BONDING POLYPROPYLENES TO ALUMINUM FOIL

Bruce Foster
Mica Corporation
This Presentation

- Polypropylene properties and processing considerations
- Existing & New Primer Technologies for Polypropylene-to-Aluminum
- Utility / Applications
Why Polypropylene?

- High Temperature Applications
  - Melt point of PP = 160 °C (320°F)
- Superior Chemical and Grease Resistance
- Highly Transparent
- High Gloss
- Non-Stick
- Can be Heat Sealable
- Relatively low cost
Polypropylene Adhesion Factors

- Processing Conditions
- Polypropylene Grade Selection
- Primer Selection
Working against Adhesion:

- High melting points & moduli
- High glass-transition temperatures
- Narrow molecular-weight distributions
- No long-chain branching
Processing Adjustments

- Maximize temperature & pressure at combining point
- Beware! – Thermally degraded polypropylene is anti-adhesive.
Polypropylene Grade Selection

- Copolymers generally easier than homopolymers
- Additive packages influence adhesion
- Blending can sometimes help
Primer Selection

- Few primers for polypropylene to aluminum
- Additional thermal energy (beyond drying) needed for best results
Primer Technologies

- Solvent-based dispersion of modified crystalline polypropylene
- Aqueous emulsion of modified crystalline polypropylene
- Aqueous emulsion of modified amorphous polypropylene
Solvent-Based Primer Technology

- Functionalized Polypropylene dispersed in solvent
- Mix before using
- Remove high boiling solvent
- Coat thick
- Fuse particles at very high temperature
- Extrusion coat with polypropylene
Water-Based Primer Technology

Functionalized Polypropylene emulsion in Water

Remove Water

Fuse particles

Coat thin

Extrusion coat with polypropylene
Water-Based Primers

- Modified polypropylene resin emulsions in water
- No co-solvents
- Small particle size
  - No settling or mixing
  - Can be coated thin
- One part system
  - Unlimited bath life
- Adhere to paper, aluminum and ink
Primer Particle Fusion and Water Resistance

Unfused PP Particles
Water Penetrates

Aluminum Foil

Fused PP Particles
Water Cannot Penetrate
Water Resistance of Fused and Non-Fused Polypropylene Primer

<table>
<thead>
<tr>
<th>Condition</th>
<th>Un-fused</th>
<th>Fused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>700</td>
<td>900</td>
</tr>
<tr>
<td>Boil 1-Hr</td>
<td>100</td>
<td>1200</td>
</tr>
<tr>
<td>Soak RT 3 Days</td>
<td>50</td>
<td>600</td>
</tr>
</tbody>
</table>
Polypropylene to Aluminum / Primer “C”

Bond Strength vs. Heat Seal Temperature

Bond, g/25mm

Heat-Seal Temperature, deg C

Primer C
No Primer
Polypropylene to Aluminum / Primer “C”

Bond Strength vs. Test Temperature

Test Temperature, deg C

Bond Strength, g/25mm
Polypropylene Extrudate to Aluminum Primer “A” (T-peels, g/25mm)

Fusion temp: 60° C
Imagine...

- Cast polypropylene sealant film
- Polypropylene extrudate
- Aluminum foil
- Extruded Tie-Layer
- Nylon Film
- Re-tort, motor oil, cooking oil, butter (no refrigeration!)
Imagine….

Vacuum-metallization (Al, Cu, Au) ➔ Polypropylene Film

Conductive circuit on a supportive surface, great adhesion
Imagine...

- **Cast polypropylene sealant film**
- **Polypropylene extrudate**
- **Ink**
- **Thick Aluminum Foil**

Lid-stock for yogurt cups or other polypropylene containers
Conclusions

Water based primers for polypropylenes offer:

• New and Simplified Structures
• Improved Performance
• Process and cost improvements