

POLYOXYMETHYLENE (POLYACETAL)

Table of Contents

A Report by Nexant's CHEMSYSTEMS
Process Evaluation/Research Planning (PERP) Program
PERP 2011S1 - Published November 2011

www.chemsystems.com

Section	Page
1 Summary	1
1.1 OVERVIEW OF THE ENGINEERING THERMOPLASTICS INDUSTRY	3
1.2 TRENDS IN POLYACETAL TECHNOLOGY	5
1.3 INVESTMENT	7
1.4 COST OF PRODUCTION ECONOMICS	8
1.5 COMMERCIAL MARKET REVIEW	10
1.5.1 Global Demand	11
1.5.2 Global Supply	12

2	Introduction	14
2.1	OVERVIEW OF POLYACETAL	14
2.2	OVERVIEW OF THE ENGINEERING THERMOPLASTICS INDUSTRY	22
3	Technology	29
3.1	CHEMISTRY	29
3.1.1	General	29
3.1.2	Homopolymer	30
3.1.3	Copolymer	32
3.2	PROCESS DESIGN	33
3.2.1	Homopolymer	33
3.2.2	Copolymer	39
3.2.3	Solution Copolymer Process	43
3.2.4	Product Finishing	47
3.2.5	Simplified Bulk Copolymer Process	47
4	Process Economics	52
4.1	BASIS	52
4.2	INVESTMENT	53
4.3	ECONOMICS	55
4.4	RAW MATERIAL SENSITIVITY	74
5	Commercial Applications	77
5.1	TRANSPORTATION	77
5.2	ELECTRICAL/ELECTRONICS	79
5.3	INDUSTRIAL/MACHINERY	79
5.4	CONSUMER	80
5.5	APPLIANCES	80
5.6	ALL OTHER	81
6	Market Analysis	82
6.1	REGIONAL DEMAND ANALYSIS	82
6.1.1	North America	82
6.1.2	Western Europe	84
6.1.3	China	86
6.1.4	Rest of World (ROW)	88
6.1.5	Global Summary	90

6.2	GLOBAL SUPPLY	92
7	Glossary	94
8	References	96

Appendix	Page
A Capital Cost Elements	A-1
B Operating Cost Elements	B-1
C PERP Program Title Index (2001 - 2011)	C-1

Figure	Page
1.1 Summary Comparison of Polyacetal Production Processes and Locations	9
1.2 Polyacetal Demand by Region, 2005-2015	11
1.3 Global Polyacetal Demand by End-Use, 2010	12
2.1 Strength/Weaknesses of Polyacetal	17
2.2 Properties of Polyacetal	18
2.3 Polyacetal's Properties can be Changed/Enhanced to Better Meet Market Needs.....	19
2.4 A Few Acetal Blends are Commercially Available	21
2.5 Engineering Thermoplastics Price/Performance Matrix.....	23
2.6 Competition Among the Engineering Thermoplastics	24
2.7 Comparison of Heat Deflection Temperatures HDT/A (1.8 MPa) of Engineering and High-Performance Plastics	25
2.8 Properties of Composite Material	27
3.1 Polyacetal Homopolymer Formaldehyde Purification.....	35
3.2 Polyacetal Homopolymer Polymerization Process	36
3.3 Polyacetal Homopolymer Stabilization Process	37
3.4 Plant for Finishing Polyacetal	40
3.5 Production and Purification Trioxane.....	42
3.6 Production of Dioxolane	44
3.7 Polyacetal Copolymer Wet End Process.....	45
3.8 Bulk Polyacetal Copolymer Polymerization Process	48
3.9 Simplified Polyacetal Copolymer Polymerization Process	49
4.1 USGC Cost Comparison of Polyacetal Processes	57
4.2 Coastal China Cost Comparison of Polyacetal Processes.....	57
4.3 Inland China Cost Comparison of Polyacetal Processes	58
4.4 Summary Comparison of Polyacetal Production Processes and Locations	74
4.5 Effect of Methanol Cost on USGC Homopolymer Polyacetal Resin Economics.....	75
4.6 Effect of Methanol Cost on USGC Copolymer Polyacetal Resin Economics.....	76
6.1 North American Polyacetal Demand by End-Use, 2020	83
6.2 West European Polyacetal Demand by End-Use, 2010.....	85
6.3 China Polyacetal Demand Summary	87
6.4 Rest of World Polyacetal Demand by End-Use, 2010.....	89
6.5 Polyacetal Demand by Region, 2005-2015	90
6.6 Global Polyacetal Demand by End-Use, 2010	91

