Dymalink® 9200 for Customizable High-Melt-Strength Polypropylene

**Description**

Polypropylene (PP) is a semi-crystalline polymer with a sharp melting point. Above its melting point most PP grades exhibit a low melt strength or strain hardening behavior. This refrains the use of standard PP in applications where melt stretching or drawing are critical in applications such as foam molding, blow molding, thermoforming, or pipe extrusion.

Traditionally, to overcome the lack of melt strength, high-melt-strength polypropylene (HMS-PP) is added at levels between 10-50%. The HMS-PP products are based on the chemical incorporation of high levels of long chain branches chemically linked to the polymer backbone. Other strategies have been proven efficient but introduce into the polymer large amounts of low-molecular-weight byproducts.

Dymalink® 9200 is a zinc salt widely used in the rubber chemical industry. It reacts with aliphatic polymers and forms a C-C link. Within the polymer, the zinc salts, thanks to their polar nature, tend to assemble themselves into ionic clusters promoting the formation of a dynamic network. This leads to an unusual melt strength behavior even at very low loadings. The following data was produced using rheological tools.

**BENEFITS**

- Melt strength improvement in extrusion processes
- Extrusion stability in foaming process
- Improved melt stretching and drawing characteristics

**TARGET MARKETS/APPLICATIONS**

- Foam or molding
- Pipe extrusion coating

**ADDITIONAL INFO**

- SDS: Dymalink® 9200
**Principle**
A neat polypropylene (without additivation) was stabilized with four amounts of Dymalink 9200 and incorporated using a double screw compounding system.

**Formulations**

<table>
<thead>
<tr>
<th>Formulations</th>
<th>Base Composition</th>
<th>Dymalink 9200</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>+0%</td>
</tr>
<tr>
<td>B</td>
<td>Polypropylene Homopolymer (PPH) Melt Index: 3.0 Stabilized with 2500 ppm AOX Package and 500 ppm Calcium Stearate</td>
<td>+0.5%</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>+1%</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>+2%</td>
</tr>
</tbody>
</table>

**Extrusion Conditions**
The extrusion process was carried out on a 19 mm Brabender® twin-screw using the following temperature profile:

**Temperature Profile**: (inlet) 20 — 190 — 200 — 200 — 200 — 210 — 210 — 210 °C (die)

The extruder die was fitted with a RHEOTENS 71.97 device comprising a 2 mm die L/D 15 with the extruder pressure maintained at 85 bar in order to record melt strength.

The following graph (Figure 1) shows that melt strength improvement is effective with percentages of Dymalink as low as 0.5% while only a very minor increase in speed at breakage is observed when increasing the Dymalink dosing from 0.5% to 2%.

![Figure 1: Dymalink Effect on Melt Strength](image)
Molecular characteristics such as molecular weight (Mw) and crystallization behavior was measured after extrusion. While no effect on Mw is observed at 0.5% addition level, the higher concentration of Dymalink did not affect extensive molecular weight degradation as shown in Figure 2.

![Figure 2: Molecular Weight Effects](image)

The melting enthalpy is not affected by the Dymalink grafting while a limited nucleation effect is observed with the 2% Dymalink. (Figure 3)

![Figure 3: Melting Enthalpy Effects](image)
**Foaming Properties**
A foaming trial was conducted using polypropylene compounded with talc (0.5%) and Dymalink 9200. The compound was processed on a single screw extruder fitted with a gas injection port, mixing system, melt cooling device, and a die. Foamed strands were produced with and without Dymalink 9200 and visually assessed.

Extruded foam rods:
1) Stable Extrusion
2) Nice Skin

Cells:
1) Higher Density
2) More Homogeneous

The presence of Dymalink 9200 improves extrusion stability and foaming process. As shown in the above images, a clear difference can be observed in terms of cell size between the polypropylene with and without Dymalink 9200.

**About Total Cray Valley**
Total Cray Valley is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemical, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings, and other materials. Total 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.

For more information, please visit [www.crayvalley.com](http://www.crayvalley.com)

**Total Cray Valley**
665 Stockton Drive, Suite 100
Exton, PA 19341, USA
1.877.US1-CRAY

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