Compostable Solutions for Packaging

FlexPackCon 2016

Randy Jester
Overview

- **Film structural polymers**
  - ecovio® aliphatic-aromatic polyester / PLA blend
  - ecoflex® aliphatic-aromatic polyester

- **Packaging applications**

- **Epotal® P100 ECO water-based polyester-polyurethane compostable adhesive**

- **Summary**
ecovio polymer blend
Product name for blends of ecoflex polymer and PLA

- Worldwide certified
  Compostability
  EU - EN 13432
  USA: ASTM D 6400-04
  Japan: GreenPla

- Adjustable stiffness
  Foam Trays
  Carrier Bags

- Excellent draw down
  - Film Thickness > 8 µm

- Extrudability
  - Up to 600 m/min – based on a laboratory extruder
**Chemical Structure of ecoflex**

*Biodegradable polymer*

**ecoflex** is a biodegradable copolyester on the basis of:

- Terephthalic acid
- 1,4 Butane diol
- Adipic acid

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**ecovio**

[Diagram showing the chemical structure of ecoflex and ecovio with PLA (stiff) and ecoflex (flexible)]
Biodegradable polymers cover a wide range of mechanical properties

- ecoflex is an excellent performance enhancer for starch, PLA, and PHB.
- ecovio (ecoflex-PLA) covers a wide range of mechanical properties.
Compostability is measured using a controlled composting test.

- ecoflex yields more than 90% conversion to CO₂ after only 80 days.
### Typical basic material properties for extrusion coating grade ecovio (1 mil thickness)

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Test Method</th>
<th>ecovio</th>
<th>Polyethylene PE-LD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass density</td>
<td>g/cm³</td>
<td>ISO 1183</td>
<td>1.24 – 1.26</td>
<td>0.92</td>
</tr>
<tr>
<td>Melt flow rate</td>
<td>g/10 min. ml/10 min.</td>
<td>ISO 1133</td>
<td>–</td>
<td>8 – 25</td>
</tr>
<tr>
<td>Melt flow rate</td>
<td></td>
<td>ISO 1133</td>
<td>18 – 27</td>
<td>–</td>
</tr>
<tr>
<td>Melting points</td>
<td>°C</td>
<td>DSC DSC</td>
<td>103 – 115 160 – 170</td>
<td>111</td>
</tr>
<tr>
<td>Vicat VST A/50</td>
<td>°C</td>
<td>ISO 306</td>
<td>61</td>
<td>96</td>
</tr>
<tr>
<td>Shore D hardness</td>
<td>-</td>
<td>ISO 868</td>
<td>71</td>
<td>48</td>
</tr>
<tr>
<td>Water Vapor Transmission Rate</td>
<td>g/(m²*d)</td>
<td>ASTM F 1249</td>
<td>220 @ 38C, 90% RH</td>
<td>13 @ 38C, 90% RH</td>
</tr>
<tr>
<td>Oxygen Transmission Rate</td>
<td>cm³/(m²<em>d</em>bar)</td>
<td>ASTM D 3985</td>
<td>1400 @ 23C, 50% RH</td>
<td>11000 @ 23C, 50% RH</td>
</tr>
</tbody>
</table>
Technology gaps in sustainable packaging

Moisture Barrier WVTR (g-mil/meter sq - day - atm)

• Barrier performance
• Packaging space

• GAP

0 0.01 0.1 1 10 100 1,000 10,000

Metal and Glass
High Performance Barrier Films and Laminates
Metalized BOPP
Coated Barrier Polymers
Metalized ecoinov
Metalized Black PLA
Barrier Plastics
Amorphous Plastics
ecovio
Filters and Felts

Very High <1
High 1-5
Medium 6-100
Low >100
Barrier Properties of Polymers

Sources: *Permeability Properties of Plastics and Elastomers*, Massey, 2nd Edition; various datasheets; internal data
From Products to Solutions

Film applications
- Mulch
- Produce bags
- Waste bags

Packaging solutions
- Hot & cold cups
- Foam Packaging
- Coated board
- OGR barrier
- Flexible packaging
Laminated Film Flexible Packaging

Typical Structure

- Structural Film
- Inks
- Adhesive
- Metallization
- Primer
- Sealant
Water-based COMPOSTABLE Laminating Adhesives

- An aqueous dispersion of a polyester-polyurethane elastomer

\[
\text{OCN} - \text{NCO} + \text{HO} - \text{OH} + \text{OCN} - \text{NCO} \quad \text{aliphatic linear polyol}
\]

\[\text{Isocyanate & Polyol react}\]

in acetone / catalyst

\[\text{OCN} - \text{U} - \text{U} - \text{U} - \text{NCO}\]

\[\text{to form pre-polymer}\]

which further reacts with an ionomer salt to further extend the molecular chains during polymerization...

water allows for a dispersion of finely divided PU particles

addition of water distillation of acetone

acetone removal yields a Solvent free dispersion
The Key to Compostability, Aliphatic Linear Polyester

- Hydrolysis disintegrates (converts) the aliphatic linear polyester
- Microorganisms (bacteria, fungi) incorporate these fragments
- The temperature in the industrial compost (50-60°C) accelerates this process
- \( T_{\text{compost}} > T_{\text{crystallization}} \)
Proving Compostability
TÜV Rhineland Certification

EN (European norm) 13432: To call a substance “compostable”, it must biodegrade more than 90% within 90 days. Epotal P 100 ECO accomplishes this in just 70 days.
Compostable Flexible Packaging

- Made better with property optimized polymer and water-based adhesive systems
  - Aliphatic-aromatic polyester / PLA blend compostable films
  - Compostable water-based polyester-polyurethane adhesive
- Made possible through collaboration along the value chain
- Makes zero waste more achievable
Acknowledgements

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