

MARKETS AND PROFITABILITY

Market Analytics: Caprolactam - 2020

December 2020



This Report was prepared by Nexant Energy & Chemicals Advisory ("NexantECA"). Except where specifically stated in this Report, the information contained herein is prepared on the basis of information that is publicly available, and contains no confidential third party technical information to the best knowledge and belief of NexantECA. The information has not been independently verified or otherwise examined to determine its accuracy, completeness or financial feasibility. Neither NexantECA, Subscriber nor any person acting on behalf of either shall have any liabilities for any loss or damage arising from or connected to the use of any information contained in this Report. NexantECA does not represent or warrant that any assumed conditions will come to pass.

The Report is for Subscriber's internal use only and shall be kept strictly confidential. The Report should not be otherwise reproduced, distributed or used without first obtaining prior written consent by NexantECA. Each Subscriber agrees to use reasonable effort to protect the confidential nature of the Report.

Copyright © by Nexant Inc. 2020. All rights reserved.



Contents

1	Executive Summary	1
1.1	Introduction	1
1.2	Caprolactam.....	3
2	The Caprolactam Industry	6
2.1	Introduction	6
2.2	Caprolactam End-Uses.....	7
2.2.1	Nylon Resins and Compounds	7
2.2.1.1	Resins Properties	7
2.2.1.2	Physical Properties.....	10
2.2.1.3	Mechanical Properties	11
2.2.1.4	Chemical Properties	12
2.2.1.5	Recycling	13
2.2.1.6	Storage	14
2.2.2	Additives and Fillers.....	14
2.2.2.1	Lubricants and Mould Release.....	16
2.2.2.2	Nucleants	16
2.2.2.3	Stabilizers.....	16
2.2.2.4	Impact Modifiers	16
2.2.2.5	Flame Retardants	16
2.2.2.6	Plasticizers	17
2.2.2.7	Fillers and Reinforcement	17
2.2.2.8	Nanocomposites.....	18
2.2.2.9	Conductive Polyamides	18
2.2.2.10	Polymer Blends or Alloys.....	18
2.2.2.11	Copolymers	19
2.2.3	Compounding	19
2.2.4	Fabrication Methods.....	20
2.2.5	Injection Moulding	21
2.2.6	Extrusion	21
2.2.7	Blow Moulding	22
2.2.8	Rotomoulding.....	23
2.2.9	Reaction Injection Moulding (RIM).....	23
2.2.9.1	Assembly Techniques.....	23
2.2.10	Nylon Major Markets	23
2.2.10.1	Automotive	25
2.2.10.2	Exterior.....	26
2.2.10.3	Electronics and Electrical.....	26
2.2.10.4	Consumer.....	27
2.2.10.5	Industrial	27
2.2.10.6	Alloys	27
2.2.10.7	Other Applications	28



	2.2.11	New Developments in Nylon 6 and 6,6 Products	28
2.3		Market Coverage.....	29
3		Caprolactam.....	30
3.1		Global	30
	3.1.1	Key Developments.....	30
	3.1.2	Consumption.....	30
	3.1.3	Supply	33
	3.1.4	Supply, Demand and Trade.....	35
3.2		North America	37
	3.2.1	Key Developments.....	37
	3.2.2	Consumption.....	37
	3.2.3	Supply	38
	3.2.4	Supply, Demand and Trade.....	40
3.3		South America.....	42
	3.3.1	Key Developments.....	42
	3.3.2	Consumption.....	42
	3.3.3	Supply	43
	3.3.4	Supply, Demand and Trade.....	43
3.4		Western Europe	44
	3.4.1	Key Developments.....	44
	3.4.2	Consumption.....	44
	3.4.3	Supply	45
	3.4.4	Supply, Demand and Trade.....	48
3.5		Central Europe	49
	3.5.1	Key Developments.....	49
	3.5.2	Consumption.....	49
	3.5.3	Supply	50
	3.5.4	Supply, Demand and Trade.....	51
3.6		Eastern Europe	52
	3.6.1	Key Developments.....	52
	3.6.2	Consumption.....	52
	3.6.2.1	Russia.....	52
	3.6.2.2	Other Eastern Europe.....	53
	3.6.3	Supply	53
	3.6.3.1	Russia.....	53
	3.6.3.2	Other Eastern Europe.....	54
	3.6.4	Supply, Demand and Trade.....	56
	3.6.4.1	Russia.....	56
	3.6.4.2	Other Eastern Europe.....	57
3.7		Middle East	59
	3.7.1	Key Developments.....	59
	3.7.2	Consumption.....	59
	3.7.3	Supply	59
	3.7.4	Supply, Demand and Trade.....	60



