COC Enhanced Polyolefin Films for Shrink Sleeves and Labels

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Chicago, IL
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TOPAS Advanced Polymers Inc.

TOPAS® Cyclic Olefin Copolymer (COC)
Your Clear Advantage.
Outline

- Sleeve Materials
  - Traditional Materials
  - Desirable Properties
  - New Developments

- Enhanced Polyolefins

- TOPAS COC for Enhanced Polyolefins

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Polymer used for Shrink Sleeves
Material comparison

- **PVC** has a high density so a water flotation recycling process is impossible. It has a poor environmental image but is low cost.

- **PETG** shows a high growth rate although it is the most expensive material. Water flotation recycling process is not possible for the transparent material due to high density. It has a steep shrink curve.

- **OPS** is the dominant material in Japan. It works well for many applications, but due to temperature sensitivity, logistics can be difficult. It is less stiff than PETG and PVC. Density borderline.

- **OPP** is not considered as a shrink sleeve material due to a maximum shrinkage of 20% at 120°C in MD and low stiffness.
Developments for Shrink Sleeves and Labels

Materials / Process

- **Materials**
  - Recycling friendly
    - Low density
    - Biopolymers not appropriate
  - Low Density
    - Polyolefin
    - Foamed PETG
  - Material Combinations / Multilayer films
    - PS/PETG
    - PS/PE/PP
    - PE/PP/Cyclic Olefins

- **Process**
  - New roll fed shrink label technology
    - Sealing by Laser / Ultrasonic / UV adhesive
  - High speed sleeve applicators
    - Automatic roll change systems

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Plastic Recycling and Sleeve Materials

Is it about density?

In order to increase recycled PET supply and quality the industry has to promote a system bottle label that:

- Can be easily separated by the consumer (tear-off), or:
- Will be removed in the recycling plant
  - Increased separation efficiency
  - DENSITY becomes an issue for materials not separated by scanning systems

Source: AWA Shrink Sleeves Conference 2009, M. Ferraio, KP-films
Standard shrink sleeve materials are not floatable for water separation
## Desirable Material:
Enhanced Polyolefin Shrink Sleeve and Label Substrates

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>◆ Desirable incumbent material</td>
<td>◆ Limited functionality</td>
</tr>
<tr>
<td></td>
<td>▪ Low density (0.9 g/cc)</td>
<td>▪ Low shrink</td>
</tr>
<tr>
<td></td>
<td>▪ Low cost</td>
<td>▪ Low stiffness</td>
</tr>
<tr>
<td></td>
<td>▪ Recycling friendly, floatable</td>
<td>▪ Not solvent sealable</td>
</tr>
<tr>
<td>Enhanced</td>
<td>◆ Polyolefin solution</td>
<td>◆ More Complex</td>
</tr>
<tr>
<td>Polyolefin</td>
<td>▪ Low density (0.95 g/cc)</td>
<td>▪ Multilayer film</td>
</tr>
<tr>
<td></td>
<td>▪ Recycling friendly, floatable</td>
<td>▪ Cost higher than PP</td>
</tr>
<tr>
<td></td>
<td>▪ Solvent sealable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Medium-high shrink</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Increased stiffness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Cost competitive with established materials</td>
<td></td>
</tr>
<tr>
<td>PVC PETG</td>
<td>◆ Established standards</td>
<td>◆ Not recycling friendly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ High density, 1.35 g/cc</td>
</tr>
</tbody>
</table>

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Density and Performance of Enhanced Polyolefins

Enhanced polyolefin labels float like industry standard PP non-shrink labels.
Potential for New Materials

Market Opportunity:
low density steam shrinkable
medium-high shrink

Traditional sleeve labels:
PVC, PETG

Medium to high shrink materials with low density = Benefits for volume applications with recycling requirements
Low density is not enough...

