUGH 2019 (KILOTONS)</i>	43
<i>TABLE 9 MINING CHEMICALS MARKET REVENUE FOR FROTHERS BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	43
FLOCCULANTS	44
Technical Analysis of Flocculants	44
Polymers	44
pH	44
<i>FIGURE 12 STRENGTH OF FLOCCULANT BASED ON PH</i>	45
Molecular Weight	45
Flocculants Market	45
<i>TABLE 10 GLOBAL MINING CHEMICALS DEMAND FOR FLOCCULANTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	46
<i>TABLE 11 MINING CHEMICALS MARKET VOLUME FOR FLOCCULANTS BY REGION, THROUGH 2019 (KILOTONS)</i>	46
<i>TABLE 12 MINING CHEMICALS MARKET REVENUE FOR FLOCCULANTS BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	47
COLLECTORS	47
Technical Analysis of Collectors	48
Anionic Collectors	48
Xanthates	48
Ethyl Xanthate	48
Propyl Xanthate	49
Butyl Xanthate	49
Amyl Xanthate	49
Dithiophosphate	49
Fatty Acids	49
Cationic Collectors	49
Amines	50
<i>TABLE 13 MEASURING COLLECTORS (G/T)</i>	50
Collectors Market Analysis	50

<b>TOPIC</b>	<b>PAGE NO.</b>
<i>TABLE 14 GLOBAL MINING CHEMICALS DEMAND FOR COLLECTORS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	50
<i>FIGURE 13 PROCESS OF IRON ORE BENEFICIATION</i>	51
<i>TABLE 15 MINING CHEMICALS MARKET VOLUME FOR COLLECTORS BY REGION, THROUGH 2019 (KILOTONS)</i>	51
<i>TABLE 16 MINING CHEMICALS MARKET REVENUE FOR COLLECTORS BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	52
SOLVENT EXTRACTANTS	52
Technical analysis of solvent extractants	53
Solvent Extractants Market	53
<i>TABLE 17 GLOBAL MINING CHEMICALS DEMAND FOR SOLVENT EXTRACTANT, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	53
<i>TABLE 18 MINING CHEMICALS MARKET VOLUME FOR SOLVENT EXTRACTANT BY REGION, THROUGH 2019 (KILOTONS)</i>	54
<i>TABLE 19 MINING CHEMICALS MARKET REVENUE FOR SOLVENT EXTRACTANT BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	55
GRINDING AIDS	55
<i>TABLE 20 GLOBAL MINING CHEMICALS DEMAND FOR GRINDING AIDS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	55
<i>TABLE 21 GLOBAL MINING CHEMICALS MARKET VOLUME FOR GRINDING AIDS BY REGION, THROUGH 2019 (KILOTONS)</i>	56
<i>TABLE 22 GLOBAL MINING CHEMICALS MARKET REVENUE FOR GRINDING AIDS BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	56
OTHERS (DEPRESSANTS, ACTIVATORS AND MODIFIERS)	57
Technical Analysis of Other Mining Chemicals	57
Critical pH	57
<i>TABLE 23 CRITICAL PH VALUE OF MINERALS</i>	57
Lime	58
Caustic Soda	58
Soda Ash	58
Sodium Cyanide	58
Sodium Sulfide	58
Sodium Silicate	58
Starch/Dextrin	59
Sulfide Dioxide	59
<i>TABLE 24 COMPARISON OF DEPRESSANTS</i>	59
Activators	59
Sodium Hydrosulfide	59
Copper Sulfate	60
Multivalent Ions	60
