Pigments, Fillers and FR Manufacturing
Need for Dispersants and Surface Treatment/ Hydrophobization
More Information

- New brochure available
- New video about surface treatment
There are various requirements along the compounding value chain

<table>
<thead>
<tr>
<th>Raw material suppliers</th>
<th>Processors</th>
<th>End users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment manufacturers</td>
<td>Masterbatch producers</td>
<td>End users</td>
</tr>
<tr>
<td>- Increased solid content in slurries or during milling</td>
<td>- Improved colour strength</td>
<td>Tier I</td>
</tr>
<tr>
<td>- Flocculation</td>
<td>- Easy processing of MBs</td>
<td>Tier II</td>
</tr>
<tr>
<td>Flame retardants &amp; other Fillers producers</td>
<td>- Reduced filter pressure index</td>
<td>Moulder</td>
</tr>
<tr>
<td>- Enhance filler – resin compatibility (hydrophobicity)</td>
<td></td>
<td>OEM</td>
</tr>
<tr>
<td>- Enhance properties of a composite</td>
<td>- Improved melt flow - better throughput</td>
<td></td>
</tr>
<tr>
<td>- High bulk density</td>
<td>- Less abrasion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lubrication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improved scratch resistance</td>
<td></td>
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<tr>
<td></td>
<td>- Odour absorption</td>
<td>Improved product quality and performance</td>
</tr>
</tbody>
</table>
What we offer to pigment and filler manufacturers?

### Evonik Portfolio

**Water based dispersants**
- TEGOMER® DA 850
- TEGOMER® DA 640
- TEGOMER® DA 646
- TEGOMER® DA 626

**Value we offer**
- Stabilization of smaller particle size in slurry leads to less flocculation
- Reduced viscosity or higher solid contents in wet milling operations and slurry

### Pigment
- TiO₂
- Inorganic Pigments
- Organic Pigments

### Flame retardants & other Fillers
- ATH & MDH
- MP/MPP/MCA
- Talc
- CaCO₃

### Evonik Portfolio

**Hydrophobic surface treatment**
- TEGOPREN® 6875
- TEGOPREN® 6875-45
- TEGOPREN® 6879
- TEGOPREN® 5885

**Value we offer**
- Improved compatibility with the plastics giving improved dispersion
- Reduced agglomeration during filler storage
- Reduced water absorption on the filler surface, which leads to a lower volatile content for plastics processing
TEGOMER® and TEGOPREN® for Fillers, FR and Pigments

Ground mining

Dry Stage

Milling

Tumbling equipment at >80°C

Treated Filler, FR or pigment

Precipitation

Wet Stage

Milling

Filler Slurry/Cake

Drying

Milling

Addition of TEGOMER®

Addition of TEGOPREN®

Addition of TEGOPREN®
TEGOPREN® / TEGOMER® gets the most out of the Fillers

- Create more value and give more function to tailor made pigments, flame retardants and fillers
- Focus on high value end applications, e.g.
  - functional fillers for automotive compounds
  - special MDH and ATH grades for HFFR
  - easy to disperse pigments for plastic colorizing
  - highly filled compounds for food packaging and film application
# TEGOMER® Dispersants for Wet Milling (slurry or filter cake)

<table>
<thead>
<tr>
<th>Product</th>
<th>Physical Properties</th>
<th>Benefits/ Recommended for</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEGOMER® DA 850</td>
<td>40% active; Polymeric dispersant. Viscosity: 100-500 mPas</td>
<td>➢ Excellent rheological properties even after long term storage of pigment paste&lt;br&gt; ➢ Less water uptake than polyacrylic acids or polyphosphates&lt;br&gt; ➢ Prevents settlement of high density fillers/pigments</td>
</tr>
<tr>
<td>TEGOMER® DA 646</td>
<td>100% active; Non-ionic, neutral, Viscosity: 200-800 mPas</td>
<td>➢ Manufacturing of liquid color pastes based on water, oils, polyols or phthalates containing organic pigments or carbon black&lt;br&gt; ➢ Suitable for the manufacturing of water-based pigment concentrates due to its HLB balance</td>
</tr>
<tr>
<td>TEGOMER® DA 640</td>
<td>30% active; Anionic, neutral, Viscosity: 100-500 mPas</td>
<td>➢ Dispersing of fillers as well as of inorganic/organic pigments in water-based slurries, strong viscosity drop&lt;br&gt; ➢ Flocculation of inorganic pigments or fillers (use of ppm), can be used instead of polyacrylic amides/acids&lt;br&gt; ➢ Works even in high electrolyte surroundings</td>
</tr>
<tr>
<td>TEGOMER® DA 626</td>
<td>100% active, Polymeric dispersant. High viscosity: 50,000-150,000 mPas</td>
<td>➢ Usually a dispersant for hydrophobic continuous phases (phthalates, adipates, polyols)&lt;br&gt; ➢ Can be used together with TEGO® STO 80V for pigment slurries, not water soluble itself</td>
</tr>
</tbody>
</table>
Benefits of TEGOMER® as Dispersant and Flocculent