- **Requirements**
  - Sealable, all processes
  - Shrink performance
  - Transparent, glossy
  - Printable
  - Stiff
  - Tough
  - Low density
  - Simple
  - Cost efficient
Enhanced Polyolefin
Cyclic Olefins (TOPAS®) as modifier for shrink films

- Low Density (<0.97 in a coex film)
- Compatible Polyolefin, no tie layer needed
- Highly Transparent
- High Rigidity (COC modulus up to 3 GPa)
- Easily Printable, stable surface treatment
- Solvent Seam compatible
- Copolymer family with wide range of shrink properties (33 – 140°C)
- Efficient film manufacturing
- Tough enough to survive supply chain handling
- Custom shrink properties possible
- Sealable by all common processes

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TOPAS® Cyclic Olefin Copolymer

A random metallocene copolymer of Cyclic Olefin and Ethylene

Increased Cyclic Olefin content

HDT °C

150
130
70
60
30

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TOPAS® Cyclic Olefin Copolymers
A Unique Combination of Properties

Adjustable Temperature Stability
High Transparency
High Shrink
Low Shrink Force
High Moisture Barrier
High Purity
Polyolefin
Low Density
Metallizable
Printable
High Stiffness

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Shrinkage Curves of TOPAS® 9506, 8007, 6013 Grades with Tg 65 to 140°C (qualitative comparison)
Example: Shrink Curves
TOPAS-enhanced polyolefin multilayer films

Shrink properties adjustable by formulation in a wide range between those of PP and PETG
Example: 3-Layer Polyolefin film with COC

**Composition**

Three layer Polyolefin film  
A / B / A
A: TOPAS COC rich skin layer;  
B: Polyolefin rich core layer

**Physical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Unit</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>50</td>
<td>µm</td>
<td></td>
</tr>
<tr>
<td>Solvent sealable</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>950</td>
<td>kg/m³</td>
<td>ISO 1183</td>
</tr>
</tbody>
</table>

**Mechanical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Unit</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength</td>
<td>50</td>
<td>MPa</td>
<td>ISO 527-3</td>
</tr>
<tr>
<td>Elongation, MD</td>
<td>50</td>
<td>%</td>
<td>ISO 527-3</td>
</tr>
</tbody>
</table>

**Optical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Unit</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss, 60°</td>
<td>130</td>
<td>%</td>
<td>ISO 2813</td>
</tr>
<tr>
<td>Haze</td>
<td>2</td>
<td>%</td>
<td>ISO 14782</td>
</tr>
</tbody>
</table>

**Shrink Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Unit</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>90° C, MD</td>
<td>50</td>
<td>°C</td>
<td>10 sec in Oil</td>
</tr>
<tr>
<td>90° C, TD</td>
<td>0</td>
<td>°C</td>
<td>10 sec in Oil</td>
</tr>
</tbody>
</table>
Summary: COC Advantages in Shrink Films

- COC is a polyolefin like PE and PP, but amorphous for high shrink
- Stretched films show high shrinkage at low shrink force
- Brilliant appearance, high gloss
- Stiff for reliable sleeve handling
- Adjustable shrinkage behavior
- High yield due to low film density
- Separates from PET by standard water flotation process
- Simplifies recycling for consumer per How2Recycle label
- Proven successful by major brand owners

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Last but not least
on TOPAS® COC and TOPAS Advanced Polymers

■ TOPAS® COC
  ■ A copolymer of ethylene and cyclic olefin
  ■ Performance Solutions for
    ■ Packaging
    ■ Healthcare
    ■ Optics
    ■ Electronics

■ TOPAS Advanced Polymers
  ■ Dedicated producer of TOPAS® COC resin
  ■ As part of the Polyplastics Group, a world-scale technical resin manufacturer
Thank you for your attention!

- For more information: www.topas.com
- Contact EU info@topas.com
- Contact US info@topas-us.com

TOPAS® Cyclic Olefin Copolymer (COC)
Your Clear Advantage.