<i>TABLE 25 COMPARISON OF ACTIVATORS</i>	60
Market Analysis of Other Mining Chemicals	60
<i>TABLE 26 GLOBAL MINING CHEMICALS DEMAND FOR OTHER PRODUCTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	61
<i>TABLE 27 GLOBAL MINING CHEMICALS MARKET VOLUME FOR OTHER PRODUCTS BY REGION, THROUGH 2019 (KILOTONS)</i>	61
<i>TABLE 28 GLOBAL MINING CHEMICALS MARKET REVENUE FOR OTHER PRODUCTS BY REGION THROUGH 2019 (\$ MILLIONS)</i>	62
CHAPTER 5 GLOBAL MINING TREATMENT MARKET BY APPLICATION	64

<b>TOPIC</b>	<b>PAGE NO.</b>
WATER AND WASTEWATER TREATMENT	64
TYPES OF MINE WATER	64
POTENTIAL FOR WATER CONTAMINATION	64
ACTIVE WATER TREATMENT	65
PASSIVE WATER TREATMENT	65
MARKET ANALYSIS OF MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT APPLICATIONS	65
<i>TABLE 29 GLOBAL MARKET FOR MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	66
<i>TABLE 30 CHEMICAL COMPOUNDS FOR THE TREATMENT OF AMD</i>	66
<i>TABLE 31 CHEMICALS FOR ACID NEUTRALIZATION, COAGULATION/FLOCCULATION AND OXIDATION</i>	67
<i>TABLE 32 MARKET VOLUME OF MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT BY REGION, THROUGH 2019 (KILOTONS)</i>	68
<i>TABLE 33 MARKET REVENUE OF MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	68
MINERAL PROCESSING	69
<i>FIGURE 14 SCHEMATIC REPRESENTATION OF THE MINERAL PROCESSING PROCESS</i>	69
MILLING	69
FLOATATION	69
LEACHING	70
MARKET ANALYSIS OF MINING CHEMICALS IN MINERAL PROCESSING	70
<i>TABLE 34 GLOBAL MARKET FOR MINING CHEMICALS IN MINERAL PROCESSING, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	70
<i>TABLE 35 METAL MINING AND EXTRACTION TECHNIQUES</i>	71
<i>TABLE 36 MARKET VOLUME OF MINING CHEMICALS IN MINERAL PROCESSING BY REGION, THROUGH 2019 (KILOTONS)</i>	71
<i>TABLE 37 MARKET REVENUE OF MINING CHEMICALS IN MINERAL PROCESSING BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	72
EXPLOSIVES AND DRILLING	73
MARKET ANALYSIS OF MINING CHEMICALS USED IN EXPLOSIVES AND DRILLING	74
<i>TABLE 38 GLOBAL MARKET FOR MINING CHEMICALS IN EXPLOSIVE AND DRILLING, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	74
<i>TABLE 39 MARKET VOLUME OF MINING CHEMICALS IN EXPLOSIVES AND DRILLING BY REGION, THROUGH 2019 (KILOTONS)</i>	75
<i>TABLE 40 MARKET REVENUE OF MINING CHEMICALS IN EXPLOSIVES AND DRILLING BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	76
OTHERS	76
ELECTROWINNING	76
Role of Smoothing Aids in Electrowinning	76
Role of Dust Control Suppressants	77
MARKET ANALYSIS OF MINING CHEMICALS USED IN OTHER APPLICATIONS	77
<i>TABLE 41 GLOBAL MARKET FOR MINING CHEMICALS IN OTHER APPLICATIONS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	78
