CERANOVUS®
A SERIES WAXES
for Roofing Applications

Polymer Modified Asphalt Shingles,
Membranes and Underlayments
NORTH AMERICANS THROW AWAY 30+ MILLION TONS OF PLASTIC ANNUALLY — MOST ENDS UP IN LANDFILLS

This is a mountain of valuable carbon chains just waiting to be used as feedstock for chemical upcycling. And since 2010, GreenMantra Technologies has been transforming recycled plastics into value-creating waxes and polymer additives for industrial applications. By providing a stable outlet for waste plastics, GreenMantra advances the circular economy.

USING 100% POST CONSUMER RECYCLED PLASTICS AS A FEEDSTOCK...

GREENMANTRA TECHNOLOGIES UTILIZES A PATENTED AND PROPRIETARY THERMO-CATALYTIC DEPOLYMERIZATION PROCESS...

TO PRODUCE CERANOVUS A SERIES POLYETHYLENE AND POLYPROPYLENE WAXES AND POLYMER ADDITIVES...

WHICH ENABLE LONG-TERM CARBON SEQUESTERING IN INDUSTRIAL APPLICATIONS SUCH AS POLYMER MODIFIED ASPHALT SHINGLES, MEMBRANES AND UNDERLAYMENTS
CERANOVUS WAXES FOR POLYMER MODIFIED ASPHALT ROOFING PRODUCTS

GreenMantra combines technology with sustainability to create unique CERANOVUS A Series waxes which have low viscosity and penetration hardness but also exhibit amorphous polymer characteristics and greater polarity due to higher molecular weights and short chain branching.

<table>
<thead>
<tr>
<th>Ceranovus PE Wax</th>
<th>Density (g/cm³) ASTM D298</th>
<th>Drop Point (°C) ASTM D9594</th>
<th>Penetration @ 25°C in dmm (0.1MM) ASTM D1132</th>
<th>Viscosity cps @ 140°C BROOKFIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A115</td>
<td>0.92</td>
<td>116</td>
<td>2</td>
<td>225</td>
</tr>
<tr>
<td>A120</td>
<td>0.93</td>
<td>122</td>
<td>2</td>
<td>700</td>
</tr>
<tr>
<td>A125</td>
<td>0.94</td>
<td>126</td>
<td>1</td>
<td>2025</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ceranovus PP Wax</th>
<th>Density (g/cm³) ASTM D298</th>
<th>Drop Point (°C) ASTM D9594</th>
<th>Penetration @ 25°C in dmm (0.1MM) ASTM D1132</th>
<th>Viscosity cps @ 190°C BROOKFIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A155</td>
<td>0.90</td>
<td>155</td>
<td>2</td>
<td>75</td>
</tr>
</tbody>
</table>

CERANOVUS A Series waxes deliver improved product performance, formulation cost savings and operational processing advantages in polymer modified asphalt roofing shingles, membranes and underlayments.

BENEFITS OF CERANOVUS WAXES IN POLYMER MODIFIED ASPHALT APPLICATIONS

**IMPROVE PRODUCT PERFORMANCE**
- Improves thermal stability and impact resistance
- Decreases penetration for improved durability
- Maintains low temperature flexibility
- Increase adhesion performance at low and high temperatures

**REDUCE FORMULATION COSTS**
- Lowers formulation viscosity for ease of processing
- Enables formulation flexibility to incorporate higher filler loading
- Optimizes substrate saturation and film coating thickness

**ENABLE OPERATIONAL PROCESSING ADVANTAGES**
- Blends easily with standard low shear mixing
- Decreases polymer mixing times
- Lowers processing viscosity for faster line speed
CERANOVUS A155 PP wax was evaluated as a partial replacement for approx. 30% of the SBS in the polymer modified asphalt formulation shown in Table 1.

Ideally, Penetration Hardness values should decrease and Softening Point values should increase to optimize thermal stability, durability and stiffness of the formulation. As shown in Table 2, CERANOVUS A155 PP wax provides these advantages in the polymer modified asphalt formulation, while also maintaining low temperature flexibility, improving the adhesion to plywood and reducing the formulation viscosity.

CERANOVUS A155 PP wax delivers a 10% decrease in Penetration (see Graph 1). Lower Penetration indicates improved stiffness which should promote less deformation and fewer defects during installation from mechanical stresses such as foot traffic. Lower Penetration also prevents blocking during storage and shipping.

CERANOVUS A155 PP wax increases the Softening Point by 9% (see Graph 2) which improves thermal stability and durability and provides less sagging over time.
Better Adhesion to Plywood combined with Flexibility and Thermal Stability are critical properties to improve the overall durability and resistance to deformation from seasonal temperature fluctuations.

**CERANOVUS A155 PP Wax** demonstrates exceptional improvement in the Adhesion to Plywood of +200% at 4 °C and +36% at 25 °C and can prevent sagging, peeling and bubbling over time (see Graph 3).

![Graph 3: Adhesion to Plywood, lbf/in (ASTM D1970 - 7.4)](image)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>A155 PP Wax</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 °C</td>
<td>3.54</td>
<td>10.89</td>
</tr>
<tr>
<td>25 °C</td>
<td>6.10</td>
<td>8.30</td>
</tr>
</tbody>
</table>

**CERANOVUS A155 PP Wax** at 30% replacement of SBS passes the physical requirements of ASTM D1970 for Flexibility and Thermal Stability as shown in Table 3. This ensures that the formulation will not crack or become too sticky upon use.

<table>
<thead>
<tr>
<th>Properties</th>
<th>A155 Results</th>
<th>ASTM Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility, @ -28 °C</td>
<td>Pass</td>
<td>D1970 - 76</td>
</tr>
<tr>
<td>Thermal Stability, @ 70 °C</td>
<td>Pass</td>
<td>D1970 - 7.5</td>
</tr>
</tbody>
</table>

**FORMULATION COST SAVINGS AND OPERATIONAL PROCESSING ADVANTAGES**

**CERANOVUS A155 PP Wax** dramatically reduces formulation viscosity by 67% (see Graph 4). This significant decrease in viscosity can enable formulation cost savings through:

1. Greater flexibility to incorporate higher filler content
2. Reduced film coating thickness

Lower formulation viscosity also has tangible operational advantages such as:

1. Ease of processing and lower overall energy requirements
2. Higher line speeds which could provide incremental capacity
3. Faster penetration of the substrate mat

**CERANOVUS A Series waxes** blend easily into polymer modified asphalt formulations with standard low shear mixing equipment and can decrease polymer mixing times.

![Graph 4: Viscosity, cps at 170 °C (ASTM D4402)](image)
GREENMANTRA TECHNOLOGIES IS STRATEGICALLY LOCATED IN SOUTHERN ONTARIO

Utilizing our proprietary thermo-catalytic system and patented process, GreenMantra transforms recycled plastics into value-added waxes and specialty polymers for industrial applications such as roofing, roads, plastic composites and polymer processing. Our CERANOVUS waxes are available in pastille form and are packaged in super sacks and kraft bags.

Please contact us at: info@greenmantra.com for product information or to request a sample.