Due to their special chemical nature TEGOMER® DA additives

- can work as flocculants when used in very small dosages
- interact with the pigment or filler surface and form a stable layer on it
- will compatibilize the pigment/filler to the polymer matrix
- are compatible with polyolefins and technical polymers
- reduce the viscosity of the slurry enabling higher loadings during wet grinding stage
Advantages of Using Dispersants in Pigment Manufacturing Processes

Filter cake with high water content

Filter cake turned liquid with TEGOMER® to remove additional water
Less drying capacity needed

Filter cake with low water content

High retention of pigment without discoloration (fine pigment particles) in cycled water

Control

with TEGOMER® DA 850

with TEGOMER® DA 640

- Increased pigment content in the filter cake and less drying capacity needed
- Fine particle size does not reduce retention in filtration
- Fine particle size results in higher color strength in the final masterbatches or colorants
Evaluation of the Filter Pressure Index of Pigment PY 83

Filter Pressure of Pigment PY 83

<table>
<thead>
<tr>
<th>Pure LDPE</th>
<th>with out Treatment</th>
<th>TEGOMER® DA 626 with TEGO® STO 85V</th>
<th>TEGOMER® DA 626 with TEGO® Surten W 111</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Processing of treatment**

- TEGOMER® additives blended with co-additives TEGO® STO 85V or TEGO® Surten W 111 in ratio 1:1 and dispersed in water
- Mixture added to a 50% untreated organic pigment slurry
- Filtering and drying the resulting filter cake
- Milling the treated pigment
- Producing a color masterbatch with 30% pigment content

**Dilution for filter pressure test:**

- 5% color masterbatch
- 95% LDPE
TEGOMER® used for Well Dispersed Fillers and Viscosity Reduction

CaCO3 (top picture) wet milling – slurry will be used for paper coating with high gloss (picture below with TEGOMER® DA 850)

Left: no dispersant used, coarse particles result in settlement

Middle: TEGOMER DA 850 used, stable dispersion for transport which results in high gloss paper coating

Right: Dispersant used but still settlement and coarser particle

Using TEGOMER® DA 850 results in significant viscosity reduction enabling wet milling on a MDH filter cake (55% solid content)
# Recommendations

## Dispersant in Pigment Manufacturing

<table>
<thead>
<tr>
<th>Pigment, Filler, Flame Retardant</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂ (Titanium Dioxide)</td>
<td></td>
</tr>
<tr>
<td>FeₓOᵧ (Iron Oxide)</td>
<td></td>
</tr>
<tr>
<td>BiVO₄ (Bismuth vanadate)</td>
<td></td>
</tr>
<tr>
<td>Ultramarine Blue</td>
<td></td>
</tr>
<tr>
<td>ATH (Aluminium Hydroxide)</td>
<td>TEGOMER® DA 640</td>
</tr>
<tr>
<td>MDH (Magnesium Hydroxide)</td>
<td>TEGOMER® DA 850</td>
</tr>
<tr>
<td>CaCO₃ (Calcium Carbonate)</td>
<td></td>
</tr>
<tr>
<td>Talc</td>
<td></td>
</tr>
<tr>
<td>Phthalocyanine Organic Pigments</td>
<td></td>
</tr>
<tr>
<td>Organic Pigments (Azo or Diarylid)</td>
<td></td>
</tr>
</tbody>
</table>

![Evonik Logo](Evonik_Logo.png)
## Efficient Surface Treatment with TEGOPREN® (filter cake or final milling)