<i>TABLE 42 MARKET VOLUME OF MINING CHEMICALS IN OTHER APPLICATIONS BY REGION, THROUGH 2019 (KILOTONS)</i>	78
<i>TABLE 43 MARKET REVENUE OF MINING CHEMICALS IN OTHER APPLICATIONS BY REGION, THROUGH 2019 (\$ MILLIONS)</i>	78

<b>TOPIC</b>	<b>PAGE NO.</b>
CHAPTER 6 MINING CHEMICALS MARKET BY REGION	81
OVERVIEW	81
NORTH AMERICA	81
<i>TABLE 44 NORTH AMERICAN MINING CHEMICALS MARKET ESTIMATES AND FORECAST THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	81
<i>TABLE 45 NORTH AMERICAN MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)</i>	82
<i>TABLE 46 NORTH AMERICAN MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)</i>	83
<i>TABLE 47 NORTH AMERICAN MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)</i>	84
<i>TABLE 48 NORTH AMERICAN MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)</i>	84
EUROPE	85
<i>TABLE 49 EUROPEAN MINING CHEMICALS MARKET ESTIMATES AND FORECASTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	85
<i>TABLE 50 EUROPEAN MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)</i>	86
<i>TABLE 51 EUROPEAN MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)</i>	86
<i>TABLE 52 EUROPEAN MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)</i>	87
<i>TABLE 53 EUROPEAN MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)</i>	87
ASIA-PACIFIC	88
<i>TABLE 54 ASIA-PACIFIC MINING CHEMICALS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	88
<i>TABLE 55 ASIA-PACIFIC MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)</i>	89
<i>TABLE 56 ASIA-PACIFIC MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)</i>	89
<i>TABLE 57 ASIA-PACIFIC MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)</i>	90
<i>TABLE 58 ASIA-PACIFIC MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)</i>	91
ROW	91
<i>TABLE 59 ROW MINING CHEMICALS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)</i>	91
<i>TABLE 60 ROW MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)</i>	92
<i>TABLE 61 ROW MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)</i>	92
<i>TABLE 62 ROW MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)</i>	94
CHAPTER 7 COMPETITIVE LANDSCAPE	96
<i>FIGURE 15 STRATEGIES FOLLOWED IN THE MINING CHEMICALS MARKET BY PARTICIPANT, 2011 TO SEPT. 2013</i>	96
<i>TABLE 63 PRODUCT LAUNCHES, EXPANSIONS, R &amp;D, REORGANIZATION AND AGREEMENTS IN THE MINING CHEMICALS MARKET</i>	97
<i>TABLE 64 MERGERS, ACQUISITIONS, DIVESTMENTS, INVESTMENTS AND JOINT VENTURES IN THE MINING CHEMICALS MARKET</i>	100

TOPIC	PAGE NO.
CHAPTER 8 COMPANY PROFILES	107
3M	107
<i>TABLE 65 3M PRODUCT PORTFOLIO</i>	107
AIR PRODUCTS AND CHEMICALS	107
