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>
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<td>Resin, parts by weight (by volume)</td>
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<td>EPON Resin 8132</td>
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<td>(82)</td>
<td>(109)</td>
<td>(109)</td>
<td>(109)</td>
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<td>EPON Resin 828</td>
<td>25</td>
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<td>(77)</td>
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<td>EPON Resin 58005</td>
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<tr>
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<td>(28)</td>
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<td>EPON Resin 862</td>
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<td>EPON Resin 58003</td>
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<td>PON Resin 58135</td>
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<td>Formulation number</td>
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<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Resin viscosity @ 25 °C, Pa</td>
<td>2(1)</td>
<td>2(1)</td>
<td>2(1)</td>
<td>2(1)</td>
<td>2(1)</td>
<td>2(1)</td>
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<td>@ 0.3 rpm</td>
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<td>1360</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
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<tr>
<td>@ 0.6 rpm</td>
<td>–</td>
<td>1320</td>
<td>–</td>
<td>873</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>@ 1.5 rpm</td>
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<td>1300</td>
<td>436</td>
<td>828</td>
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<td>–</td>
</tr>
<tr>
<td>@ 3 rpm</td>
<td>–</td>
<td>1290</td>
<td>421</td>
<td>805</td>
<td>–</td>
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<td>–</td>
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<td>@ 6 rpm</td>
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<td>407</td>
<td>787</td>
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<td>@ 12 rpm</td>
<td>37.2</td>
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<td>396</td>
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<tr>
<td>@ 30 rpm</td>
<td>32.9</td>
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<td>19.9</td>
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<td>@ 60 rpm</td>
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<td>18.7</td>
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<td>Curing agent, parts by weight (by volume)</td>
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<tr>
<td>EPI-CURE Curing Agent 3055</td>
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<td>42</td>
<td>46</td>
<td>42</td>
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</tr>
<tr>
<td></td>
<td>(53)</td>
<td>(53)</td>
<td>(58)</td>
<td>(53)</td>
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<tr>
<td>EPI-CURE Curing Agent 3125</td>
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<td>–</td>
<td>–</td>
<td>50</td>
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<td>–</td>
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<td></td>
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<td>(62)</td>
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<tr>
<td>EPI-CURE Curing Agent 3163</td>
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<td>–</td>
<td>–</td>
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<td></td>
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<td></td>
<td></td>
<td>(169)</td>
<td></td>
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<tr>
<td>EPI-CURE Curing Agent 3164</td>
<td>–</td>
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<td>–</td>
<td>86</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(106)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing Agent Viscosity @ 25 °C, Pa</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>330</td>
<td>1490</td>
<td>82</td>
</tr>
<tr>
<td>Gel Time @ 25 °C²</td>
<td>345</td>
<td>165</td>
<td>178</td>
<td>142</td>
<td>193</td>
<td>113</td>
<td>109</td>
</tr>
<tr>
<td>Gel Time @ 25 °C² 100 gram mass, min.</td>
<td>16</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>20.5</td>
<td>34.5</td>
</tr>
<tr>
<td>Dry Time, thin film Gel Time @ 25 °C³, hr.</td>
<td>1 Brookfield DV-II</td>
<td>2 Shyodu Gel Timer</td>
<td>3 Gardco Circular Drying Time Recorder, 0.2 mm film</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 Table 2 / Typical Properties

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Room Temperature Cure

Cure Schedule
7 days @ 25 °C (77 °F)

Lap shear strength 1, psi

CARILON® P-1000 2
Average 1012  884  950  832  691  621  499
Standard Deviation 193  216  189  166  43  81  33

Polyvinylchloride (PVC) 3
Average 691*  677*  754*  776  308  549  529
Standard Deviation 199  77  37  136  31  55  61

Polyurethane 4
Average 479  435  759  573  718  906  730
Standard Deviation 252  83  103  168  70  122  150

Polyethylene terephthalate (PET) 5
Average 255  254  487  506  525  800  632
Standard Deviation 68  29  139  81  75  52

Elevated Temperature Cure

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

Lap shear strength 1, psi

CARILON® P-1000 2
Average 1396*  1401*  1359*  688  784  886  388
Standard Deviation 119  187  169  230  128  27  54

Polyvinylchloride (PVC) 3
Average 1216*  1281*  939*  951*  661*  969*  674*
Standard Deviation 346  193  434  220  111  123  98

Polyurethane 4
Average 319  550  385  407  307  583  429
Standard Deviation 75  38  124  112  49  103  77

Polyethylene terephthalate (PET) 5
Average 768  653  890  796  964  1244  848
Standard Deviation 125  160  117  113  79  106  44

Nylon 6
Average 434  –  414  444  650  725  466
Standard Deviation 105  –  168  67  188  27  57

Glass Transition Temperature 7, °C
Average 60  86  75  70  50  45  40

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 web site at [www.hexion.com](http://www.hexion.com)

General Information

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.

Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

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Contact Information

For product prices, availability, or order placement, please contact customer service:

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For literature and technical assistance, visit our website at [www.hexion.com](http://www.hexion.com)

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