

REFINERY CATALYSTS: TECHNOLOGIES AND GLOBAL MARKETS



CHM078A
April 2017

Tanmay Joshi
Project Analyst

ISBN: 1-62296-468-3



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
info@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
STUDY GOALS AND OBJECTIVES	2
GLOBAL REFINERY CATALYST MARKET DESCRIPTION	2
SCOPE OF THE REPORT	2
MARKET STRUCTURE	3
INTENDED AUDIENCE	3
RESEARCH METHODOLOGY	3
ANALYST'S CREDENTIALS	3
RELATED BCC RESEARCH REPORTS	4
DISCLAIMER	4
CHAPTER 2 SUMMARY	6
<i>SUMMARY TABLE GLOBAL REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)</i>	6
<i>SUMMARY FIGURE GLOBAL REFINERY CATALYST MARKET VOLUME, BY MATERIAL, 2015-2021 (METRIC KILOTONS)</i>	7
CHAPTER 3 MARKET OVERVIEW	10
DEFINITION OF REFINERY CATALYSTS	10
CLASSIFICATION OF REFINERY CATALYSTS	10
<i>FIGURE 1 MARKET CLASSIFICATION</i>	10
<i>TABLE 1 CATALYST TYPE ON THE BASIS OF PROCESS</i>	11
PETROLEUM REFINING CATALYST	12
REGULATIONS AND POLICIES IMPACTING REFINERY CATALYSTS MARKET	12
U.S. ENVIRONMENTAL PROTECTION AGENCY	12
Subpart A - Topping Subcategory	13
Subpart B - Cracking Subcategory	13
Subpart C - Petrochemical Subcategory	14
Subpart D - Lube Subcategory	14
Subpart E - Integrated Subcategory	15
EUROPEAN COMMISSION	15
ENVIRONMENTAL ISSUES	15
MARKET DRIVERS	16
INCREASING DEMAND FOR POLYMERS	16
<i>FIGURE 2 GLOBAL POLYMERS MARKET REVENUE, 2010-2018 (\$ BILLIONS)</i>	16
STRONG GROWTH OF REFINERIES	17
<i>FIGURE 3 GLOBAL REFINERY CATALYST MARKET VOLUME, 2010-2018 (MILLION TONS)</i>	17
MARKET RESTRAINTS	18
RAW MATERIAL PRICE VOLATILITY	18
RAPIDLY DEPLETING CRUDE OIL RESERVES	19
MARKET OPPORTUNITIES	19
DEVELOPMENT OF BIOCATALYSTS	19
Robust Industrial Growth in Emerging Economies	19
<i>FIGURE 4 ASIA-PACIFIC CHEMICAL MARKET REVENUE, 2010-2018 (\$ BILLIONS)</i>	20
USE OF NANOTECHNOLOGY	20

TOPIC	PAGE NO.
TRENDS	21
MARKET SHARE OF TOP PLAYERS	21
<i>FIGURE 5 GLOBAL REFINERY CATALYSTS REVENUE MARKET SHARE, BY COMPANY, 2015 (%)</i>	21
CHAPTER 4 REFINERY CATALYST MARKET BY INGREDIENT	25
ZEOLITES	25
<i>TABLE 2 GLOBAL ZEOLITE CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	25
<i>TABLE 3 GLOBAL ZEOLITE REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	26
<i>TABLE 4 GLOBAL ZEOLITE REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	26
METALS	27
<i>TABLE 5 GLOBAL METAL REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	27
<i>TABLE 6 GLOBAL METAL REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	28
<i>TABLE 7 GLOBAL METAL REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	28
CHEMICALS	29
<i>TABLE 8 GLOBAL CHEMICAL REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	29
<i>TABLE 9 GLOBAL CHEMICAL REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	30
<i>TABLE 10 GLOBAL CHEMICAL REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	30
OTHER CATALYSTS	31
<i>TABLE 11 GLOBAL OTHER CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	31
<i>TABLE 12 GLOBAL OTHER CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	31
<i>TABLE 13 GLOBAL OTHER CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	32
CHAPTER 5 REFINERY CATALYST MARKET BY PRODUCT	34
FLUID CATALYTIC CRACKING CATALYST	34
<i>TABLE 14 GLOBAL FCC CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	34
<i>TABLE 15 GLOBAL FCC CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	35
<i>TABLE 16 GLOBAL FCC CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	35
ALKYLATION CATALYSTS	36
<i>TABLE 17 GLOBAL ALKYLATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	36
<i>TABLE 18 GLOBAL ALKYLATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	36
<i>TABLE 19 GLOBAL ALKYLATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	37
HYDROPROCESSING CATALYSTS	37