<i>TABLE 66 AIR PRODUCTS PRODUCT PORTFOLIO</i>	108
<i>TABLE 67 RECENT DEVELOPMENTS, 2012</i>	108
AKZONOBEL	108
<i>TABLE 68 AKZONOBEL PRODUCT PORTFOLIO</i>	109
<i>TABLE 69 RECENT DEVELOPMENTS, 2011 TO JUNE 2012</i>	109
ARIZONA CHEMICAL CO.	109
<i>TABLE 70 ARIZONA CHEMICAL PRODUCT PORTFOLIO</i>	110
<i>TABLE 71 RECENT DEVELOPMENTS, 2011 TO JAN. 2013</i>	110
ARRMAZCUSTOM CHEMICALS	110
<i>TABLE 72 ARRMAZCUSTOM CHEMICALS PRODUCT PORTFOLIO</i>	111
<i>TABLE 73 RECENT DEVELOPMENTS, 2013</i>	111
ARRMAZ GULF CHEMICALS	111
<i>TABLE 74 ARRMAZ GULF CHEMICALS PRODUCT PORTFOLIO</i>	112
ASHLAND INC.	112
<i>TABLE 75 ASHLAND PRODUCT PORTFOLIO</i>	113
<i>TABLE 76 RECENT DEVELOPMENTS, 2013</i>	114
AUSTIN POWDER CO.	115
<i>TABLE 77 AUSTIN POWDER PRODUCT PORTFOLIO</i>	115
BASF	115
<i>TABLE 78 BASF PRODUCT PORTFOLIO</i>	116
CHEMINOVA DANAFLOAT	116
<i>TABLE 79 CHEMINOVA PRODUCT PORTFOLIO</i>	117
CHEVRON PHILLIPS CHEMICAL	117
<i>TABLE 80 CHEVRON PHILIPS CHEMICAL PRODUCT PORTFOLIO</i>	117
CLARIANT INTERNATIONAL	118
<i>TABLE 81 CLARIANT INTERNATIONAL PRODUCT PORTFOLIO</i>	119
<i>TABLE 82 RECENT DEVELOPMENTS, 2011 TO APRIL 2014)</i>	119
COOGE CHEMICALS PTY. LTD.	120
<i>TABLE 83 COOGEE CHEMICALS PRODUCT PORTFOLIO</i>	121
CP KELCO	121
<i>TABLE 84 CP KELCO PRODUCT PORTFOLIO</i>	121
CYTEC INDUSTRIES	122
<i>TABLE 85 PRODUCT PORTFOLIO</i>	122
<i>TABLE 86 RECENT DEVELOPMENTS, 2011-2013</i>	123
DUPONT	123
<i>TABLE 87 DUPONT PRODUCT PORTFOLIO</i>	124
DYNO NOBEL	124
<i>TABLE 88 DYNO NOBEL PRODUCT PORTFOLIO</i>	125
EKOF FLOTATION GMBH	126
<i>TABLE 89 EKOF FLOTATION PRODUCT PORTFOLIO</i>	127
FUCHS PETROLUB AGV	127
<i>TABLE 90 FUCHS PETROLUB PRODUCT PORTFOLIO</i>	128



<b>TOPIC</b>	<b>PAGE NO.</b>
<i>TABLE 91 RECENT DEVELOPMENTS, MAY 2014</i>	128
GE WATER AND PROCESS TECHNOLOGIES	128
<i>TABLE 92 GE WATER AND PROCESS TECHNOLOGIES PRODUCT PORTFOLIO</i>	129
HUNTSMAN CORP.	129
<i>TABLE 93 HUNTSMAN CORP. PRODUCT PORTFOLIO</i>	130
HYCHEM INC.	130
<i>TABLE 94 HYCHEM PRODUCT PORTFOLIO</i>	130
ISRAEL CHEMICALS LTD.	131
<i>TABLE 95 ISRAEL CHEMICALS PRODUCT PORTFOLIO</i>	132
<i>TABLE 96 RECENT DEVELOPMENTS, 2013 TO APRIL 2014</i>	132
KEMIRA OYJ	133
<i>TABLE 97 KEMIRA PRODUCT PORTFOLIO</i>	133
<i>TABLE 98 RECENT DEVELOPMENTS, 2011 TO OCT, 2013</i>	134
MAXAM CORP.	134
<i>TABLE 99 MAXAM PRODUCT PORTFOLIO</i>	134
NALCO HOLDING CO.	135
<i>TABLE 100 NALCO PRODUCT PORTFOLIO</i>	135
<i>TABLE 101 RECENT DEVELOPMENTS, 2011</i>	136
NASACO INTERNATIONAL	136
<i>TABLE 102 NASACO INTERNATIONAL PRODUCT PORTFOLIO</i>	136
ORICA MINING CHEMICALS	137
<i>TABLE 103 ORICA MINING CHEMICALS PRODUCT PORTFOLIO</i>	137
