Starting Formulation

SF 4009 Adhesive Formulations EPON and Epikure Adhesive Formulations for Thermoplastic Substrates

EPON™ Resins 8132, 828, 58005, 862, 58003 / EPIKURE™ Curing Agent 30055, 3125, 3163, and 3164

Introduction

These adhesive systems are designed for use in ambient or elevated temperature bonding of thermoplastic substrates such as Nylon 11, polyethylene terephthalate, polyvinyl chloride, and polyurethane.

Features

- Good adhesion to thermoplastic substrates
- Solvent-free, no volatile by-products

Mixing Instructions

Processing data are presented in Table 1. All of the starting point formulations discussed in this bulletin utilize Cab-O-Sil M-5 as the thixotropic agent (see Table 1). The Cab-O-Sil M-5 should be dispersed into a portion of the base resin (EPON Resin 8132, EPON Resin 828, EPON Resin 862) using a high shear dispersing technique. Add the remaining base resin and any other resins in the formulation to the resulting dispersion and mix using conventional mixing equipment, until a uniform consistency is attained.

This formulation is a basic starting point and can be modified with other filler types, such as aluminum powder, talc, alumina, silica, wollastonite, or calcium carbonate. Addition of a sufficient quantity of filler can adjust the combining ratio to a convenient level. Modification with silane coupling agents improves bonds to concrete and glass. Pigment may be incorporated into either or both portions for the purpose of color-coding.

Processing Properties Table 1 / Processing Properties

<table>
<thead>
<tr>
<th>Formulation number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin, parts by weight (by volume)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPON Resin 8132</td>
<td>75</td>
<td>(82)</td>
<td>75</td>
<td>(77)</td>
<td>75</td>
<td>(76)</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
</tr>
<tr>
<td>EPON Resin 58005</td>
<td>–</td>
<td>75</td>
<td>75</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>(28)</td>
<td>(76)</td>
<td>(76)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
</tr>
<tr>
<td>EPON Resin 58003</td>
<td>–</td>
<td>25</td>
<td>25</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(28)</td>
<td>(28)</td>
<td>(28)</td>
<td>(105)</td>
<td>(105)</td>
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<td>(105)</td>
</tr>
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</table>

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Cab-O-Sil M-5

Resin viscosity @ 25 °C , P

<table>
<thead>
<tr>
<th>RPM</th>
<th>0.3</th>
<th>0.6</th>
<th>1.5</th>
<th>3</th>
<th>6</th>
<th>12</th>
<th>30</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>1360</td>
<td>1320</td>
<td>1300</td>
<td>1290</td>
<td>407</td>
<td>37.2</td>
<td>32.9</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Curing agent, parts by weight (by volume)

<table>
<thead>
<tr>
<th>Curing Agent</th>
<th>3055</th>
<th>3125</th>
<th>3163</th>
<th>3164</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPI-CURE</td>
<td>42</td>
<td>50</td>
<td>138</td>
<td>86</td>
</tr>
<tr>
<td>Formulation</td>
<td>(53)</td>
<td>(58)</td>
<td>(169)</td>
<td>(106)</td>
</tr>
</tbody>
</table>

Gel Time @ 25 °C

<table>
<thead>
<tr>
<th>RPM</th>
<th>100 gram</th>
<th>345</th>
<th>165</th>
<th>178</th>
<th>142</th>
<th>193</th>
<th>113</th>
<th>109</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gel</td>
<td>mass</td>
<td>min.</td>
<td>min.</td>
<td>min.</td>
<td>min.</td>
<td>min.</td>
<td>min.</td>
<td>min.</td>
</tr>
</tbody>
</table>

Dry Time, thin film Gel Time @ 25 °C

<table>
<thead>
<tr>
<th>RPM</th>
<th>16</th>
<th>11</th>
<th>13</th>
<th>13</th>
<th>10</th>
<th>20.5</th>
<th>34.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>hr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Application Instructions
Surfaces to be bonded should be clean and free of dust, dirt, grease, or other extraneous material. Mix the adhesive components and apply immediately by spreading a thin film over the surface to be bonded. Maintain light pressure during cure to achieve the best bond. For the data presented, the surfaces were wiped with acetone or methyl ethyl ketone in order to remove dust, dirt, oils, etc.

The initial cure step may be carried out at room temperature or at elevated temperature. If initially cured at room temperature, an elevated temperature post cure should be evaluated depending on the requirements of the desired application. An elevated temperature cure will decrease the cure time significantly and will reduce the need for an additional post cure. Data are presented in Table 2 for both room and elevated temperature cure schedules. The cure schedule used was 30 minutes at 140 °C (280 °F).

Performance Properties

<table>
<thead>
<tr>
<th>Formulation number</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</table>

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Revision:

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Room Temperature Cure

Cure Schedule
7 days @ 25 °C (77 °F)

Lap shear strength \(^1\), psi

<table>
<thead>
<tr>
<th>Material</th>
<th>Average (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARILON® P-1000 (^2)</td>
<td>1012</td>
<td>193</td>
</tr>
<tr>
<td>Polyvinylchloride (PVC) (^3)</td>
<td>691*</td>
<td>199</td>
</tr>
<tr>
<td>Polyurethane (^4)</td>
<td>479</td>
<td>252</td>
</tr>
<tr>
<td>Polyethylene terephthalate (PET) (^5)</td>
<td>255</td>
<td>68</td>
</tr>
<tr>
<td>Nylon (^6)</td>
<td>434</td>
<td>75</td>
</tr>
</tbody>
</table>

Elevated Temperature Cure

Cure Schedule
30 minutes @ 140 °C (284 °F)

Lap shear strength \(^1\), psi

<table>
<thead>
<tr>
<th>Material</th>
<th>Average (psi)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARILON® P-1000 (^2)</td>
<td>1396*</td>
<td>119</td>
</tr>
<tr>
<td>Polyvinylchloride (PVC) (^3)</td>
<td>1216*</td>
<td>346</td>
</tr>
<tr>
<td>Polyurethane (^4)</td>
<td>319</td>
<td>75</td>
</tr>
<tr>
<td>Polyethylene terephthalate (PET) (^5)</td>
<td>768</td>
<td>125</td>
</tr>
<tr>
<td>Nylon (^6)</td>
<td>434</td>
<td>105</td>
</tr>
</tbody>
</table>

Glass Transition Temperature \(^7\), °C

<table>
<thead>
<tr>
<th>Material</th>
<th>Average (°C)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARILON® P-1000 (^2)</td>
<td>60</td>
<td>105</td>
</tr>
</tbody>
</table>

\(^1\) ASTM D 3163 96 AT 25 °C, Average of 5 Specimens, Solvent Wiped

\(^2\) CARILON® P-1000 was supplied by Shell Chemical Company

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Polyvinylchloride (PVC), Type 1, was supplied by McMaster-Carr Supply Company

Polyurethane was supplied by McMaster-Carr Supply Company and had a Shore Durometer reading of 75 and a tensile strength of 7500 psi

Polyethylene terephthalate (PET) was supplied by McMaster-Carr Supply Company

Nylon was supplied by ElfAtochem as Rilsan® Polyamide 11 Resin

Dynamic Mechanical Analysis, Rectangular Torsional Geometry, 1 °C/min

* All samples failed in tensile mode within the bond line.

Storage

Recommendations regarding storage conditions can be obtained by visiting our website at www.hexion.com

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These are starting formulations and are not proven in the user’s particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user’s own formulation. It is the user’s responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user’s knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

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