TOPIC	PAGE NO.
<i>TABLE 20 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	38
<i>TABLE 21 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	38
<i>TABLE 22 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	38
HYDROGEN MANUFACTURING REFINERY CATALYSTS	39
<i>TABLE 23 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	39
<i>TABLE 24 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	40
<i>TABLE 25 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	40
HYDRODESULFURIZATION CATALYSTS	41
<i>TABLE 26 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	41
<i>TABLE 27 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	42
<i>TABLE 28 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	42
ISOMERIZATION CATALYSTS	43
<i>TABLE 29 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	43
<i>TABLE 30 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	43
<i>TABLE 31 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	44
OTHERS	44
<i>TABLE 32 GLOBAL OTHER REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	44
<i>TABLE 33 GLOBAL OTHER REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)</i>	45
<i>TABLE 34 GLOBAL OTHER REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)</i>	45
CHAPTER 6 REFINERY CATALYST MARKET BY REGION	47
NORTH AMERICA	47
<i>TABLE 35 NORTH AMERICAN REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)</i>	47
<i>TABLE 36 NORTH AMERICAN REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)</i>	48
<i>TABLE 37 NORTH AMERICAN REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)</i>	48
<i>TABLE 38 NORTH AMERICAN REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)</i>	48
<i>TABLE 39 NORTH AMERICAN REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)</i>	49
<i>TABLE 40 NORTH AMERICAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)</i>	50
<i>TABLE 41 NORTH AMERICAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)</i>	50
U.S.	51

TOPIC	PAGE NO.
CANADA	51
MEXICO	51
EUROPE	52
TABLE 42 EUROPEAN REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	52
TABLE 43 EUROPEAN REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	52
TABLE 44 EUROPEAN REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	53
TABLE 45 EUROPEAN REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	53
TABLE 46 EUROPEAN REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	53
TABLE 47 EUROPEAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	54
TABLE 48 EUROPEAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	55
RUSSIA	55
ITALY	55
GERMANY	56
REST OF EUROPE	56
ASIA-PACIFIC	57
TABLE 49 ASIA-PACIFIC REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	57
TABLE 50 ASIA-PACIFIC REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	57
TABLE 51 ASIA-PACIFIC REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	58
TABLE 52 ASIA-PACIFIC REFINERY CATALYST MARKET VOLUME BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	58
TABLE 53 ASIA-PACIFIC REFINERY CATALYST MARKET REVENUE BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	58
TABLE 54 ASIA-PACIFIC REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	59
TABLE 55 ASIA-PACIFIC REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	60
CHINA	60
JAPAN	60
INDIA	61
REST OF ASIA-PACIFIC	61
REST OF WORLD (ROW)	61
TABLE 56 ROW REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	62
TABLE 57 ROW REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	62
TABLE 58 ROW REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	62
TABLE 59 ROW REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	63
TABLE 60 ROW REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	63