<i>TABLE 104 RECENT DEVELOPMENTS, MARCH, 2014</i>	138
QUAKER CHEMICAL CORP.	138
<i>TABLE 105 QUAKER CHEMICAL PRODUCT PORTFOLIO</i>	138
<i>TABLE 106 RECENT DEVELOPMENTS, 2013</i>	139
SANYO CHEMICAL INDUSTRIES	140
<i>TABLE 107 SANYO CHEMICAL PRODUCT PORTFOLIO</i>	140
SASOL	141
<i>TABLE 108 SASOL PRODUCT PORTFOLIO</i>	141
SIKA AUSTRALIA	141
<i>TABLE 109 SIKA AUSTRALIA PRODUCT PORTFOLIO</i>	142
SNF FLOMIN	142
<i>TABLE 110 PRODUCT PORTFOLIO</i>	142
SNF FLOERGER	143
<i>TABLE 111 PRODUCT PORTFOLIO</i>	143
ZINKAN ENTERPRISES	144
<i>TABLE 112 ZINKAN ENTERPRISES PRODUCT PORTFOLIO</i>	144
CHAPTER 9 PATENT ANALYSIS	147
<i>FIGURE 16 PATENTS BY REGION, 2011 TO JULY 2014 (NO. OF PATENTS)</i>	147
LIST OF PATENTS	148
<i>TABLE 113 U.S. PATENTS, 2011 TO JULY 2014</i>	148
<i>TABLE 114 EUROPEAN PATENTS, 2011 TO JULY 2014</i>	152
<i>TABLE 115 JAPANESE PATENTS, 2011 TO JULY 2014</i>	155

**LIST OF TABLES**

<b>TABLE HEADING</b>	<b>PAGE NO.</b>
SUMMARY TABLE GLOBAL MARKET FOR MINING CHEMICALS, THROUGH 2019 (\$ MILLIONS)	6
TABLE 1 APPLICATIONS OF FLOCCULANTS IN MINING	10
TABLE 2 MINERALS BASED ON COLLECTOR TYPE	12
TABLE 3 FACTORS AFFECTING MINING ACTIVITIES IN AFRICA	24
TABLE 4 FACTORS AFFECTING MINING ACTIVITIES IN LATIN AMERICA	25
TABLE 5 PROJECT PIPELINE, MINE INVESTMENT BY REGION, 2013 (\$ BILLIONS/%)	26
TABLE 6 COMPARISON OF COMMERCIALY AVAILABLE FROTHERS	42
TABLE 7 GLOBAL MINING CHEMICALS DEMAND FOR FROTHERS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	42
TABLE 8 MINING CHEMICALS MARKET VOLUME FOR FROTHERS BY REGION, THROUGH 2019 (KILOTONS)	43
TABLE 9 MINING CHEMICALS MARKET REVENUE FOR FROTHERS BY REGION, THROUGH 2019 (\$ MILLIONS)	43
TABLE 10 GLOBAL MINING CHEMICALS DEMAND FOR FLOCCULANTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	46
TABLE 11 MINING CHEMICALS MARKET VOLUME FOR FLOCCULANTS BY REGION, THROUGH 2019 (KILOTONS)	46
TABLE 12 MINING CHEMICALS MARKET REVENUE FOR FLOCCULANTS BY REGION, THROUGH 2019 (\$ MILLIONS)	47
TABLE 13 MEASURING COLLECTORS (G/T)	50
TABLE 14 GLOBAL MINING CHEMICALS DEMAND FOR COLLECTORS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	50
TABLE 15 MINING CHEMICALS MARKET VOLUME FOR COLLECTORS BY REGION, THROUGH 2019 (KILOTONS)	51
TABLE 16 MINING CHEMICALS MARKET REVENUE FOR COLLECTORS BY REGION, THROUGH 2019 (\$ MILLIONS)	52
TABLE 17 GLOBAL MINING CHEMICALS DEMAND FOR SOLVENT EXTRACTANT, THROUGH 2019 (KILOTONS/\$ MILLIONS)	53
TABLE 18 MINING CHEMICALS MARKET VOLUME FOR SOLVENT EXTRACTANT BY REGION, THROUGH 2019 (KILOTONS)	54
TABLE 19 MINING CHEMICALS MARKET REVENUE FOR SOLVENT EXTRACTANT BY REGION, THROUGH 2019 (\$ MILLIONS)	55