Table	Page
1.1 Selected Polyacetal Grades	2
1.2 USGC Polyacetal Production Capital Cost Estimates	7
1.3 Coastal China Polyacetal Production Capital Cost Estimates	8
1.4 Inland China Polyacetal Production Capital Cost Estimates	8
1.5 Typical Acetal Resin Use.....	10
1.6 Global Polyacetal Demand Summary	11
1.7 Global Polyacetal Capacity, 1Q 2011	13
2.1 Physical Properties of Acetal Resins	15
2.2 Selected Polyacetal Grades	20
2.3 Application of General Purpose Polyacetal Grades.....	20
2.4 Effect of Glass Fibers on Acetal Properties	21
2.5 Performance Factors (Neat Resin) of Interpolymer Competition.....	26
2.6 Properties of Selected Glass Filled Engineering Thermoplastics	28
4.1 USGC Polyacetal Production Capital Cost Estimates	54
4.2 Coastal China Polyacetal Production Capital Cost Estimates	54
4.3 Inland China Polyacetal Production Capital Cost Estimates	54
4.4 USGC Cost Comparison of Polyacetal Polymerization Processes	55
4.5 Coastal China Cost Comparison of Polyacetal Polymerization Processes	56
4.6 Inland China Cost Comparison of Polyacetal Polymerization Processes	56
4.7 Cost of Production estimate for: Formaldehyde (37 weight percent) Process: Mo/Fe Oxide Catalyst Capacity is 216 kta 37% Basis or 80 kta 100% Basis.....	59
4.8 Cost of Production Estimate for: Polyacetal Homopolymer Process: DuPont (Includes Finishing).....	60
4.9 Cost of Production Estimate for: Polyacetal Copolymer Process: Solution (Includes Trioxane and Dioxolane Units and Finishing)	61
4.10 Cost of Production Estimate for: Polyacetal Copolymer Process: Bulk (Includes Trioxane and Dioxolane Units and Finishing)	62
4.11 Cost of Production Estimate for: Polyacetal Copolymers Process: Simplified Bulk Process (Includes Trioxane and Dioxolane Units and Finishing)	63
4.12 Cost of Production Estimate for: Formaldehyde (37 weight percent) Process: Mo/Fe Oxide Catalyst Capacity is 216 kta 37% Basis or 80 kta 100% Basis.....	64
4.13 Cost of Production Estimate for: Polyacetal Homopolymer Process: DuPont (Includes Finishing).....	65
4.14 Cost of Production Estimate for: Polyacetal Copolymer Process: Solution (Includes Trioxane and Dioxolane Units and Finishing)	66
4.15 Cost of Production Estimate for: Polyacetal Copolymer Process: Bulk (Includes Trioxane and Dioxolane Units and Finishing)	67

4.16 Cost of Production Estimate for: Polyacetal Copolymers Process: Simplified Bulk Process (Includes Trioxane and Dioxolane Units and Finishing)	68
4.17 Cost of Production Estimate for: Formaldehyde (37 Weight Percent) Process: MO/Fe Oxide Catalyst Capacity is 216 kta 37% Basis or 80 kta 100% Basis.....	69
4.18 Cost of Production Estimate for: Polyacetal Homopolymer Process: DuPont (Includes Finishing).....	70
4.19 Cost of Production Estimate for: Polyacetal Copolymers Process: Solution (Includes Trioxane and Dioxolane Units and Finishing).....	71
4.20 Cost of Production Estimate for: Polyacetal Copolymer Process: Bulk (Includes Trioxane and Dioxolane Units and Finishing	72
4.21 Cost of Production Estimate for: Polyacetal Copolymer Process: Simplified Bulk Process (Includes Trioxane and Dioxolane Units and Finishing	73
5.1 Typical Acetal Resin Use.....	78
5.2 Transportation Applications for Polyacetal	79
6.1 North American Polyacetal Demand Summary.....	82
6.2 West European Polyacetal Demand Summary	84
6.3 China Polyacetal Demand Summary	86
6.4 Rest of World Polyacetal Demand Summary	88
6.5 Global Polyacetal Demand Summary	90
6.6 Global Polyacetal Capacity, 1Q 2011	93

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.