Metallocene & Single-Site Polymers


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# Table of Contents

## EXECUTIVE SUMMARY

## MARKET ENVIRONMENT
- General ........................................ 4
- Macroeconomic Outlook ................... 4
- Consumer Income & Spending .......... 8
- Demographic Trends ....................... 10
- Manufacturing Outlook .................... 13
- Packaging Overview ....................... 16
- Construction Outlook ...................... 19
- Motor Vehicle Outlook ..................... 23
- Plastic Resin Overview .................... 25
- Rubber Overview ............................. 26
- Thermoplastic Elastomers
  - Overview .................................... 29
  - Polyolefin Outlook ....................... 30
  - Thermoplastic Polyolefins ............... 32
  - Polyolefin-Based Elastomers ............. 35
- Pricing Trends ................................ 38
- International Activity & Foreign Trade 39

## TECHNOLOGY OVERVIEW
- General ........................................ 42
- Product Developments ..................... 43
- Cooperative Agreements .................. 44
- Technology Ventures ...................... 46
- Licensing .................................... 47
- Catalyst Demand ............................ 49
- Growth Factors ............................. 50
- Suppliers .................................... 52

## APPLICATIONS & MARKETS
- General ........................................ 54
- Applications ................................ 55
- Film & Sheet ................................ 58
- Injection & Blow Molding ............... 60
- Elastomers ................................. 62
- Other ......................................... 64
- Markets ...................................... 66
- Packaging .................................... 69
- Consumer Goods & Durable Equipment 72
- Motor Vehicles ............................. 74
- Other ......................................... 77

## METALLOCENE & SINGLE-SITE THERMOPLASTICS
- General ........................................ 81
- Metallocene & Single-Site
  - Thermoplastics ............................ 82
  - Applications .............................. 84
  - Markets ................................... 87
- Metallocene & Single-Site LLDPE ......... 89
  - Applications .............................. 91
  - Markets ................................... 93
  - Suppliers .................................. 95
- Metallocene & Single-Site HDPE ........... 97
  - Applications .............................. 99
  - Markets ................................... 102
  - Suppliers .................................. 103
- Metallocene & Single-Site Polypropylene 103
  - Applications .............................. 105
  - Markets ................................... 109
  - Suppliers .................................. 111

## METALLOCENE & SINGLE-SITE ELASTOMERS & PLASTOMERS
- General ........................................ 113
- Applications ................................ 114
- Markets ...................................... 116
- Metallocene & Single-Site EPDM ........... 117
  - Markets ................................... 119
  - Suppliers .................................. 122
- Metallocene TPEs & Plastomers .......... 124
  - Applications .............................. 126
- Markets & Suppliers ...................... 129
- Other Metallocene & Single-Site Polymers 131

## INDUSTRY STRUCTURE
- General ........................................ 135

## COMPANY PROFILES
- Ashland Incorporated ....................... 150
- Atlantis Plastics ............................ 151
- Basell AF SCA ............................... 152
- Blueridge Films ............................. 154
- Borealis GmbH ............................... 155
- BP plc ......................................... 157
- Chemtura Corporation ..................... 158
- Chevron Phillips Chemical ............... 159
- Clariant International ..................... 160
- Dow Chemical ............................... 162
- DuPont (EI) de Nemours ................. 164
- Eastman Chemical ......................... 167
- Exxon Mobil .................................. 168
- INEOS ......................................... 170
- LANXESS AG ................................. 172
- Lyondell Chemical ......................... 174
- Mitsui Chemicals ........................... 176
- NOVA Chemicals ............................ 178
- Pinnacle Films .............................. 180
- Pliant Corporation ......................... 181
- PolyOne Corporation ....................... 182
- Roplast Industries ......................... 183
- Schulman (A.) Incorporated .............. 184
- Symyx Technologies ....................... 185
- TOPAS Advanced Polymers ............... 186
- Total SA ...................................... 187
- Univation Technologies ................... 189
- Westlake Chemical ......................... 190
List of Tables/Charts

EXECUTIVE SUMMARY
1 Summary Table .................................. 3

MARKET ENVIRONMENT
1 Macroeconomic Indicators ......................... 8
2 Personal Consumption Expenditures .............. 10
3 Resident Population by Age Group ................ 13
4 Manufacturers’ Shipments ........................ 15
5 Packaging Shipments ...............................19
6 Construction Expenditures ....................... 22
7 Motor Vehicle Indicators ..........................24
8 Plastic Supply & Demand ......................... 26
9 Rubber Demand by Use & Type ................... 28
10 Thermoplastic Elastomer
   Demand by Type .................................. 30
11 Polyolefin Demand by Type ....................... 31
12 Thermoplastic Polyolefin
   Demand by Type ..................................34
13 Polyolefin-Based Elastomer
   Demand by Type .................................. 37
14 Pricing Trends ..................................... 39
15 World Metallocene & Single-Site
   Polymer Demand, 2006 ........................... 41

TECHNOLOGY OVERVIEW
1 Selected Cooperative Agreements ................. 45
2 Metallocene & Single-Site
   Catalyst Demand ..................................50

