

ACRYLIC FIBER

Table of Contents

A Report by Nexant's CHEMSYSTEMS
Process Evaluation/Research Planning (PERP) Program
PERP 09/10S7 - Published December 2011

www.chemsystems.com

Section	Page
1 Executive Summary	1
1.1 BUSINESS CONSIDERATIONS	1
1.2 CHARACTERISTIC PROPERTIES	2
1.3 TECHNOLOGY	2
1.3.1 Polymerization	2
1.3.2 Spinning	3
1.3.3 Treatment	3
1.4 LICENSING STATUS	4
1.5 LITERATURE REVIEW (TECHNOLOGY DEVELOPMENTS).....	5
1.6 PROCESS ECONOMICS.....	5
1.7 COMMERCIAL MARKET REVIEW	6
1.7.1 Global Demand	6
1.7.2 Global Supply	7
1.7.3 Global Trade	8
2 Introduction.....	10
2.1 COMONOMERS	10
2.2 BUSINESS CONSIDERATIONS	11
2.3 LICENSING STATUS	11
2.4 CHARACTERISTIC PROPERTIES.....	13
3 Commercial Technologies	15
3.1 POLYMERIZATION PROCESSES	15
3.1.1 Solution Polymerization.....	16
3.1.2 Suspension Process	21
3.2 SPINNING PROCESSES	25

3.2.1	Dope Solution	25
3.2.2	Solvent Selection	25
3.2.3	Dry Spinning.....	27
3.2.4	Wet Spinning	27
3.2.5	Air Gap Spinning	28
3.3	FURTHER TREATMENTS	31
3.3.1	Washing	31
3.3.2	Stretching	31
3.3.3	Finishing	31
3.3.4	Drying	31
3.3.5	Crimping	32
3.3.6	Baling.....	32
3.3.7	Staple.....	32
4	Literature Review (Technology Developments)	33
4.1	“GREEN” TECHNOLOGY	34
4.1.1	Melt Spinning.....	34
4.1.2	Bio-Processes.....	40
4.1.3	Pre-Dyed Fibers	40
4.1.4	Biodegradable Acrylic Fibers	41
4.2	HIGH STRENGTH HIGH MODULUS FIBERS	42
4.3	CARBON FIBERS	44
4.4	CONDUCTIVE ACRYLIC FIBERS	46
4.5	ABSORBENT ACRYLIC FIBERS.....	47
4.6	DEVELOPMENTS IN OTHER APPLICATIONS.....	48
5	Process Economics	50
5.1	COSTING BASIS	50
5.1.1	Investment Basis	50
5.1.2	Pricing Basis	50
5.1.3	Cost of Production Basis.....	51
5.2	SOLUTION POLYMERIZATION WITH WET SPINNING	52
5.3	SUSPENSION POLYMERIZATION WITH WET SPINNING	56
5.4	SUMMARY OF PROCESS ECONOMICS	60
5.5	SENSITIVITY ANALYSIS	63
5.5.1	Acrylonitrile Prices	63

5.5.2	Plant Capacity	64
6	Commercial Applications	65
7	Commercial Market Analysis	67
7.1	GLOBAL DEMAND	67
7.2	GLOBAL SUPPLY	70
7.3	GLOBAL TRADE	73
7.4	GLOBAL SUPPLY/DEMAND AND TRADE BALANCE	74
7.5	CHINA REGIONAL FOCUS.....	75
7.6	MIDDLE EAST REGIONAL FOCUS.....	77
7.7	WESTERN EUROPE REGIONAL FOCUS.....	78
7.8	NORTH AMERICA REGIONAL FOCUS	80
8	Glossary	81
9	References	86

Appendix	Page
A Capital Cost Terms Used in Process Economics Section	A-1
B Operating Cost Terms Used in Process Economics Section.....	B-1
C PERP Program Title Index (2000/2001 - 2009/2010).....	C-1

