Our Chemistries Improve Thermoplastic Performance

SMA® 9000 Series

Improves the processability and performance characteristics of polyamides
Introduction

Over the last 50 years plastics have become irreplaceable in virtually every facet of modern life, from simple molded articles to intricate medical devices. Although the industry has made monumental advances in generating marketable attributes by manipulating the base molecules, the future of the plastics market will rely on further differentiation through additive technology. Additives can make plastics stronger, more durable, more rigid or more ductile, which then opens up entirely new applications and markets for plastics manufacturers.

The Hydrocarbon Specialty Chemicals division of Cray Valley USA, LLC, is a premier global supplier of low molecular weight anhydride functional additives that are uniquely suited to modify the physical and mechanical attributes of polyamide compounds. Characteristics such as melt strength, ductility and impact can be enhanced by introducing low doses of reactive styrene maleic anhydride (SMA®) copolymer. A simple and efficient chain extension reaction can take place in an extruder without the need to modify the production setup. Furthermore, the SMA® 9000 Series concentrates are formulated to provide greater effectiveness and homogeneity than previous-generation SMA® powders, plus offer productivity enhancement being in pellet form.

SMA® 9000 series concentrates are suited to span the breadth of polyamide chemistry and composition. Relevant to both commodity polyamides (6, 6/6) and specialty (12, HTN) the chain extension mechanism functions by tethering adjacent chains at the terminal amine group. As a result, the concept applies to virgin, recycled, blended and filled systems alike. The chain extenders are multi-functional compounds that are easily incorporated, thermally stable, non-volatile and capable of fast reaction. Table 1 outlines the two first-generation SMA® 9000 series products and their typical application spaces.

Table 1:
SMA® 9000 Series concentrates and their primary application spaces. SMA® 9001 is based on an LLDPE carrier, whereas SMA® 9002 is based on a PP homopolymer carrier.

<table>
<thead>
<tr>
<th>Product</th>
<th>Virgin PA</th>
<th>Recycled*</th>
<th>Contaminated**</th>
<th>Blended</th>
<th>Filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA® 9001</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SMA® 9002</td>
<td>X</td>
<td></td>
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<td></td>
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</tbody>
</table>

* Post-industrial polyamide (PIPA), ‘clean’ post-consumer polyamide (PCPA).
** Contaminated PCPA with >5% PP and/or >10% contaminants.

Polyamides present the challenge of exceptionally low melt viscosities, which can be detrimental to productivity and applicability. Figure 1 illustrates the dramatic effect on melt flow rate for both virgin commodity polyamides and recycled streams of PA6/6. Note how SMA® 9000 Series concentrates permit the user to dial in to a prescribed melt flow rate as the application demands.

Figure 1:
SMA® 9001 effect on virgin PA6 (250 °C, 5.0 kg), virgin PA6/6 (280 °C, 2.16 kg) and recycled streams of PA6/6 (280 °C, 2.16 kg) melt flow. Note beyond 2% by weight SMA® 9001 in virgin PA6/6 was estimated due to extreme changes in flux.
Virgin Polyamides

Widely used in many strenuous applications, polyamides in their many forms have become synonymous with performance. However, very little development has been made in the industry to further differentiate polyamides. Leveraging a reactive species such as SMA® 9001, new advances in augmenting melt strength, blending with other polymers, and enhancing key performance attributes can be tuned to penetrate new application spaces. Figure 2 and Figure 3 illustrate the influence of small amounts of SMA® 9001 on neat PA6 and PA6/6, respectively.

Figure 2:
Net influence on mechanical properties of virgin-grade PA6 using SMA® 9001.

Figure 3:
Net influence on mechanical properties of virgin-grade PA6/6 using SMA® 9001.
Recycled Polyamides

Globally, there has been a shift to repurposing polyamide from a variety of sources, such as end-of-life carpet and automotive. Despite significant efforts in separation and cleaning technology, only a small fraction of recycled polyamide 6 and polyamide 6/6 can be reintroduced into their incumbent applications. Post-industrial and post-consumer polyamides tend to have lower than desirable properties for injection molding. Figure 4 and Figure 5 outline the effectiveness of SMA® 9001 and SMA® 9002 on a purified r-PA6/6 and contaminated r-PA6/6, respectively.

Summary

SMA® 9000 series concentrates are the ideal additive to effectively modify the property landscape of virgin, recycled, blended and filled polyamides. A formulated pellet provides a balance of productivity, efficiency and homogeneity when used in your existing setup. Look for additional next-generation SMA® concentrates to impart tensile properties in addition to those shown above.

About Cray Valley HSC Division

Cray Valley USA, LLC, is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemicals, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings and other materials. Cray Valley has pioneered the development of these advanced technologies, introducing hundreds of products that enhance the performance of products in energy, printing, packaging, construction, tire manufacture, electronics and other demanding applications.
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