TOPIC	PAGE NO.
<i>TABLE 61 ROW REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)</i>	64
<i>TABLE 62 ROW REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)</i>	64
SAUDI ARABIA	65
REST OF ROW	65
CHAPTER 7 COMPANY PROFILES	67
ALBEMARLE CORPORATION	67
<i>TABLE 63 ALBEMARLE'S RECENT DEVELOPMENTS, 2014-2015</i>	68
AXENS	68
OVERVIEW	68
<i>TABLE 64 AXENS' CATALYSTS PORTFOLIO</i>	69
<i>TABLE 65 AXENS' RECENT DEVELOPMENTS, 2014-2015</i>	69
BASF CATALYST LLC	70
OVERVIEW	70
<i>TABLE 66 BASF CATALYSTS' (FCC) PRODUCT PORTFOLIO</i>	71
<i>TABLE 67 BASF CATALYSTS' RECENT DEVELOPMENTS, 2014-2015</i>	71
CB & I	72
OVERVIEW	72
<i>TABLE 68 CB & I'S PRODUCT PORTFOLIO</i>	73
<i>TABLE 69 CB & I'S RECENT DEVELOPMENTS, 2014-2015</i>	74
CLARIANT	74
OVERVIEW	74
<i>TABLE 70 CLARIANT'S PRODUCT PORTFOLIO</i>	75
<i>TABLE 71 CLARIANT'S RECENT DEVELOPMENTS, 2014</i>	75
CRITERION	75
OVERVIEW	75
<i>TABLE 72 CRITERION'S PRODUCT PORTFOLIO</i>	76
<i>TABLE 73 CRITERION INTERNATIONAL LTD.'S RECENT DEVELOPMENTS, 2014</i>	76
EVONIK INDUSTRIES AG	77
OVERVIEW	77
<i>TABLE 74 EVONIK'S PRODUCT PORTFOLIO</i>	77
<i>TABLE 75 EVONIK'S RECENT DEVELOPMENTS, 2015-2016</i>	78
EXXONMOBIL CORP	78
OVERVIEW	78
<i>TABLE 76 EXXONMOBIL'S PRODUCT PORTFOLIO</i>	79
<i>TABLE 77 EXXONMOBIL CORP.'S RECENT DEVELOPMENTS, 2014-2015</i>	79
GRACE	80
OVERVIEW	80
<i>TABLE 78 GRACE'S PRODUCT PORTFOLIO</i>	80
<i>TABLE 79 GRACE'S RECENT DEVELOPMENTS, 2013-2015</i>	81
HALDORTOPSOE	81
OVERVIEW	81
<i>TABLE 80 HALDORTOPSOE'S RECENT DEVELOPMENTS, 2015-2016</i>	82
HEADWATERS	82
OVERVIEW	82
HONEYWELL	83

TOPIC	PAGE NO.
OVERVIEW	83
TABLE 81 HONEYWELL'S PRODUCT PORTFOLIO	83
JOHNSON MATTHEY	84
TABLE 82 JOHNSON MATTHEY'S PRODUCT PORTFOLIO	84
TABLE 83 JOHNSON MATTHEY'S RECENT DEVELOPMENTS, 2014	84
LYONDELLBASELL	85
TABLE 84 LYONDELLBASELL'S PRODUCT PORTFOLIO	85
TABLE 85 LYONDELLBASELL'S RECENT DEVELOPMENTS, 2016	85
NIPPON KETJEN	85
TABLE 86 NIPPON KETJEN'S PRODUCT PORTFOLIO	86
POLYNT	86
OVERVIEW	86
TABLE 87 POLYNT'S PRODUCT PORTFOLIO	87
PQ CORP.	87
OVERVIEW	87
TABLE 88 PQ CORP.'S PRODUCT PORTFOLIO	88
SHELL GLOBAL SOLUTIONS	88
TABLE 89 SHELL GLOBAL SOLUTIONS' PRODUCT PORTFOLIO	89
TABLE 90 SHELL GLOBAL SOLUTIONS' RECENT DEVELOPMENTS, 2012-2016	89
SINOPEC CATALYST CO.	90
TABLE 91 SINOPEC'S CATALYST COMPANY PRODUCT PORTFOLIO	90
TABLE 92 SINOPEC'S RECENT DEVELOPMENTS, 2014-2015	91
SUD-CHEMIE AG	92
OVERVIEW	92
TABLE 93 SUD-CHEMIE AG'S PRODUCT PORTFOLIO	92
TABLE 94 SUD-CHEMIE AG'S RECENT DEVELOPMENTS, 2014-2016	93
UNICAT CATALYST TECHNOLOGIES INC.	93
OVERVIEW	93
TABLE 95 UNICAT CATALYST TECHNOLOGIES' PRODUCT PORTFOLIO	93
UOP LLC	94
OVERVIEW	94
TABLE 96 UOP LLC'S PRODUCT PORTFOLIO	94
TABLE 97 UOP LLC'S RECENT DEVELOPMENTS, 2015-2016	94
W R GRACE & CO.	95
OVERVIEW	95
TABLE 98 W R GRACE PRODUCT PORTFOLIO	95
ZEOLYST	96
OVERVIEW	96
TABLE 99 ZEOLYST'S PRODUCT PORTFOLIO	96
CHAPTER 8 PATENT ANALYSIS	98
TABLE 100 U.S. PATENTS, 2010-2016	98
TABLE 101 EUROPEAN PATENTS, 2010-2016	106
TABLE 102 JAPANESE PATENTS, 2016	108

LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE GLOBAL REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	6
TABLE 1 CATALYST TYPE ON THE BASIS OF PROCESS	11
TABLE 2 GLOBAL ZEOLITE CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	25
TABLE 3 GLOBAL ZEOLITE REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	26
TABLE 4 GLOBAL ZEOLITE REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	26
TABLE 5 GLOBAL METAL REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	27
TABLE 6 GLOBAL METAL REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	28
TABLE 7 GLOBAL METAL REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	28
TABLE 8 GLOBAL CHEMICAL REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	29
TABLE 9 GLOBAL CHEMICAL REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	30
TABLE 10 GLOBAL CHEMICAL REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	30
TABLE 11 GLOBAL OTHER CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	31
TABLE 12 GLOBAL OTHER CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	31
TABLE 13 GLOBAL OTHER CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	32
TABLE 14 GLOBAL FCC CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	34
TABLE 15 GLOBAL FCC CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	35
TABLE 16 GLOBAL FCC CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	35
TABLE 17 GLOBAL ALKYLATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	36
TABLE 18 GLOBAL ALKYLATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	36
TABLE 19 GLOBAL ALKYLATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	37
TABLE 20 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	38
TABLE 21 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	38
TABLE 22 GLOBAL HYDROPROCESSING REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	38
TABLE 23 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	39
TABLE 24 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	40
TABLE 25 GLOBAL HYDROGEN MANUFACTURING REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	40

TABLE HEADING	PAGE NO.
TABLE 26 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	41
TABLE 27 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	42
TABLE 28 GLOBAL HYDRODESULFURIZATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	42
TABLE 29 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	43
TABLE 30 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	43
TABLE 31 GLOBAL ISOMERIZATION REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	44
TABLE 32 GLOBAL OTHER REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	44
TABLE 33 GLOBAL OTHER REFINERY CATALYST MARKET VOLUME, BY REGION, THROUGH 2021 (METRIC KILOTONS)	45
TABLE 34 GLOBAL OTHER REFINERY CATALYST MARKET REVENUE, BY REGION, THROUGH 2021 (\$ MILLIONS)	45
TABLE 35 NORTH AMERICAN REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	47
TABLE 36 NORTH AMERICAN REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	48
TABLE 37 NORTH AMERICAN REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	48
TABLE 38 NORTH AMERICAN REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	48
TABLE 39 NORTH AMERICAN REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	49
TABLE 40 NORTH AMERICAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	50
TABLE 41 NORTH AMERICAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	50
TABLE 42 EUROPEAN REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	52
TABLE 43 EUROPEAN REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	52
TABLE 44 EUROPEAN REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	53
TABLE 45 EUROPEAN REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	53
TABLE 46 EUROPEAN REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	53
TABLE 47 EUROPEAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	54
TABLE 48 EUROPEAN REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	55
TABLE 49 ASIA-PACIFIC REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	57
TABLE 50 ASIA-PACIFIC REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	57
TABLE 51 ASIA-PACIFIC REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	58

