Welding Polymer Film for Packaging Applications with Ultrasonics

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Overview

• Objectives
• Background
• Equipment and Material
• Sample Creation Methods
• Performance Analysis
  • Visual Inspection
  • Ultimate Strength
  • Tearing Force
• Conclusions
• Future Research
Objectives

• Characterize the weldability of 6 coextruded polymer laminate films
  • Benchtop
  • Vertical Form Fill Seal at state of industry speed
• Determine optimal parameters for welding those materials
  • Energy
  • Amplitude
  • Weld Force
Background

- Applications include:
  - Food & Beverage
  - Cosmetic & Pharmaceutical
  - Chemical

- Advantages
  - Use energy only when needed ~ .5sec/weld
  - No glue or consumables
  - High repeatability
  - Ability to seal through contaminates
Equipment

- Branson 2000 X single converter/booster
- 30kHz
- 6” long riser back rectangular slotted horn
- Horn gain = 3
- Booster gain = 1.5
- Amplitude approx 0.0032”
## Machine Factors

<table>
<thead>
<tr>
<th>Energy (J)</th>
<th>Amplitude (%)</th>
<th>Weld Force (psi) / Trigger Force (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>100</td>
<td>70 / 125</td>
</tr>
<tr>
<td>300</td>
<td>90</td>
<td>60 / 100</td>
</tr>
<tr>
<td>250</td>
<td>80</td>
<td>50 / 75</td>
</tr>
<tr>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Material

OUTSIDE

VARIABLE OPP

PE

METALLIZED OPP

INSIDE
Coextruded polymer laminate

- Thickness: 200g = 2mil = 0.002” = 50 microns
- Metallized biaxially oriented polypropylene (OPP)
- Polyethylene
- Variable layer:

<table>
<thead>
<tr>
<th>ID</th>
<th>Variable Layer Description</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Printable OPP, lower friction</td>
<td>70</td>
</tr>
<tr>
<td>B</td>
<td>Printable OPP, lower friction</td>
<td>90</td>
</tr>
<tr>
<td>C</td>
<td>Thicker OPP, lower friction</td>
<td>90</td>
</tr>
<tr>
<td>D</td>
<td>High barrier OPP</td>
<td>80</td>
</tr>
<tr>
<td>E</td>
<td>OPP, both sides metallized</td>
<td>70</td>
</tr>
<tr>
<td>F</td>
<td>Metallizable base OPP</td>
<td>70</td>
</tr>
</tbody>
</table>
Cross Section View of Welded Sample
Visual Inspection

Checking for:

- Completeness (6” weld)
- Burn-through of metallized layer
Modified ASTM D882 Peel Strength
Mean Ultimate Strength – All Materials

![Graph showing the relationship between Ultimate Strength, Amplitude, and Energy for different Weld Forces (50, 60, 70 psig).]
Mean Ultimate Strength – A

Amplitude (%)

80  90  100

Weld Force (psig)
- 50
- 60
- 70

Ultimate Strength (MPa)

Energy (J)

100  200  300  400  100  200  300  100  200  300  400
Mean Ultimate Strength – C
ASTM D1922 Tear Resistance
Mean Tearing Force – All Materials

![Graph showing the relationship between Amplitude (%) and Tearing Force (N) at different energy levels for materials with different weld forces (50, 60, 70 psig).]
Mean Tearing Force – C
Conclusions

• **Ultimate Strength**: Increased pressure, amplitude, and energy generally correlates with increased strength.

• **Tearing Force**: No strong correlation, high energy results in breaks along weld due to micro holes.

• **Customer**: may have visual or barrier requirements that will reduce weld strength.

• **Trade-offs**: will be required to satisfy all requirements.
Future Research: Vertical Form Fill Seal
VFFS
Vacuum Testing
Burst Testing
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