TABLE 20 GLOBAL MINING CHEMICALS DEMAND FOR GRINDING AIDS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	55
TABLE 21 GLOBAL MINING CHEMICALS MARKET VOLUME FOR GRINDING AIDS BY REGION, THROUGH 2019 (KILOTONS)	56
TABLE 22 GLOBAL MINING CHEMICALS MARKET REVENUE FOR GRINDING AIDS BY REGION, THROUGH 2019 (\$ MILLIONS)	56
TABLE 23 CRITICAL PH VALUE OF MINERALS	57
TABLE 24 COMPARISON OF DEPRESSANTS	59
TABLE 25 COMPARISON OF ACTIVATORS	60
TABLE 26 GLOBAL MINING CHEMICALS DEMAND FOR OTHER PRODUCTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	61
TABLE 27 GLOBAL MINING CHEMICALS MARKET VOLUME FOR OTHER PRODUCTS BY REGION, THROUGH 2019 (KILOTONS)	61
TABLE 28 GLOBAL MINING CHEMICALS MARKET REVENUE FOR OTHER PRODUCTS BY REGION THROUGH 2019 (\$ MILLIONS)	62
TABLE 29 GLOBAL MARKET FOR MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT, THROUGH 2019 (KILOTONS/\$ MILLIONS)	66

<b>TABLE HEADING</b>	<b>PAGE NO.</b>
TABLE 30 CHEMICAL COMPOUNDS FOR THE TREATMENT OF AMD	66
TABLE 31 CHEMICALS FOR ACID NEUTRALIZATION, COAGULATION/FLOCCULATION AND OXIDATION	67
TABLE 32 MARKET VOLUME OF MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT BY REGION, THROUGH 2019 (KILOTONS)	68
TABLE 33 MARKET REVENUE OF MINING CHEMICALS IN WATER AND WASTEWATER TREATMENT BY REGION, THROUGH 2019 (\$ MILLIONS)	68
TABLE 34 GLOBAL MARKET FOR MINING CHEMICALS IN MINERAL PROCESSING, THROUGH 2019 (KILOTONS/\$ MILLIONS)	70
TABLE 35 METAL MINING AND EXTRACTION TECHNIQUES	71
TABLE 36 MARKET VOLUME OF MINING CHEMICALS IN MINERAL PROCESSING BY REGION, THROUGH 2019 (KILOTONS)	71
TABLE 37 MARKET REVENUE OF MINING CHEMICALS IN MINERAL PROCESSING BY REGION, THROUGH 2019 (\$ MILLIONS)	72
TABLE 38 GLOBAL MARKET FOR MINING CHEMICALS IN EXPLOSIVE AND DRILLING, THROUGH 2019 (KILOTONS/\$ MILLIONS)	74
TABLE 39 MARKET VOLUME OF MINING CHEMICALS IN EXPLOSIVES AND DRILLING BY REGION, THROUGH 2019 (KILOTONS)	75
TABLE 40 MARKET REVENUE OF MINING CHEMICALS IN EXPLOSIVES AND DRILLING BY REGION, THROUGH 2019 (\$ MILLIONS)	76
TABLE 41 GLOBAL MARKET FOR MINING CHEMICALS IN OTHER APPLICATIONS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	78
TABLE 42 MARKET VOLUME OF MINING CHEMICALS IN OTHER APPLICATIONS BY REGION, THROUGH 2019 (KILOTONS)	78
TABLE 43 MARKET REVENUE OF MINING CHEMICALS IN OTHER APPLICATIONS BY REGION, THROUGH 2019 (\$ MILLIONS)	78
TABLE 44 NORTH AMERICAN MINING CHEMICALS MARKET ESTIMATES AND FORECAST THROUGH 2019 (KILOTONS/\$ MILLIONS)	81
TABLE 45 NORTH AMERICAN MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)	82
TABLE 46 NORTH AMERICAN MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)	83