TABLE HEADING	PAGE NO.
TABLE 52 ASIA-PACIFIC REFINERY CATALYST MARKET VOLUME BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	58
TABLE 53 ASIA-PACIFIC REFINERY CATALYST MARKET REVENUE BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	58
TABLE 54 ASIA-PACIFIC REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	59
TABLE 55 ASIA-PACIFIC REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	60
TABLE 56 ROW REFINERY CATALYST MARKET, BY VOLUME AND REVENUE, THROUGH 2021 (METRIC KILOTONS, \$ MILLIONS)	62
TABLE 57 ROW REFINERY CATALYST MARKET VOLUME, BY COUNTRY, THROUGH 2021 (METRIC KILOTONS)	62
TABLE 58 ROW REFINERY CATALYST MARKET REVENUE, BY COUNTRY, THROUGH 2021 (\$ MILLIONS)	62
TABLE 59 ROW REFINERY CATALYST MARKET VOLUME, BY MATERIAL, THROUGH 2021 (METRIC KILOTONS)	63
TABLE 60 ROW REFINERY CATALYST MARKET REVENUE, BY MATERIAL, THROUGH 2021 (\$ MILLIONS)	63
TABLE 61 ROW REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (METRIC KILOTONS)	64
TABLE 62 ROW REFINERY CATALYST MARKET DEMAND, BY PRODUCT, THROUGH 2021 (\$ MILLIONS)	64
TABLE 63 ALBEMARLE'S RECENT DEVELOPMENTS, 2014-2015	68
TABLE 64 AXENS' CATALYSTS PORTFOLIO	69
TABLE 65 AXENS' RECENT DEVELOPMENTS, 2014-2015	69
TABLE 66 BASF CATALYSTS' (FCC) PRODUCT PORTFOLIO	71
TABLE 67 BASF CATALYSTS' RECENT DEVELOPMENTS, 2014-2015	71
TABLE 68 CB & I'S PRODUCT PORTFOLIO	73
TABLE 69 CB & I'S RECENT DEVELOPMENTS, 2014-2015	74
TABLE 70 CLARIANT'S PRODUCT PORTFOLIO	75
TABLE 71 CLARIANT'S RECENT DEVELOPMENTS, 2014	75
TABLE 72 CRITERION'S PRODUCT PORTFOLIO	76
TABLE 73 CRITERION INTERNATIONAL LTD.'S RECENT DEVELOPMENTS, 2014	76
TABLE 74 EVONIK'S PRODUCT PORTFOLIO	77
TABLE 75 EVONIK'S RECENT DEVELOPMENTS, 2015-2016	78
TABLE 76 EXXONMOBIL'S PRODUCT PORTFOLIO	79
TABLE 77 EXXONMOBIL CORP.'S RECENT DEVELOPMENTS, 2014-2015	79
TABLE 78 GRACE'S PRODUCT PORTFOLIO	80
TABLE 79 GRACE'S RECENT DEVELOPMENTS, 2013-2015	81
TABLE 80 HALDORTOPSOE'S RECENT DEVELOPMENTS, 2015-2016	82
TABLE 81 HONEYWELL'S PRODUCT PORTFOLIO	83
TABLE 82 JOHNSON MATTHEY'S PRODUCT PORTFOLIO	84
TABLE 83 JOHNSON MATTHEY'S RECENT DEVELOPMENTS, 2014	84
TABLE 84 LYONDELLBASELL'S PRODUCT PORTFOLIO	85
TABLE 85 LYONDELLBASELL'S RECENT DEVELOPMENTS, 2016	85
TABLE 86 NIPPON KETJEN'S PRODUCT PORTFOLIO	86
TABLE 87 POLYNT'S PRODUCT PORTFOLIO	87
TABLE 88 PQ CORP.'S PRODUCT PORTFOLIO	88
TABLE 89 SHELL GLOBAL SOLUTIONS' PRODUCT PORTFOLIO	89
TABLE 90 SHELL GLOBAL SOLUTIONS' RECENT DEVELOPMENTS, 2012-2016	89

TABLE HEADING	PAGE NO.
TABLE 91 SINOPEC'S CATALYST COMPANY PRODUCT PORTFOLIO	90
TABLE 92 SINOPEC'S RECENT DEVELOPMENTS, 2014-2015	91
TABLE 93 SUD-CHEMIE AG'S PRODUCT PORTFOLIO	92
TABLE 94 SUD-CHEMIE AG'S RECENT DEVELOPMENTS, 2014-2016	93
TABLE 95 UNICAT CATALYST TECHNOLOGIES' PRODUCT PORTFOLIO	93
TABLE 96 UOP LLC'S PRODUCT PORTFOLIO	94
TABLE 97 UOP LLC'S RECENT DEVELOPMENTS, 2015-2016	94
TABLE 98 W R GRACE PRODUCT PORTFOLIO	95
TABLE 99 ZEOLYST'S PRODUCT PORTFOLIO	96
TABLE 100 U.S. PATENTS, 2010-2016	98
TABLE 101 EUROPEAN PATENTS, 2010-2016	106
TABLE 102 JAPANESE PATENTS, 2016	108

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE GLOBAL REFINERY CATALYST MARKET VOLUME, BY MATERIAL, 2015-2021 (METRIC KILOTONS)	7
FIGURE 1 MARKET CLASSIFICATION	10
FIGURE 2 GLOBAL POLYMERS MARKET REVENUE, 2010-2018 (\$ BILLIONS)	16
FIGURE 3 GLOBAL REFINERY CATALYST MARKET VOLUME, 2010-2018 (MILLION TONS)	17
FIGURE 4 ASIA-PACIFIC CHEMICAL MARKET REVENUE, 2010-2018 (\$ BILLIONS)	20
FIGURE 5 GLOBAL REFINERY CATALYSTS REVENUE MARKET SHARE, BY COMPANY, 2015 (%)	21