Starting Formulation

SF 7001

Flame Retardant Electrical Potting Compound
EPON™ Resin 828 and 1163 / HELOXY™ Modifier 56

Introduction

This general purpose electrical potting compound illustrates the use of brominated epoxy resins to achieve flame retardancy with minimal sacrifice in mechanical, thermal and electrical properties. Two filler options are presented to offer the compounder a choice of maximum flame retardance (Option A) or maximum economy (Option B).

<table>
<thead>
<tr>
<th>Formula</th>
<th>Material</th>
<th>Supplier</th>
<th>Pounds</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin Portion</td>
<td>EPON Resin 828</td>
<td>Hexion</td>
<td>50.0</td>
<td>5.18</td>
</tr>
<tr>
<td></td>
<td>HELOXY Modifier 56</td>
<td>Hexion</td>
<td>30.0</td>
<td>2.43</td>
</tr>
<tr>
<td></td>
<td>EPON Resin 1163</td>
<td>Hexion</td>
<td>20.0</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>Total Resin Portion</td>
<td></td>
<td>100.0</td>
<td>8.93</td>
</tr>
<tr>
<td>Converter Portion</td>
<td>Hexahydrophthalic Anhydride</td>
<td>Anhydrides &amp; Chemicals, Inc.</td>
<td>61.5</td>
<td>6.21</td>
</tr>
<tr>
<td></td>
<td>Diethylaminoethanol</td>
<td>Pennwalt Corp.</td>
<td>0.5</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>Total Converter Portion</td>
<td></td>
<td>62.0</td>
<td>6.28</td>
</tr>
<tr>
<td>Filler Portion</td>
<td>Option A</td>
<td>Hydrated Alumina C-331</td>
<td>162.0</td>
<td>8.04</td>
</tr>
<tr>
<td></td>
<td>Al-Sil-Ate NC</td>
<td>Freeport Kaolin Co.</td>
<td>152.0</td>
<td>7.07</td>
</tr>
<tr>
<td></td>
<td>Antimony Trioxide</td>
<td>PQ Corp.</td>
<td>10.0</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Total Filler Portion</td>
<td></td>
<td>162.0</td>
<td>7.28</td>
</tr>
</tbody>
</table>

Compounding Procedure

Resin Portion
Mix all resin components using high speed agitation and moderate heat until a homogeneous liquid blend is attained. A maximum temperature of 93 °C should be sufficient for this operation, and a blanket of inert gas should be maintained over the resin during mixing to retard viscosity increase and color development, respectively.

Converter Portion
Melt the hexahydrophthalic anhydride at a temperature of approximately 65 °C. Add the diethylaminoethanol and cool.
When ready to use the compound, mix the resin and converter portions under moderate speed agitation. After mixing is complete, add the filler and continue agitation until the filler has been thoroughly dispersed. Heat to a suitable viscosity for application, apply vacuum to deaerate, and pour into preheated molds.

Typical Properties Table 1 / Physical Properties

<table>
<thead>
<tr>
<th></th>
<th>Unfilled</th>
<th>Filler Option A</th>
<th>Filler Option B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 25 °C</td>
<td>cP</td>
<td>7200</td>
<td>–</td>
</tr>
<tr>
<td>Density</td>
<td>lbs/gal</td>
<td>10.65</td>
<td>13.9</td>
</tr>
<tr>
<td>Gel Time 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at 93 °C</td>
<td>min.</td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td>at 121 °C</td>
<td>min.</td>
<td>–</td>
<td>8</td>
</tr>
</tbody>
</table>

1 1/8 inch thickness.

Typical Cured State Table 2 / Cured State Properties

<table>
<thead>
<tr>
<th>Units</th>
<th>Unfilled</th>
<th>Filler Option A</th>
<th>Filler Option B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Deflection Temp</td>
<td>°C</td>
<td>90</td>
<td>89</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>psi</td>
<td>12,000</td>
<td>6,500</td>
</tr>
<tr>
<td>Tensile Elongation at Break</td>
<td>%</td>
<td>6.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>psi</td>
<td>21,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Flexural Modulus, Initial</td>
<td>ksi</td>
<td>520</td>
<td>1,100</td>
</tr>
<tr>
<td>Compressive Strength,Yield</td>
<td>psi</td>
<td>15,000</td>
<td>–</td>
</tr>
<tr>
<td>Izod Impact, notch</td>
<td>ft•lb/in.</td>
<td>0.42</td>
<td>0.32</td>
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<tr>
<td>Hardness</td>
<td>Shore D</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>Water Absorption, 24 hours</td>
<td>%</td>
<td>0.07</td>
<td>0.04</td>
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<tr>
<td>Weight Loss, 24 hours, 150 °C</td>
<td>%</td>
<td>–</td>
<td>0.04</td>
</tr>
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</table>

Flammability 3

<table>
<thead>
<tr>
<th>Rating</th>
<th></th>
<th>Self- Extinguishing</th>
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</thead>
<tbody>
<tr>
<td>Time to Self-Extinguish</td>
<td>seconds 120</td>
<td>0</td>
</tr>
<tr>
<td>Extent of Burning</td>
<td>inches 1.0</td>
<td>0</td>
</tr>
<tr>
<td>Linear Shrinkage</td>
<td>inch/inch 0.017</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Electrical Properties

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Dielectric Constant</td>
<td>3.51</td>
</tr>
<tr>
<td>Dissipation Factor</td>
<td>0.015</td>
</tr>
<tr>
<td>Volume Resistivity</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Resistivity</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>25°</td>
<td>4.9 x 10^{15} ohm-cm</td>
</tr>
<tr>
<td>66°</td>
<td>3.1 x 10^{15} ohm-cm</td>
</tr>
<tr>
<td>93°</td>
<td>3.0 x 10^{15} ohm-cm</td>
</tr>
<tr>
<td>130°</td>
<td>3.3 x 10^{13} ohm-cm</td>
</tr>
<tr>
<td>150°</td>
<td>2.9 x 10^{12} ohm-cm</td>
</tr>
<tr>
<td>180°</td>
<td>2.6 x 10^{11} ohm-cm</td>
</tr>
<tr>
<td>200°</td>
<td>7.2 x 10^{10} ohm-cm</td>
</tr>
</tbody>
</table>

1Cured at 93 °C for 2 hours and followed by 177 °C for 4 hours.
2Cured at 120 °C for 16 hours.
3Determined per ASTM D-635.
4Determined at 100 Hertz and 25 °C.

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