Alternatives to THV for Wire and Cable
We Will Discuss:

- AGC Fluon+™ AR Flexible Compounds
- AGC Fluon® LM ETFE
THV is in Short Supply

- Demand is high
- Price is high (due to high demand)
- Lead times are long (due to high demand)

…but there are alternatives.

Some even out-perform THV
What are Fluon+ AR Products?

- Blends of ETFE with fluoroelastomer
- Easy to process (same as ETFE)
- Per cent of elongation at break is much greater than for ETFE
- Flexural modulus is much lower than for ETFE
- Can be cross-linked by electron beam or other high-energy radiation sources
Advantages of Fluon+ AR Products

- Resistant to attack from most chemicals
- Rugged vs. std. fluoroelastomers
- Wide service temperature range (up to 200 deg. C)
- Raw materials are much more available than for THV
- Can be custom-tailored to meet individual applications in wire and cable
What is an LM ETFE?

- ETFE with lower melting point and lower processing temperatures than standard ETFE
- Three different MFI versions are available
Advantages of Fluon LM ETFE vs. Standard ETFE

- Higher transparency
- Slightly more flexible
- Lower melting temperatures
- Lower processing temperatures
- Higher throughput rates on extruder (at same melt temperature)
- Better resistance to stress cracking
- Higher limiting oxygen index (less flammable)
Flexural modulus of various fluorinated materials

• Flexural Modulus is close to that of THV

• AR grades are nearly as flexible as fluoroelastomers, but can be extruded in conventional fashion from pellet feeds
Fluon+ AR ETFE

- Flexural Modulus lower than for standard ETFE
- Has higher temperature resistance than standard ETFE
- Processing temperatures are lower than for standard ETFE
Use Fluon+ AR Grades For

- Ultra-flexible wire and cable (or tubing)
- Resistance to chemicals
- Applications requiring good opacity
- High/extended service temperature applications
- Applications requiring a custom-tailored solution to enhance physical properties, service temperatures, etc.
Use Fluon LM ETFE Grades For

- Flexible wire and cable (or tubing)
- Resistance to fuels and chemicals
- Applications requiring good transparency
- High/extended service temperature applications
- Applications that require good abrasion resistance and toughness
### Fluon+ AR and Fluon LM ETFE vs. THV and ETFE

<table>
<thead>
<tr>
<th>Material</th>
<th>THV</th>
<th>ETFE</th>
<th>FLUON LM ETFE</th>
<th>FLUON+ AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.93-2.06</td>
<td>1.73</td>
<td>1.78</td>
<td>1.62-1.64</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>moderate to high</td>
<td>very high</td>
<td>high</td>
<td>moderate to high</td>
</tr>
<tr>
<td>Elongation</td>
<td>high</td>
<td>low to moderate</td>
<td>moderate</td>
<td>high</td>
</tr>
<tr>
<td>Flexibility</td>
<td>moderate to high</td>
<td>low</td>
<td>moderate</td>
<td>high</td>
</tr>
<tr>
<td>Flammability UL94</td>
<td>V-0</td>
<td>V-0</td>
<td>V-0</td>
<td>V-2 to V-0</td>
</tr>
<tr>
<td>Appearance</td>
<td>transparent</td>
<td>transparent</td>
<td>transparent</td>
<td>opaque</td>
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</tbody>
</table>
## Overview of Fluon+ Products

<table>
<thead>
<tr>
<th>GRADE:</th>
<th>AR-3300N</th>
<th>AR-3300P</th>
<th>AR-3300XL</th>
<th>AR-3300LH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended use</td>
<td>General purpose</td>
<td>V-0 UL rated for flame retardancy</td>
<td>Radiation curable (for extended life)</td>
<td>Enhanced adhesion to metals and other plastics</td>
</tr>
<tr>
<td>MFI</td>
<td>9.0</td>
<td>8.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Service Temperature</td>
<td>150° C</td>
<td>150° C</td>
<td>200° C (after cure)</td>
<td>150° C</td>
</tr>
</tbody>
</table>

AGC Chemicals Americas can also custom tailor the Fluon+ AR products to your individual applications.
Benefits to Custom Compounding

Modifier level vs tensile, elongation and flex mod
Fluon+ AR series; high temperature ETFE

Higher modifier level =>
Greater flexibility
Fluon+ AR Grades Can Be Radiation Cured

- Elongation decreases a small amount
- Tensile strength increases significantly

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Units</th>
<th>Fluon+ AR-3300N</th>
<th>With EB irradiation 120 kGy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melt Flow Rate (MFR)</td>
<td>ASTM D-2116</td>
<td>g/10min</td>
<td>8.7</td>
<td>NA</td>
</tr>
<tr>
<td>Melting Point</td>
<td>AGC Internal</td>
<td>°C</td>
<td>225</td>
<td>NA</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D638</td>
<td>MPa</td>
<td>10.4</td>
<td>29.3</td>
</tr>
<tr>
<td>Tensile Elongation</td>
<td>ASTM D638</td>
<td>%</td>
<td>441</td>
<td>366</td>
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<tr>
<td>Flex Modulus</td>
<td>ASTM D790</td>
<td>MPa</td>
<td>141</td>
<td>148</td>
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<tr>
<td>Durometer Hardness</td>
<td>ASTM D1706</td>
<td>Shore D</td>
<td>42</td>
<td>44</td>
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<tr>
<td>Flammability</td>
<td>UL 94</td>
<td>V-2</td>
<td>V-2</td>
<td>V-2</td>
</tr>
</tbody>
</table>

Your Dreams, Our Challenge
<table>
<thead>
<tr>
<th>GRADE:</th>
<th>LM-720A</th>
<th>LM-730A</th>
<th>LM-740A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended use</td>
<td>General purpose extrusion / injection molding; Better stress crack resistance over LM-730A</td>
<td>General purpose extrusion / injection molding</td>
<td>General purpose extrusion / injection molding; higher flow than LM-730A</td>
</tr>
<tr>
<td>MFI</td>
<td>10 – 20</td>
<td>20 – 30</td>
<td>30 - 40</td>
</tr>
<tr>
<td>Service Temperature</td>
<td>150⁰ C</td>
<td>150⁰ C</td>
<td>150⁰ C</td>
</tr>
</tbody>
</table>
Available Colors

- Specifically designed for use in colorizing Fluon+ AR and Fluon LM ETFE
- Custom color matching capabilities
AGC Chemicals Flexible Resins

• AGC offers two products to replace THV, depending on specific application requirements.
• All solutions provide improved flexibility over traditional ETFE.
• The AR series offers similar or superior flexibility to THV.

Fluon+ AR and LM ETFE also offer:
• High resistance to heat
• Excellent chemical resistance
• Physical toughness
• Outstanding resistance to weather and aging
• Good dielectric properties