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.

**Raw material suppliers**

- **Pigment manufacturers**
  - Increased solid content in slurries or during milling
  - Flocculation

- **Flame retardants & other Fillers producers**
  - Enhance filler – resin compatibility (hydrophobicity)
  - Enhance properties of a composite
  - High bulk density

**Processors**

- **Masterbatch producers**
  - Improved colour strength
  - Easy processing of MBs
  - Reduced filter pressure index

- **Compounders**
  - Improved melt flow - better throughput
  - Less abrasion
  - Lubrication
  - Improved scratch resistance
  - Odour absorption

**End users**

- Tier I
- Tier II
- Moulder
- OEM

**Improved product quality and performance**
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

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

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

- 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
- 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

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

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>TiO$_2$ (Titanium Dioxide)</td>
<td>TEGOMER® DA 640</td>
</tr>
<tr>
<td>Fe$_x$O$_y$ (Iron Oxide)</td>
<td>TEGOMER® DA 850</td>
</tr>
<tr>
<td>BiVO$_4$ (Bismuth vanadate)</td>
<td></td>
</tr>
<tr>
<td>Ultramarine Blue</td>
<td></td>
</tr>
<tr>
<td>ATH (Aluminium Hydroxide)</td>
<td></td>
</tr>
<tr>
<td>MDH (Magnesium Hydroxide)</td>
<td></td>
</tr>
<tr>
<td>CaCO$_3$ (Calcium Carbonate)</td>
<td></td>
</tr>
<tr>
<td>Talc</td>
<td></td>
</tr>
<tr>
<td>Phthalocyanine Organic Pigments</td>
<td>TEGOMER® DA 646</td>
</tr>
<tr>
<td>Organic Pigments (Azo or Diarylid)</td>
<td>TEGOMER® DA 850</td>
</tr>
<tr>
<td></td>
<td>TEGOMER® DA 640</td>
</tr>
<tr>
<td>Product</td>
<td>Physical Properties (mPas / 25°C)</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>TEGOPREN® 6875</td>
<td>Liquid (~350)</td>
</tr>
<tr>
<td>TEGOPREN® 6875 - 45</td>
<td>Liquid (~30)</td>
</tr>
<tr>
<td>TEGOPREN® 6879</td>
<td>Liquid (~300)</td>
</tr>
<tr>
<td>TEGOPREN® 5885</td>
<td>Liquid (~100)</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, …
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
Titanium Dioxide: TEGOPREN® 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 Draw</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
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 without modification
Talc OMS modified
Talc: Treated talc in automotive leads to optimized Processing

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 → Improved electrical insulation properties
- Smooth printable cable surfaces
- Better flame retardant properties in UL 94V, LOI and Cone Calorimeter

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**Water Absorption EVA/PE Compound [65%MDH]**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Water Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated MDH</td>
<td>0.60</td>
</tr>
<tr>
<td>TEGOPREN®6875</td>
<td>0.44</td>
</tr>
<tr>
<td>TEGOPREN®6875-45</td>
<td>0.40</td>
</tr>
<tr>
<td>TEGOPREN®5885</td>
<td>0.60</td>
</tr>
</tbody>
</table>

- 44% reduction
- 60% reduction
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 with Surface Treatment

EVA19
65 wt.-% ATH

- ATH without Additive
- ATH + 1% TEGOPREN® 6875
- MDH without Additive
- MDH + 1% TEGOMER® 6875

RSR [m²/s m²]

Time [s]
Surface Treatment of Organic Pigments with TEGOPREN®

- 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>1st recommendation</th>
<th>2nd recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂ (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</td>
</tr>
<tr>
<td>AMH (Aluminium Monohydrate)</td>
<td>TEGOPREN® 6879</td>
<td>TEGOPREN® 6879</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>TEGOMER® A-Si 2322</td>
<td></td>
</tr>
<tr>
<td>APP (Ammonium Polyphosphate)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOMER® A-Si 2322</td>
</tr>
<tr>
<td>Clay (Montmorolite, Illit)</td>
<td>TEGOMER® A-Si 2322</td>
<td>TEGOPREN® 6875</td>
</tr>
<tr>
<td>MC (Melamine Cyanurate)</td>
<td>TEGOPREN® 6875</td>
<td>TEGOMER® A-Si 2322</td>
</tr>
<tr>
<td>CaCO₃ (Calcium Carbonate)</td>
<td>TEGOPREN® 6879</td>
<td>TEGOPREN® 6875</td>
</tr>
<tr>
<td>Al₂O₃ (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.