APPLICATIONS & MARKETS
1 Metallocene & Single-Site Polymer
   Demand by Type .................................. 55
2 Metallocene & Single-Site Polymer
   Demand by Application ............................ 57
16 Metallocene & Single-Site Polymer
   Demand by Application, 2006 .................... 57
3 Film & Sheet Applications for
   Metallocene & Single-Site Polymers ............ 60
4 Injection & Blow Molding
   Applications for Metallocene &
   Single-Site Polymers ............................. 62
5 Elastomer Applications for Metallocene &
   Single-Site Polymers ............................. 64
6 Other Applications for Metallocene &
   Single-Site Polymers ............................. 66
7 Metallocene & Single-Site
   Polymer Demand by Market ..................... 68
17 Metallocene & Single-Site Polymer
   Demand by Market, 2006 ......................... 68
8 Packaging Markets for Metallocene &
   Single-Site Polymers ............................. 71
9 Consumer Goods & Durable Equipment
   Markets for Metallocene &
   Single-Site Polymers ............................. 74
10 Motor Vehicle Market for
   Metallocene & Single-Site Polymers ...... 77
11 Other Markets for Metallocene &
   Single-Site Polymers ............................. 80

METALLOCENE & SINGLE-SITE THERMOPLASTICS
1 Metallocene & Single-Site
   Thermoplastic Demand by Type ............... 83
2 Metallocene & Single-Site
   Thermoplastic Demand by Application ........ 86
12 Metallocene & Single-Site Polymers
   Demand by Market, 2006 ......................... 108
8 Metallocene & Single-Site HDPE
   Demand by Application .......................... 108
13 Metallocene & Single-Site EPDM
   Rubber Demand, Volume & Value .......... 110
14 Metallocene & Single-Site TPE &
   Plastomer Demand ............................... 126
15 Metallocene & Single-Site HDPE
   Rubber Demand by Market ..................... 126
16 Metallocene & Single-Site TPE &
   Plastomer Demand by Application .......... 128
17 Metallocene & Single-Site TPE &
   Plastomer Demand by Market ............... 130
18 Metallocene & Single-Site TPE &
   Plastomer Demand by Market ............... 134

INDUSTRY STRUCTURE
1 US Suppliers of Metallocene &
   Single-Site Polymers, 2006 .................... 137
2 Selected Acquisitions & Divestitures .. 142
Enhanced puncture resistance, improved sealing abilities, higher clarity and other advantages make mLLDPE well suited for use in stretch film, trash bags, heavy-duty sacks and flexible food packaging.

US demand to grow 17.7% annually through 2010

US demand for metallocene and single-site polymers is forecast to grow nearly 18 percent yearly to 5.2 billion pounds in 2011, valued at $5.8 billion. Advances will be stimulated by continued cost and performance optimization of metallocene catalysts and materials, and growing economies of scale. Further increases will be threatened by higher costs compared to conventional materials, and competition from improved Ziegler-Natta catalyst systems. Film and sheet is the leading application due to the importance of mLLDPE in packaging uses. Prices will moderate following the rapid increases in crude petroleum and natural gas feedstock costs from 2004 to 2006.

mLLDPE to stay dominant, mHDPE & polypropylene to see fastest gains

Metallocene linear low density polyethylene (mLLDPE) will remain the dominant type, and is projected to expand more than 15 percent annually to three billion pounds in 2011. Stimulants include processing and performance advantages over conventional thermoplastics, such as enhanced puncture and impact resistance, improved sealing capabilities, higher clarity and gloss, and easy blending with other polyolefins. These capabilities make mLLDPE ideally suited for the production of stretch film, trash bags, heavy-duty sacks and flexible food packaging. Metallocene HDPE (mHDPE) demand will increase at a more rapid pace, reflecting an expanded range of product offerings, as well as performance advantages over other materials, such as flexibility, high gloss, and impact and stress crack resistance. Applications are heavily concentrated in the packaging industry, particularly for food and cosmetic/toiletry bottles. Polypropylene will also experience more rapid advancements, stimulated by metallocene’s ability to control polypropylene’s tacticity and comonomer distribution, with particular opportunities anticipated in areas such as injection molding, and fibers and nonwovens.

Demand for metallocene elastomers and plastomers will increase 18 percent per annum to 800 million pounds in 2011. Elastomers include ethylene-propylene-diene-monomer (EPDM) and thermoplastic elastomers (TPEs). These materials perform like thermsot rubber but have the processing ease of thermoplastics. Motor vehicles are a leading market due to processing advantages and recyclability. Demand for mEPDM, widely used in roofing and membranes, will be fueled by new grades that offer improved processing, cleanliness and lot-to-lot consistency. Rapid growth is also anticipated for plastomers, which are used neat or as polymer modifiers to enhance the toughness, clarity and sealing performance of flexible packaging.
Motor vehicles and packaging accounted for two-thirds of all metallocene and single-site TPE and plastomer markets in 2006. Motor vehicle markets are projected to increase 21 percent per annum through 2011 to 155 million pounds, driven by increased use in areas such as bumpers and exterior components. Metallocene TPOs are tough, flexible, dimensionally stable, easy to process and recyclable. They also have good low temperature performance and weatherability. Typical applications include use in instrument panels, steering wheels, instrument covers, and door panels. Seating materials, instrument panels, door panels, and other interior components can be used as bumpers based on their impact resistance.