Figure	Page
1.1 Global Acrylic Fiber Net Trade Pattern.....	9
3.1 Solution Polymerization Process	20
3.2 Suspension (Aqueous Dispersion) Polymerization Process	24
3.3 Dry Spinning Process.....	29
3.4 Wet Spinning Organic Solvent Process	30
4.1 Spinning Process Flow Schemes Compared.....	35
4.2 BASF Process for Melt-Spun Acrylic Fibers.....	37
4.3 Hatschek Machine Schematic	43
4.4 Schematic Representation of a Spinneret designed for Sheath and Core Fibers	47
5.1 Sensitivity of Acrylic Fiber Cash Cost to Acrylonitrile Prices.....	63
5.2 Sensitivity of Acrylic Fiber Cash Cost to Plant Scale	64
6.1 Global Acrylic Fiber End-Uses, 2010.....	66
7.1 Acrylic Fiber Consumption by Region, 2010	68
7.2 Acrylic Fiber Consumption by Region	68
7.3 Acrylic Fiber Main Players	70
7.4 Acrylic Fiber Supply by Region	71
7.5 Acrylic Fiber Capacity Additions	72
7.6 Global Acrylic Fiber Net Trade Pattern.....	73
7.7 Global Acrylic Fiber Supply/Demand Analysis	74
7.8 Acrylic Fiber Supply/Demand Analysis - China	75
7.9 Acrylic Fiber Supply/Demand Analysis – Middle East.....	77
7.10 Acrylic Fiber Supply/Demand Analysis – Western Europe	78
7.11 Acrylic Fiber Supply/Demand Analysis – North America	80

Table	Page
1.1 Licensors and Major Producers	4
1.2 Summary of Process Economics.....	6
1.3 Global Acrylic Fiber Demand by Region	7
1.4 Global Acrylic Fiber Supply by Region	8
2.1 Licensors and Major Producers	12
2.2 Comparison of Properties of Selected Commercial Staple Fibers.....	14
3.1 Solvents.....	26
5.1 Cost of Production Estimate for: Acrylic Fiber Process: Solution Polymerization with Wet Spinning, China Basis.....	54
5.2 Cost of Production Estimate for: Acrylic Fiber Process: Solution Polymerization with Wet Spinning, West European Basis.....	55
5.3 Cost of Production Estimate for: Acrylic Fiber Process: Suspension Polymerization with Wet Spinning, China Basis	58
5.4 Cost of Production Estimate for: Acrylic Fiber Process: Suspension Polymerization with Wet Spinning, West European Basis	59
5.5 Summary of Process Economics.....	60
5.6 Comparison of Polymerization Processes.....	61
5.7 Comparison of Continuous versus Batch Polymerization Processes.....	61
5.8 Comparison of Spinning Processes.....	62
7.1 Global Acrylic Fiber Demand by Region	69
7.2 Global Acrylic Fiber Supply by Region	71
7.3 Acrylic Fibers Supply, Demand, and Trade – China	76
7.4 China Acrylic Fibers Capacity, 2010.....	76
7.5 Acrylic Fibers Supply, Demand, and Trade – Middle East	77
7.6 Middle East Acrylic Fibers Capacity, 2010.....	77
7.7 Acrylic Fibers Supply, Demand, and Trade – Western Europe.....	79
7.8 Western Europe Acrylic Fibers Capacity, 2010	79
7.9 Acrylic Fibers Supply, Demand and Trade – North America	80
7.10 North America Acrylic Fibers Capacity, 2010	80

CHEMSYSTEMS

PERP PROGRAM



www.chemsystems.com

The ChemSystems Process Evaluation/Research Planning (PERP) program is recognized globally as the industry standard source for information relevant to the chemical process and refining industries. PERP reports are available as a subscription program or on a single report basis.

Contact Details:

London: Dr. Alexander Coker, Manager, PERP Program
Phone: + 44-(20)-7950-1570, e-mail: acoker@nexant.com

New York: Heidi Junker Coleman, Multi-Client Programs Administrator
Phone: + 1-914-609-0381, e-mail: hcoleman@nexant.com

Shanghai: Dr. Y. Larry Song, General Manager, Nexant China
Phone: +86 21 6182 6791, e-mail: ylsong@nexant.com

Nexant, Inc. (www.nexant.com) is a leading management consultancy to the global energy, chemical, and related industries. For over 38 years, ChemSystems has helped clients increase business value through assistance in all aspects of business strategy, including business intelligence, project feasibility and implementation, operational improvement, portfolio planning, and growth through M&A activities. Nexant has its main offices in San Francisco (California), White Plains (New York), and London (UK), and satellite offices worldwide.

Copyright © by Nexant Inc. 2011. All Rights Reserved.