<table>
<thead>
<tr>
<th>Product</th>
<th>Physical Properties (mPas / 25°C)</th>
<th>Recommended for</th>
<th>Dosage/ incorporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEGOPREN® 6875</td>
<td>Liquid (~350)</td>
<td>Surface treatment of inorganic fillers, pigments and flame retardants, e.g. ATH, MDH to make them compatible with polymers. Most often used in the final milling step before packaging</td>
<td>0.2 – 2.0 % based on the surface area of the pigment/filler</td>
</tr>
<tr>
<td>TEGOPREN® 6875 - 45</td>
<td>Liquid (~30)</td>
<td>Used in aqueous precipitation or filtration steps in the production of pigments, fillers and flame retardants, e.g. ATH, MDH</td>
<td>Additives are liquid at room temperature and do not need to be applied at higher temperatures however, they are high temperature resistant (relevant for steam mill use)</td>
</tr>
<tr>
<td>TEGOPREN® 6879</td>
<td>Liquid (~300)</td>
<td>Surface treatment of TiO2 for PVC, MDH with superhydrophobic surface and suitable for Sulfates and Carbonates. Used in the final milling step before packaging</td>
<td>Direct application via spray drying or in milling stage. Emulsions used in filler slurries</td>
</tr>
<tr>
<td>TEGOPREN® 5885</td>
<td>Liquid (~100)</td>
<td>Fine or nano scaled fillers, such as organo clays or hydroxides can be treated for use within high filled thermoplastic HFFR cable compounds or film application</td>
<td>Materials do not create any VOC therefore no requirement for explosion safe production equipment</td>
</tr>
</tbody>
</table>
Many reasons to use Evonik’s OMS Technology for Surface Treatment

- No VOC and no migration
- Faster filtration – saves drying time and energy
- Less agglomeration gives finer particle size
- Easy dispersion with higher filling grades in polymers, thermoplastics, thermoset, sealants
- Less specks and high color strength in finished plastic articles
- Surface hydrophobicity improves weatherability and water repellence or lowers water uptake
- Improves mechanical and surface properties

R= Alkyl, Polyester, Acrylate, Epoxy, Hydroxyalkyl, Aminoalkyl, …
TiO₂: Benefits of Surface Treatment with TEGOPREN®

- Higher bulk density allows better storage properties of pallets
- Enhanced hydrophobicity improves filler – resin compatibility
- Easier feeding and compounding than with untreated TiO₂
- Without disadvantages such as migration which causes fish eyes, sealing or printing problems or lost mechanical properties in final application which are observed when using silicone oil

Improved bulk density and less dusty material

Viscosity reduction in pigment slurries result in low drying costs
# TiO₂: TEGOPRENE® 6875 improves Processing and avoids Lacing

<table>
<thead>
<tr>
<th>LDPE Masterbatch</th>
<th>Surface Treatment</th>
<th>Compounding</th>
<th>Lacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Amperage</td>
<td>Head Pressure</td>
</tr>
<tr>
<td>70% TiO₂</td>
<td>without</td>
<td>70</td>
<td>51</td>
</tr>
<tr>
<td>70% TiO₂</td>
<td>0.5% TEGOPREN® 6875</td>
<td>69</td>
<td>48</td>
</tr>
<tr>
<td>70% TiO₂</td>
<td>1.0% TEGOPREN® 6875</td>
<td>69</td>
<td>47</td>
</tr>
</tbody>
</table>

Advantages due to surface treatment of pigments:
- Improved processing due to less dusty appearance and no bridging in the feeder appears
- Higher loading possible
- Better dispersion
- No specks
- No lacing
- Higher color strength/better hiding power

![Silicone oil treated grade](image1.png)

No Agglomerates
No Lacing

![TEGOPRENE® 6875](image2.png)
TEGOPREN® 6875 allows to reduce Dustiness and Imparts Free Flow

Advantages due to surface treatment of pigments:

- 25-50% reduction in dust with a TEGOPREN 6875 treated grade compared with a silicon oil treated grade. This can be proved using the Continuous Drop Down method (see principal picture on the right)

- Free flowing pigments are available due to the TEGOPREN 6875 treatment-allowing easy discharge of silos and IBC‘s
Talc: Benefits of Surface Treatment in TPO Applications

1. No reduced stiffness
2. Better effect in impact resistance
3. Important reduction of CLTE
4. Increased scratched resistance
5. Improved Hydrophobicity
6. Better dispersion and distribution of the talc → Enhanced polymer affinity / better anti-scratch properties

Contact angle evaluation
Improved talc hydrophobicity
Compatibilisation and wetting of the talc in the PP matrix
Talc: Treated talc in automotive leads to optimized Processing