3.8	Africa.....	61
3.8.1	Key Developments.....	61
3.8.2	Consumption.....	61
3.8.3	Supply	61
3.8.4	Supply, Demand and Trade.....	62
3.9	Asia Pacific.....	63
3.9.1	Key Developments.....	63
3.9.2	Consumption.....	63
3.9.2.1	China	63
3.9.2.2	North-East Asia	64
3.9.2.3	South-East Asia.....	64
3.9.2.4	South Asia.....	64
3.9.2.5	Australasia	65
3.9.3	Supply	66
3.9.3.1	China	66
3.9.3.2	North-East Asia	67
3.9.3.3	South-East Asia.....	67
3.9.3.4	South Asia.....	67
3.9.3.5	Australasia	67
3.9.4	Supply, Demand and Trade.....	72
3.9.4.1	China	72
3.9.4.2	North-East Asia	72
3.9.4.3	South-East Asia.....	73
3.9.4.4	South Asia.....	73
3.9.4.5	Australasia	73
Appendices		
A	Methodology	76
A.1	Market Dynamics Forecasting Methodology.....	76
A.1.1	Capacity Availability and Forecasting	76
A.1.2	End-Use Consumption Forecasting.....	76
A.1.2.1	End-Use Sector Growth.....	77
A.1.2.2	Penetration (New Application Growth)	77
A.1.2.3	Short-term Influences	78
A.1.3	Monomer Consumption Forecasting.....	78
A.1.4	Production and Trade Forecasting	79
B	The Caprolactam Industry	80
B.1	Technology.....	80
B.2	Developing Technologies	81



Figures

Figure 1	Caprolactam and 6-Aminocaproic Acid	6
Figure 2	Polyamide 6.....	6
Figure 3	Modifications in Polyamides Properties to Fill Market Needs	15
Figure 4	Global GDP Growth vs. Caprolactam Consumption Growth	31
Figure 5	Global Caprolactam Consumption.....	32
Figure 6	Global Caprolactam Capacity Share by Marketer in 2020.....	33
Figure 7	Global Caprolactam Capacity Additions	34
Figure 8	Global Caprolactam Capacity	34
Figure 9	Global Caprolactam Supply and Demand.....	35
Figure 10	Regional Caprolactam Net Exports/Imports.....	36
Figure 11	Location of Caprolactam Plants in North America.....	39
Figure 12	North America Caprolactam Supply, Demand and Trade	40
Figure 13	United States Caprolactam Supply, Demand and Trade.....	41
Figure 14	South America Caprolactam Supply, Demand and Trade.....	43
Figure 15	Location of Caprolactam Plants in Western Europe.....	47
Figure 16	Western Europe Caprolactam Supply, Demand and Trade.....	48
Figure 17	Location of Caprolactam Plants in Central Europe	50
Figure 18	Central Europe Caprolactam Supply, Demand and Trade	51
Figure 19	Location of Caprolactam Plants in Russia	54
Figure 20	Location of Caprolactam Plants in Other Eastern Europe	55
Figure 21	Russia Caprolactam Supply, Demand and Trade.....	56
Figure 22	Other Eastern Europe Caprolactam Supply, Demand and Trade.....	57
Figure 23	Total Eastern Europe Caprolactam Supply, Demand and Trade.....	58
Figure 24	Middle East Caprolactam Supply, Demand and Trade	60
Figure 25	Africa Caprolactam Supply, Demand and Trade.....	62
Figure 26	Location of Caprolactam Plants in China.....	69
Figure 27	Location of Caprolactam Plants in North-East Asia	70
Figure 28	Location of Caprolactam Plants in India	71
Figure 29	Asia Pacific Caprolactam Supply, Demand and Trade.....	74
Figure 30	China Caprolactam Supply, Demand and Trade	75
Figure 31	End-Use Consumption Drivers.....	77
Figure 32	Monomer Consumption Drivers	78
Figure 33	Trade Considerations	79
Figure 34	Summary of Caprolactam Production Chemistry from Aromatics.....	80