TABLE 47 NORTH AMERICAN MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)	84
TABLE 48 NORTH AMERICAN MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)	84
TABLE 49 EUROPEAN MINING CHEMICALS MARKET ESTIMATES AND FORECASTS, THROUGH 2019 (KILOTONS/\$ MILLIONS)	85
TABLE 50 EUROPEAN MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)	86
TABLE 51 EUROPEAN MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)	86
TABLE 52 EUROPEAN MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)	87
TABLE 53 EUROPEAN MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)	87
TABLE 54 ASIA-PACIFIC MINING CHEMICALS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)	88
TABLE 55 ASIA-PACIFIC MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)	89
TABLE 56 ASIA-PACIFIC MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)	89

<b>TABLE HEADING</b>	<b>PAGE NO.</b>
TABLE 57 ASIA-PACIFIC MINING CHEMICALS MARKET VOLUME BY APPLICATION, THROUGH 2019 (KILOTONS)	90
TABLE 58 ASIA-PACIFIC MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)	91
TABLE 59 ROW MINING CHEMICALS MARKET ESTIMATES AND FORECAST, THROUGH 2019 (KILOTONS/\$ MILLIONS)	91
TABLE 60 ROW MINING CHEMICALS MARKET VOLUME BY PRODUCT, THROUGH 2019 (KILOTONS)	92
TABLE 61 ROW MINING CHEMICALS MARKET REVENUE BY PRODUCT, THROUGH 2019 (\$ MILLIONS)	92
TABLE 62 ROW MINING CHEMICALS MARKET REVENUE BY APPLICATION, THROUGH 2019 (\$ MILLIONS)	94
TABLE 63 PRODUCT LAUNCHES, EXPANSIONS, R &D, REORGANIZATION AND AGREEMENTS IN THE MINING CHEMICALS MARKET	97
TABLE 64 MERGERS, ACQUISITIONS, DIVESTMENTS, INVESTMENTS AND JOINT VENTURES IN THE MINING CHEMICALS MARKET	100
TABLE 65 3M PRODUCT PORTFOLIO	107
TABLE 66 AIR PRODUCTS PRODUCT PORTFOLIO	108
TABLE 67 RECENT DEVELOPMENTS, 2012	108
TABLE 68 AKZONOBEL PRODUCT PORTFOLIO	109
TABLE 69 RECENT DEVELOPMENTS, 2011 TO JUNE 2012	109
TABLE 70 ARIZONA CHEMICAL PRODUCT PORTFOLIO	110
TABLE 71 RECENT DEVELOPMENTS, 2011 TO JAN. 2013	110
TABLE 72 ARMAZCUSTOM CHEMICALS PRODUCT PORTFOLIO	111
TABLE 73 RECENT DEVELOPMENTS, 2013	111
TABLE 74 ARMAZ GULF CHEMICALS PRODUCT PORTFOLIO	112
TABLE 75 ASHLAND PRODUCT PORTFOLIO	113
TABLE 76 RECENT DEVELOPMENTS, 2013	114
TABLE 77 AUSTIN POWDER PRODUCT PORTFOLIO	115
TABLE 78 BASF PRODUCT PORTFOLIO	116
TABLE 79 CHEMINOVA PRODUCT PORTFOLIO	117
TABLE 80 CHEVRON PHILIPS CHEMICAL PRODUCT PORTFOLIO	117
TABLE 81 CLARIANT INTERNATIONAL PRODUCT PORTFOLIO	119
TABLE 82 RECENT DEVELOPMENTS, 2011 TO APRIL 2014)	119
TABLE 83 COOGEE CHEMICALS PRODUCT PORTFOLIO	121
TABLE 84 CP KELCO PRODUCT PORTFOLIO	121
TABLE 85 PRODUCT PORTFOLIO	122