PP/Talc compound with 40% treated Talc

- Deviation [%] +

- 50 – 40 – 30 – 20 – 10 – 0

MFI  Amperage Draw  Pressure

MFI increase leads to

- Decrease in amperage draw → Reduced electricity consumption by 15 to 50%
- Decrease in injection pressure → Better mold filling and easier processing
Hydroxides - Benefits of OMS for Surface Treatment in HFFR Compounds

- Internal lubrication and dispersion leads to reduced abrasion and die drool
- Higher output by optimized melt rheology
- Less pressure built-up and amperage draw during extrusion
- Less maintenance costs
- Better dispersion of fillers resulting in very good flame resistant classification
- Smooth cable surfaces with excellent printability

Char formation without additive is poor
Char formation elevated with 2.0 % TEGOPREN®
MDH - Turning Grades
Hydrophobic with TEGOPREN®

**Benefits**

- Improved dispersing of fillers
- Less water uptake \(\rightarrow\) Improved electrical insulation properties
- Smooth printable cable surfaces
- Better flame retardant properties in UL 94V, LOI and Cone Calorimeter
Hydroxides - Reduced Heat Release with Surface Treated ATH and MDH

EVA19
65 wt.-% ATH

ATH without Additive
ATH + 1% TEGOPREN® 6875
MDH without Additive
MDH + 1% TEGOPREN® 6875.
Hydroxides - Reduced Rate of Smoke Released

EVA19
65 wt.-% ATH

ATH without Additive
ATH + 1% TEGOPREN® 6875
MDH without Additive
MDH + 1% TEGOMER® 6875
Surface Treatment of Organic Pigments with TEGOPRENG®

- TEGOPREN® is not only good for the hydrophobization of inorganic pigments but works for organics as well.
- High loading in masterbatches and excellent low filter pressure values can be achieved.
- Blooming of critical organic pigments and dyes can be avoided in engineering resin application avoiding additional water uptake.
# Recommendations

## Hydrophobic Surface Treatment

<table>
<thead>
<tr>
<th>Pigment, Filler, Flame Retardant</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; recommendation</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO&lt;sub&gt;2&lt;/sub&gt; (Titanium Dioxide)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOPREN® 6879</td>
</tr>
<tr>
<td>ATH (Aluminium Hydroxide)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOPREN® 5885 TEGOPREN® 6879</td>
</tr>
<tr>
<td>AMH (Aluminium Monohydrate)</td>
<td>TEGOPREN® 6879</td>
<td>TEGOPREN® 6875</td>
</tr>
<tr>
<td>MDH (Magnesium Hydroxide)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOPREN® 5885</td>
</tr>
<tr>
<td>MP (Melamine Phosphate)</td>
<td>TEGOMER® E-Si 2330</td>
<td>TEGOPREN® 6875</td>
</tr>
<tr>
<td>MPP (Melamine Polyphosphate)</td>
<td>TEGO® XP 21010</td>
<td></td>
</tr>
<tr>
<td>APP (Ammonium Polyphosphate)</td>
<td>TEGOPREN® 6875</td>
<td>TEGO® XP 21010 TEGOPREN® 5885</td>
</tr>
<tr>
<td>Clay (Montmorolite, Illit)</td>
<td>TEGOMER® A-Si 2322</td>
<td>TEGOPREN® 6875 TEGOPREN® 5885</td>
</tr>
<tr>
<td>MC (Melamine Cyanurate)</td>
<td>TEGOPREN® 6875</td>
<td>TEGO® XP 21010</td>
</tr>
<tr>
<td>CaCO&lt;sub&gt;3&lt;/sub&gt; (Calcium Carbonate)</td>
<td>TEGOPREN® 6879</td>
<td>TEGOPREN® 6875</td>
</tr>
<tr>
<td>Al&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;3&lt;/sub&gt; (Aluminium Oxide)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOPREN® 5885</td>
</tr>
<tr>
<td>Talc, Mica, Wollastonite</td>
<td>TEGOPREN® 6875</td>
<td>TEGOPREN® 6880-55</td>
</tr>
<tr>
<td>Triazine or APP/Triazine</td>
<td>TEGOPREN® 6875</td>
<td></td>
</tr>
</tbody>
</table>

Remark: TEGOPREN® 6875 is also available as emulsion called TEGOPREN® 6875-45, if a lower viscosity is necessary.