Novel High Performance Polymers
Peter Heydasch, Dow Europe GmbH

Dubai PlastPro
April 23rd to 25th, 2007
Specialty Plastics & Elastomers

Monomers and Linkages

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Process and Catalyst Progression

1933
- High Pressure, Tube/Autoclave
- No Catalyst
- Highly branched, Low Density PE

1955
- Low Pressure, Slurry
- Z/N Catalyst
- Linear, High Density PE

1957
- Low Pressure, Slurry
- Stereo-Specific Z/N Catalyst
- Highly Isotactic PP, Low Density
Leading Innovation

DOWLEX™ Polyethylene Resins
- More toughness, puncture resistance and good tear resistance
- Higher performance and processability
- Wide variety of applications

ATTANE™ Ultra Low Density Polyethylene Resins
- Greater low temperature flexibility and flex crack resistance
- Offers excellent optics, high tear resistance
Specialty Plastics & Elastomers

...based on INSITE™ Technology

Linking the Science of Catalyst, Process and Materials

AFFINITY™ Polyolefin Plastomers  
AFFINTY™ GA Polyolefin Plastomers  
ENGAGE™ Polyolefin Elastomers  
ELITE™ Enhanced Polyethylene  
NORDEL™ Hydrocarbon Rubber (EPDM)

Food & Specialty Packaging  
Hot Melt Adhesive  
Automotive Bumper TPO  
Enhanced Film  
Automotive Weather-Strip

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Plastics Innovation and Continuous Growth

Forecast in the Seventies

... commodities shrink ...
... ETP & high temperature expand ...

Process Improvements
Catalyst Progression
Additive Enhancement
Blends / Compounding

What happened
Great People
Molecular Architecture

Monomer and Comonomers are arranged into alternating „soft“ and „hard“ blocks.
INFUSE™ Olefin Block Copolymer (OBCs)

INFUSE™ Olefin Block Copolymers provide property combinations beyond most other products

Advantages

• Improved abrasion resistance
• Faster set-up in processing for shorter cycle times
• Better elasticity recovery and compression set properties at ambient and elevated temperatures
• Improved balance between flexibility & higher temperature resistance

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INFUSE™ Olefin Block Copolymers (OBC)

**Versus Flexible Polyolefins**
(POE, POP, APAO)
- Better Elastic and Compression Set Properties at High Temperatures
- Better Abrasion Resistance
- Faster Cycle Times

**Versus Styrene Block Copolymers**
- Elasticity and Soft Formulations at Lower Cost
- Improved Temperature Performance
- Excellent Weatherability
- Lighter Weight

**Versus EVA**
- Greater Elasticity
- Higher Heat Resistance
- Better Compression Set
- Lighter Weight
- Better Organoleptics

**Versus TPVs**
- Similar Compression Set
- Improved Processability
- Lower Cost

**Versus f-PVC**
- Polyolefin Based f-PVC Alternative – Plasticizer free
- Wider Service Temp Range
- Lighter Weight
- Better Organoleptics

**New Inter-material Substitution Possibilities**
INFUSE™ OBC: Applications

- Flexible molded goods
- Profile extruded products
- Elastic films and fibers
- Crosslinked foams

and many, many more ...
Molecular Architecture

High Mw isotactic PP, modest activity

Higher activity, 140 °C Mp

Comonomer Distribution

VERSIFY™ Plastomer
Ziegler-Natta catalyst based resin
Metalloocene catalyst base resin

Higher activity, 145 °C Mp

example of the high-throughput evolution of catalyst
VERSIFY™ Plastomers and Elastomers

Performance Polymers that closes the gap between Polyethylene and Polypropylene

Advantages

• Softening of PP film to allow tailored flexibility
• Modification of polyethylene surfaces to provide cling properties
• Greater compatibility for multilayer lamination and sealant substrates
• Enhancement of mechanical properties of cast PE & PP film
• Exceptionally suited for blown film including double-bubble shrink film
• Easy on-line mixing for impact modification for transparent PP goods
Speed to Market

20 million pounds in two years following introduction
VERSIFY™ Plastomers & Elastomers: Applications

Transparent Impact Modification - Easy On-line Mixing

Tailored Level of Impact Strength - Quick Adjustment
VERSIFY™ Plastomers & Elastomers: Applications

Balanced Level of Shrinkage and Forces - MD versus CD

Very broad Sealing and Shrinkage Window - High Transparency
VERSIFY™ Plastomers & Elastomers: Applications

Membranes - Profiles & Tubes - Flexible Properties

Easy Dispersion - High Loading - Masterbatches & Compounds
VERSIFY™ Plastomers & Elastomers: Applications

Blown Film - Multilayer Extrusion - Package Integrity

Five Sided Protection - Brand Exposure - Resistance to Puncture

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VERSIFY™ Plastomers & Elastomers: Product Mix

<table>
<thead>
<tr>
<th>Product Designation</th>
<th>MFR</th>
<th>Density (g/cc)</th>
<th>Shore A</th>
<th>Flex Modulus (MPa)</th>
<th>Typical Applications</th>
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*Commercial grade slate as of January 31, 2007
VERSIFY™ Plastomers & Elastomers: Application Grid

- **Injection Molding/Extrusion Coating**
  - VERSIFY™ 4000
  - VERSIFY™ 4200

- **Film Sealants**
  - VERSIFY™ 3000
  - VERSIFY™ 3200

- **General Purpose**
  - VERSIFY™ 3300
  - VERSIFY™ 3401

- **Extrusion Grades**
  - VERSIFY™ 2000
  - VERSIFY™ 2200
  - VERSIFY™ 2300
  - VERSIFY™ 2400

**Density**
- 0.888
- 0.876
- 0.866
- 0.858

**MFR @ 230°C**
- 2
- 8
- 25
Thank You!

Please visit us

http://www.dow.com
http://plastics.dow.com/about/performance.htm
http://www.dow.com/versify/index.htm
http://www.dow.com/infuse/index.htm

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