TABLE 86 RECENT DEVELOPMENTS, 2011-2013	123
TABLE 87 DUPONT PRODUCT PORTFOLIO	124
TABLE 88 DYNO NOBEL PRODUCT PORTFOLIO	125
TABLE 89 EKOF FLOTATION PRODUCT PORTFOLIO	127
TABLE 90 FUCHS PETROLUB PRODUCT PORTFOLIO	128
TABLE 91 RECENT DEVELOPMENTS, MAY 2014	128
TABLE 92 GE WATER AND PROCESS TECHNOLOGIES PRODUCT PORTFOLIO	129
TABLE 93 HUNTSMAN CORP. PRODUCT PORTFOLIO	130
TABLE 94 HYCHEM PRODUCT PORTFOLIO	130
TABLE 95 ISRAEL CHEMICALS PRODUCT PORTFOLIO	132
TABLE 96 RECENT DEVELOPMENTS, 2013 TO APRIL 2014	132
TABLE 97 KEMIRA PRODUCT PORTFOLIO	133

<b>TABLE HEADING</b>	<b>PAGE NO.</b>
TABLE 98 RECENT DEVELOPMENTS, 2011 TO OCT, 2013	134
TABLE 99 MAXAM PRODUCT PORTFOLIO	134
TABLE 100 NALCO PRODUCT PORTFOLIO	135
TABLE 101 RECENT DEVELOPMENTS, 2011	136
TABLE 102 NASACO INTERNATIONAL PRODUCT PORTFOLIO	136
TABLE 103 ORICA MINING CHEMICALS PRODUCT PORTFOLIO	137
TABLE 104 RECENT DEVELOPMENTS, MARCH, 2014	138
TABLE 105 QUAKER CHEMICAL PRODUCT PORTFOLIO	138
TABLE 106 RECENT DEVELOPMENTS, 2013	139
TABLE 107 SANYO CHEMICAL PRODUCT PORTFOLIO	140
TABLE 108 SASOL PRODUCT PORTFOLIO	141
TABLE 109 SIKA AUSTRALIA PRODUCT PORTFOLIO	142
TABLE 110 PRODUCT PORTFOLIO	142
TABLE 111 PRODUCT PORTFOLIO	143
TABLE 112 ZINKAN ENTERPRISES PRODUCT PORTFOLIO	144
TABLE 113 U.S. PATENTS, 2011 TO JULY 2014	148
TABLE 114 EUROPEAN PATENTS, 2011 TO JULY 2014	152
TABLE 115 JAPANESE PATENTS, 2011 TO JULY 2014	155

**LIST OF FIGURES**

<b>FIGURE TITLE</b>	<b>PAGE NO.</b>
SUMMARY FIGURE GLOBAL MARKET FOR MINING CHEMICALS, 2013-2019 (\$ MILLIONS)	7
FIGURE 1 CATEGORIES OF COLLECTORS	11
FIGURE 2 PROCESS OF SEPARATION, PURIFICATION AND RECOVERY OF METALS	12
FIGURE 3 DECLINING ORE GRADES (%)	14
FIGURE 4 BAUXITE PRODUCTION AND CAGRS OVER THE PAST 10 YEARS, BY COUNTRY, 2003-2013 (MILLION TONS/%)	16
FIGURE 5 COPPER PRODUCTION AND CAGR OVER THE PAST 10 YEARS, 2003-2013 (KILOTONS/%)	17
FIGURE 6 IRON ORE PRODUCTION AND CAGR OVER THE PAST 10 YEARS, 2003-2013 (MILLION TONS/%)	18
FIGURE 7 GLOBAL DISTRIBUTION OF MINERAL RESERVES, 2013 (%)	19
FIGURE 8 PROJECTED GROWTH IN CONTAINER SHIP FLEET (NO. OF SHIPS/MILLION TEU)	20
FIGURE 9 GLOBAL LOGISTICS MARKET BY SEGMENT, 2013 (%)	21
FIGURE 10 MINING CHEMICALS: VALUE CHAIN ANALYSIS	35
FIGURE 11 MINING CHEMICALS MARKET: COMPANY MARKET SHARE ANALYSIS (%)	36
FIGURE 12 STRENGTH OF FLOCCULANT BASED ON PH	45
FIGURE 13 PROCESS OF IRON ORE BENEFICIATION	51
FIGURE 14 SCHEMATIC REPRESENTATION OF THE MINERAL PROCESSING PROCESS	69
FIGURE 15 STRATEGIES FOLLOWED IN THE MINING CHEMICALS MARKET BY PARTICIPANT, 2011 TO SEPT. 2013	96
FIGURE 16 PATENTS BY REGION, 2011 TO JULY 2014 (NO. OF PATENTS)	147