US demand for plastomers in packaging markets is forecast to reach 145 million pounds, driven mainly by opportunities in the packaging arena. In packaging uses, plastomers can offer strength, high gloss, low melting points, enhanced cleanliness and unique barrier properties, particularly when used in blends with thermoplastics such as polypropylene. Uses include packaging for personal care products such as shampoos and detergents, as well as food packaging sealants for items such as produce, milk, fresh and processed meat, and bulk cheeses. Other uses include packaging films for products such as baby diapers, incontinence products, and other hygiene products.

Demand for metallocene TPEs and plastomers in the appliances, housewares, sporting goods and office machinery, including parts, handles and hoses. Attributes of mTPEs in these uses include colorability, durability, flexibility and lower density (resulting in lighter weight end-products).

### Table V-1

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<td>Gross Domestic Product (bil 2000$)</td>
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<td>9891</td>
<td>11415</td>
<td>13150</td>
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<td>lbs polyolefins/000$ GDP</td>
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<td>M/SS Thermoplastic Demand (mil $)</td>
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<td>1760</td>
<td>4150</td>
<td>8660</td>
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A. Schulman is a leading international producer and supplier of high-performance plastic resins and compounds. The Company operates in two geographic segments: North America and Europe.

The Company participates in the US metallocene and single-site polymer industry through the North America segment, which had FY 2006 sales of $494 million. Schulman also conducts business through five primary product groups, of which the Polyolefins group manufactures polyethylene and polypropylene resins and compounds, including metallocene-based products. The Polyolefins group, which generated sales of $495 million in FY 2006, formulates SUPERLINEAR metallocene-based polyethylene, among other products.

SUPERLINEAR resins are engineered for rotational molding applications and include the XL 0370 grade, which is marketed as a next-generation product that exhibits higher stiffness and heat-deflection qualities that previous versions. SUPERLINEAR XL 0370 features enhanced impact resistance and stiffness, as well as less heat distortion than conventionally formulated polyethylene resins. SUPERLINEAR resins are produced in a range of colors for applications that include watercraft, refuse containers, pressure tanks and display cases.
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**Metallocene & Single-Site Polymers**

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Page 7
Flexible Bulk Packaging
US demand for flexible bulk packaging will grow 3.4% yearly through 2011. Film wrap, plastic strapping and plastic shipping sacks will lead gains. Plastic such as polyethylene will remain the dominant material, with the limiting effect of downgauging softened by new applications and further inroads on paper sacks. This study analyzes the $6.1 billion US flexible bulk packaging industry, with forecasts for 2011 and 2016 by material, product and market. It also details market share and profiles major players.

Fluoropolymers
US fluoropolymers demand will rise 5.7% yearly through 2011. PVDF resins will lead gains among major types based on strength in architectural coatings. Fluoroelastomers will also do well, benefiting from improved motor vehicle and aerospace markets. Electrical and electronic products will be the fastest growing market. This study analyzes the $1.4 billion US fluoropolymer industry, with forecasts for 2011 and 2016 by product, application and market. It also details market share and profiles major firms.

Specialty Films
US specialty film demand will grow 4.8% annually through 2010. Gains will be driven by higher value materials, the rapid adoption of modified atmosphere packaging and improved film coating and metallization. Barrier films will remain dominant while biodegradable and water soluble films will grow the fastest from a small base. The study analyzes the $5.8 billion US specialty film industry to 2010 and 2015 by product, function and market. It also evaluates company market share and profiles leading competitors.

Natural Polymers
US natural polymer demand will grow 5.9% annually through 2010 based on increased food production and opportunities in packaging and medical uses. Starch and fermentation products will grow the fastest and surpass cellulose ethers as the dominant type by 2015. The food and beverage market will remain dominant while medical uses will lead gains. The study analyzes the $2.7 billion US natural polymer industry to 2010 and 2015 by product and market. It also details market share and profiles major players.

Plastic Film
US plastic film demand will grow 4.5% annually through 2010, driven by cost/performance and source reduction advantages over rigid packaging. Low density polyethylene film will remain dominant while polypropylene will grow the fastest. Secondary packaging will lead market gains based on strength in stretch and shrink wrap and retail bags. This study analyzes the $23 billion US plastic film industry to 2010 and 2015 by type, application and market. It also details market share and profiles major players.

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The Freedonia Group, Inc., is a leading international industry market research company that provides its clients with information and analysis needed to make informed strategic decisions for their businesses. Studies help clients identify business opportunities, develop strategies, make investment decisions and evaluate opportunities and threats. Freedonia research is designed to deliver unbiased views and reliable outlooks to assist clients in making the right decisions. Freedonia capitalizes on the resources of its proprietary in-house research team of experienced economists, professional analysts, industry researchers and editorial groups. Freedonia covers a diverse group of industries throughout the United States, the emerging China market, and other world markets. Industries analyzed by Freedonia include:

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