**Dispersions of Titanium Dioxide with SMA® Resins**

SMA® Resins are a family of low molecular weight styrene/maleic anhydride copolymers and their derivatives. SMA® 1000, 2000, 3000 are copolymers with a styrene/maleic anhydride ratio equal to 1, 2 and 3 respectively. SMA® 1440, 17352 are partially esterified derivatives of SMA® copolymers which contain ester, carboxylic acid and anhydride functional groups.

These resins can act as efficient polymeric surfactants in a variety of water-based dispersing and emulsifying applications. For example, SMA® Resins are well known as dispersing resins for pigments, where they provide benefits such as high dispersion stability, even at high pigment/dispersing resin ratios.

In addition to solid SMA® Resins, Cray Valley Company, Inc. produces aqueous solutions of SMA® Resins as either their ammonium salts (H grades) or their sodium salts (HNa grades) to facilitate their use in water-based formulations. The hydrolyzed SMA® solutions have anionic carboxylate functionality.

This bulletin describes the ability of SMA® Resins to disperse titanium dioxide pigment under basic conditions. The SMA® materials are found to be highly efficient dispersing agents compared to other commonly used material, especially to produce titanium dioxide slurries with high concentration and low viscosity.

### TiO₂ studied

We selected two titanium oxides from Millenium Inorganic Chemical. They have the following characteristics:

<table>
<thead>
<tr>
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<th>Oil Absorption</th>
<th>Surface treatment</th>
<th>TiO₂ content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiONA RCL 535</td>
<td>17</td>
<td>Al₂O₃ + Org.</td>
<td>95</td>
</tr>
<tr>
<td>TiONA 568</td>
<td>22</td>
<td>Al₂O₃ + SiO₂ + Org</td>
<td>93</td>
</tr>
</tbody>
</table>

### Dispersing agent demand or requirement

We used the procedure described in Millenium literature, which consists of starting with a TiO₂ slurry with a pigment loading of 70-75%, and measuring the viscosity as a function of the added dispersant amount.

On the resulting curve, there will be a point where the viscosity no longer decreases. This is the point where the pigment is fully wetted by the dispersing agent and only dilution is occurring.

\[
\text{% dispersant demand} = \frac{\text{Mass dispersant to dilution point} \times \text{concentration}}{\text{Mass pigment used}}
\]
Results
We compared several SMA® resins. The results are expressed in % (dry part / dry content of TiO₂):

<table>
<thead>
<tr>
<th></th>
<th>SMA® 1000 H</th>
<th>SMA® 3000 H</th>
<th>SMA® 1440 H or HPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIONA 535</td>
<td>0.09</td>
<td>0.22</td>
<td>0.15</td>
</tr>
<tr>
<td>TIONA 568</td>
<td>0.11</td>
<td>0.30</td>
<td>0.15</td>
</tr>
</tbody>
</table>

The dispersing agent requirement is always very low for these titanium dioxide pigments. SMA® 1000 is the most efficient dispersing agent among the SMA® Resins tested. SMA® 1440 and SMA® 3000 are slightly more demanding.

To ensure efficient and stable dispersion of TiO₂ in water-based formulations, it is better to use twice the minimum amount of required dispersing agent.

Maximum Loading
This property is important if one wants to produce a TiO₂ slurry with a high concentration in water. We compared SMA® Resins with a reference resin (acrylate sodium salt copolymer).

Figure 2 shows the maximum loading for TIONA 568 to obtain a viscosity of 4000 mPa.s (Brookfield @ 20 rpm), with 0.3% of dispersing agent and pH=9.
With these two examples on TiONA 535 and 568, SMA Resins exhibit superior performance to produce high pigment loading slurries with a low viscosity.

**Dispersion Method**

It is recommended to first mix the SMA® Resins with water, then adjust the pH of the slurry with an amine base to pH of 9. Then slowly add the TiO₂ while mixing.

In addition to the advantages previously described, SMA® Resins will reduce the energy consumption during the milling /dispersing step.

SMA® Resins could be used alone or in combination with a wetting agent to enhance wetting of pigment agglomerates. The combination of the anionic SMA® Resins with a nonionic surfactant could be a matter of choice.

**Specific Advantages in Paint Application**

Use of SMA® Resins to disperse the pigments or further addition of SMA® Resins in a paint formulation will increase the leveling, gloss, and color intensity, as well as adhesion of the paint to many substrates.