Emerald Innovation NH-1
Non-Halogen Flame Retardant
Dear Reader

Polyurethane materials for furniture and automotive flexible polyurethane foam applications are the materials that request high performance flame retardant. Halogen materials can tolerant fire for industry standard, but the environmentally friendly flame retardant is requested at the same time. So, Chemtura have developed the green flame retardant materials called Emerald Innovation™ NH-1 to fulfill this requirement.

Moreover, Emerald Innovation™ NH-1 can be used at low load levels and enables production of foams with superior physical properties, customer need not to concern about processability and dispersion effect. Optimal Tech is proud to offer Emerald Innovation™ NH-1 to serve the Polyurethane industry with the wide range of Flame Retardant standard.

Please feel free to let us know your end application and flame Standard in order to provide you the best solution to fulfill your requirement.

Best Regards,

Cholticha Mahuttanaruk
General Manager

Emerald Innovation NH-1 is a product of Great Lake Solutions’s “Green is Better” innovation strategy to achieve the goal of providing sustainable, effective fire safety solution. It demonstrates superior long term efficacy as compared to chlorinated phosphate esters by virtue of its lower volatility upon ageing. The product is an effective flame retardant designed for use in a variety of comfort foam applications, including Cal-117, FMVSS302, UL-94 and in compliance with IKEA’s IOS-MAT-0010.
Emerald Innovation™ NH-1 offers a host of benefits to flexible polyurethane foam manufacturers. Customer will benefit from using Emerald Innovation™ NH-1 because it:

- Cost-effective, halogen-free replacement for chlorinated phosphate ester in automotive PU foam
- Low emissions/fogging in slabstock foams
- Superior foam physical properties, excellent processing and ease of use
- Compatible in common polyurethane foam components
- Excellent scorch resistance for consistent, light colored foam
- Excellent ageing retention, maintains FR performance over time
- Effective flame retardant with both polyether and polyester polyols
- Enables compliance with fire safety standards FMVSS302, UL-94 HF1 and Cal 117
- Physical property comparison in flexible PU foam
Physical Property Comparison in Flexible Polyurethane Foam

24 kg/m³ polyether foam. Test specimens are FMVSS 302 flammability compliant (12-mm thickness)

<table>
<thead>
<tr>
<th>Flame Retardant</th>
<th>Php Load Level</th>
<th>Air flow (dm³/sec)</th>
<th>IFD 25%/65% (Newton)</th>
<th>Flammability Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerald NH-1</td>
<td>12</td>
<td>1.98</td>
<td>200/400</td>
<td>SE</td>
</tr>
<tr>
<td>TDCP</td>
<td>14</td>
<td>1.89</td>
<td>182/369</td>
<td>SE</td>
</tr>
<tr>
<td>Non-Halogen A</td>
<td>23</td>
<td>1.84</td>
<td>178/365</td>
<td>SE</td>
</tr>
</tbody>
</table>

Tests performed according to ASTM D3574 and Federal Motor Vehicle Safety Standard # 302 for Interior Materials guidelines
Note: IFD = Indentation Force Deflection. SE = self extinguishing

1.5 pcf (24 Kg/m³) polyether foam. Test specimens are Cal 117 flammability compliant

<table>
<thead>
<tr>
<th>Flame Retardant</th>
<th>Php Load Level</th>
<th>Air flow (SCFM)</th>
<th>IFD 25%/65% (Pounds)</th>
<th>Average Aged</th>
<th>Average Unaged</th>
<th>Part D % Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerald NH-1</td>
<td>19</td>
<td>4</td>
<td>45/90</td>
<td>0 sec / 2.3*</td>
<td>0.6 sec / 2.4*</td>
<td>97.2</td>
</tr>
<tr>
<td>TDCP</td>
<td>14</td>
<td>4</td>
<td>41/83</td>
<td>0 sec / 2.7*</td>
<td>0.6 sec / 2.5*</td>
<td>98.1</td>
</tr>
<tr>
<td>Non-Halogen A</td>
<td>23</td>
<td>3.9</td>
<td>42/85</td>
<td>0.6 sec / 2.6*</td>
<td>0.6 sec / 2.4*</td>
<td>94.3</td>
</tr>
</tbody>
</table>

Tests performed according to ASTM D3574 and California Technical Bulletin 117 guidelines. Note: IFD = Indentation Force Deflection

NH-1 matches flammability performance and provides superior physical properties

Fogging Characteristic of Flexible Polyurethane Foam

24 kg/m³ polyether conventional foam
Test specimens are FMVSS 302 flammability compliant

Test Method: SAE J1756, ISO 6452, DIN 75 201

Acelerated Aging Study to Test Product Permanence

24 kg/m³ polyether conventional foam
Test specimens are FMVSS 302 flammability compliant

Test Method: GM 9200

Excellent fogging characteristic suitable for interior automotive application

<table>
<thead>
<tr>
<th>Flame Retardant</th>
<th>Burn Rate/ Flame Rating (Before Aging)</th>
<th>Burn Rate/ Flame Rating (After Aging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerald NH-1</td>
<td>- / SE</td>
<td>- / SE</td>
</tr>
<tr>
<td>TDCP</td>
<td>- / SE</td>
<td>2.394 mm/ min /Fail /B</td>
</tr>
<tr>
<td>Non-Halogen A</td>
<td>- / SE</td>
<td>3.55 mm/ min /Fail / B</td>
</tr>
</tbody>
</table>

NH-1 remains intact after undergoing harsh accelerated aging to provide necessary flammability performance
Emerald Innovation™ NH-1 is a liquid phosphorous flame retardant that shows considerable contribution to the formation of a char layer in the intumescent process. The char layer acts as a barrier between oxygen and polymeric decomposition gases. There is convincing evidence that in oxygen-containing polymers, phosphorous containing flame retardants can increase the char yield. Char formation implies that less of the molten polymer substrate is converted to combustible gases, so the mass loss is reduced. Secondly, char formation is often accompanied by water release, which dilutes the combustible vapors, making the vapors less combustible. Char formation is also sometimes an endothermic process.
Polymers Solution
“Ultimate Technology for Polymer “

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