Tables

Table 1	Nylon 6 Strengths and Weaknesses	8
Table 2	Nylon 6,6 Strengths and Weaknesses.....	8
Table 3	Typical Properties of Nylon 6 and Nylon 6,6 ⁰	9
Table 4	Typical Grades of Nylon 6 and Nylon 6,6	15
Table 5	Selected Properties of Dry, Filled/Reinforced Nylon 6,6 ⁰	17
Table 6	Properties of Nanocomposite Nylon 6, High Cycle Nylon 6 and 35 % Mineral Reinforced Nylon 6	18
Table 7	Strengths and Weaknesses of Nylon/Polymer Blends	19
Table 8	Major Applications for Nylon 6 by Fabrication Process	21
Table 9	Typical Temperatures (°C) for Nylon Extrusion.....	22
Table 10	Nylon 6 and Nylon 6,6 End-Use by Major Market	24
Table 11	Market Requirements of Nylon 6 and Nylon 6,6	25
Table 12	Nylon Alloys (Representative List).....	27
Table 13	Global Caprolactam Consumption by Derivative	31
Table 14	Global Caprolactam Consumption by Region	32
Table 15	Global Caprolactam Supply and Demand.....	35
Table 16	North America Caprolactam Consumption	38
Table 17	North America Caprolactam Consumption by Country.....	38
Table 18	Caprolactam Capacity in North America.....	39
Table 19	North America Caprolactam Supply, Demand and Trade	40
Table 20	United States Caprolactam Supply, Demand and Trade.....	41
Table 21	South America Caprolactam Consumption.....	42
Table 22	South America Caprolactam Consumption by Country	42
Table 23	South America Caprolactam Supply, Demand and Trade.....	43
Table 24	Western Europe Caprolactam Consumption	45
Table 25	Caprolactam Capacity in Western Europe.....	46
Table 26	Western Europe Caprolactam Supply, Demand and Trade.....	48
Table 27	Central Europe Caprolactam Consumption	49
Table 28	Caprolactam Capacity in Central Europe	50
Table 29	Central Europe Caprolactam Supply, Demand and Trade	51
Table 30	Russia Caprolactam Consumption	52
Table 31	Other Eastern Europe Caprolactam Consumption.....	53
Table 32	Caprolactam Capacity in Russia	53
Table 33	Caprolactam Capacity in Other Eastern Europe	54
Table 34	Russia Caprolactam Supply, Demand and Trade	56
Table 35	Other Eastern Europe Caprolactam Supply, Demand and Trade.....	57
Table 36	Total Eastern Europe Caprolactam Supply, Demand and Trade.....	58
Table 37	Middle East Caprolactam Consumption	59
Table 38	Middle East Caprolactam Consumption by Country.....	59
Table 39	Middle East Caprolactam Supply, Demand and Trade	60
Table 40	Africa Caprolactam Consumption.....	61
Table 41	Africa Caprolactam Consumption by Country	61
Table 42	Africa Caprolactam Supply, Demand and Trade.....	62



Table 43	Asia Pacific Caprolactam Consumption.....	66
Table 44	Asia Pacific Caprolactam Consumption by Country.....	66
Table 45	Caprolactam Capacity in Asia Pacific.....	68
Table 46	Asia Pacific Caprolactam Supply, Demand and Trade.....	74
Table 47	China Caprolactam Supply, Demand and Trade	75